Exhibit PUB # 58-5

Volume 5 – Board Counsel's Book of Documents

NFAT Review
Subject: Manitoba Hydro Societal Issues Panel

INDEX

Tab	Description	Reference
	SOCIO-ECONOMIC MATTERS	
1.	Scope of Socio-Economic Review	NFAT Terms of Reference (Excerpt) Board Order 92/13 (Excerpt)
2.	Socio-Economic Concepts	NFAT Appendix 9.1 NFAT Table 13.1 CAC/MH I-156a Shaffer, "Multiple Account Benefit Cost Analysis" (Excerpt) PUB Advisor List – Potential Stakeholders Grady, "On the Use and Misuse of Input-Output Based Analysis in Evaluation
3.	Economic Evaluation	NFAT Table 9.1 NFAT Appendix 2.3 Typlan Report (Excerpts) PUB/MH I-227 PUB/MH I-229 PUB/MH I-293
4.	Leakages	MNP Report (Excerpts) MMF/MH II-039 NFAT Figure 13.5
5.	Partnership Income	CAC/MH II-019 NFAT Appendix 2.2 – JKDA Benefits Summary
6.	First Nations Business Opportunities	MMF/MH II-037 PUB/MH II-499b Transcript Excerpt – March 11, 2014
7.	Training Opportunities	JKDA, Article 12 MMF/MH II-039 PUB/MH II-423c
8.	Discounting	NFAT Chapter 13 (Excerpt) Exhibit MH-95, Page 49 Moore, "More Appropriate Discounting: The Rate of Social Time Preference and the Value of the Social Discount Rate" NFAT Figure 10.1 Shaffer, "Multiple Account Cost Benefit Analysis" (Excerpt)

9.	Manitoba Hydro's Socio-Economic Update	NFAT Chapter 13 – February 2014 Update
MACRO-ENVIRONMENTAL MATTERS		
10.	Choice of VECs / Caribou	CAC/MH I-231a PUB/MNP-001
11.	Lake Sturgeon	MNP Report (Excerpt) PUB/MNP-023 Manitoba Lake Sturgeon Management Strategy, 2012 (Excerpts) PUB/MNP-024 PUB/MNP-026
12.	Adverse Effects Agreements	Fox Lake Adverse Effects Agreement (Excerpt) Tataskweyak Adverse Effects Agreement (Excerpt) War Lake Adverse Effects Agreement (Excerpt) York Factory Adverse Effects Agreement (Excerpt)
13.	Greenhouse Gas Emissions	NFAT Appendix 7.3 MNP Report (Excerpt) PUB/MH II-452
14.	Provincial Policy	Manitoba's Clean Energy Strategy Principles of Sustainable Development
15.	Keeyask & Nelson River Maps	JKDA Schedule 7.1

TAB 1

(b) may exercise discretion over the access of any person to Commercially Sensitive Information; and

(c) shall follow the Rules of Practice and Procedure of the PUB, as amended from time to time, if not otherwise dealt with under these Terms of Reference.

At the completion of its review, the Panel will provide a report to the Minister responsible for the administration of *The Public Utilities Board Act* (currently the Minister of Healthy Living, Seniors and Consumer Affairs) no later than June 20, 2014. The report will include recommendations to the Government of Manitoba on the needs for Hydro's preferred development Plan and an overall assessment as to whether or not the Plan is in the best long-term interest of the province of Manitoba when compared to other options and alternatives.

PUBLIC PARTICIPATION

The public will be encouraged to provide input and comment on the Plan as part of the NFAT.

SCOPE OF THE NFAT REVIEW

The Panel will review and assess the needs for and alternatives to Hydro's Plan. Its assessment will be based upon the evidence submitted by Hydro, intervenors and independent expert consultants used by PUB to assist in the NFAT. The Panel's report to the Minister will address the following items:

1. An assessment as to whether the needs for Hydro's Plan are thoroughly justified, and sound, its timing is warranted, and the factors that Hydro is relying upon to prove its needs are complete, reasonable and accurate. The assessment will take the following factors into consideration:
    a. The alignment of the Plan to Hydro's mandate, as set out in Section 2 of *The Manitoba Hydro Act*.
    b. The alignment of the Plan to Manitoba's Clean Energy Strategy and the Principles of Sustainable Development as outlined in *The Sustainable Development Act*.
    c. The extent to which the Plan is needed to address reliability and security requirements of Manitoba's electricity supply.
    d. The reasonableness, thoroughness and soundness of all critical inputs and assumptions Hydro relied upon for its justification of its needs. This should include Hydro's planning load forecast and future load scenarios, its demand and supply analysis, export expectations and commitments, and demand side management and conservation forecasts.

2. An assessment as to whether the Plan is justified as superior to potential alternatives that could fulfill the need. The assessment will take the following factors into consideration:

    a. If preferred and alternative resource and conservation evaluations are complete, accurate, thorough, reasonable and sound;
    b. The alignment of the Plan and alternatives to Manitoba's Clean Energy Strategy, *The Climate Change and Emissions Reduction Act* and the Principles of Sustainable Development as outlined in *The Sustainable Development Act*;

c. The accuracy and reasonableness of the modeling of export contract sale prices, terms, conditions, scheduling provisions, export transmission costs, and the reasonableness of projected revenues;
d. The reasonableness of forecasted critical inputs including construction costs, opportunity export revenues, future fuel prices, electricity market price forecasts, the determinants of those values, and export volumes;
e. The reasonableness of the scope and evaluation of risks and the benefits proposed to arise from the development and the reasonableness and the reliability of Hydro's interpretation of the most likely future outcomes as a result of climate changes, interest rate fluctuations, export market prices, domestic load fluctuations, droughts, competing technologies, fuel prices, carbon pricing, technology developments, economic conditions, Hydro's transmission positions and other relevant factors;
f. The impact on domestic electricity rates over time with and without the Plan and with alternatives;
g. The financial and economic risks of the Plan and export contracts and export opportunity revenues in relation to alternative development strategies;
h. The socio-economic impacts and benefits of the Plan and alternatives to northern and aboriginal communities;
i. The macro environmental impact of the Plan compared to alternatives;
j. If the Plan has been justified to provide the highest level of overall socio-economic benefit to Manitobans, and is justified to be the preferable long-term electricity development option for Manitoba when compared to alternatives.

Independent Expert Consultants

The Panel shall establish a process for the thorough review of any information that the Panel determines to be relevant to the conduct of the NFAT, including relevant Commercially Sensitive Information, as defined in Appendix A, subject to these Terms of Reference.

The Panel may use one or more independent expert consultant(s) for the purpose of the NFAT. In addition to such other questions and issues as the Panel may determine they should examine, the independent expert consultant(s) shall be expected to critically examine the following:

(a) the high level forecasts of export revenues that are filed by Hydro and whether the forecasts appropriately and accurately reflect the export contracts, including Commercially Sensitive Information.

(b) the accuracy and reasonableness of Hydro's approach to producing an assessment of financial risks (including drought), the assessment of which is derived using Commercially Sensitive Information;

(c) the appropriateness and correct application of methodologies that cannot be publicly disclosed by MH because they contain Commercially Sensitive Information, such as whether Hydro's approach to comparing generation sequences follows sound industry practice;

5.0.0 SCOPING OUT THE MEANING OF "SOCIO-ECONOMIC" IMPACT

The NFAT Terms of Reference include the assessment of alternatives to Manitoba Hydro's Preferred Development Plan. Such assessment is to take into consideration:

> 2 h *"The Socio-Economic Impacts and benefits of the Plan and Alternatives to Northern and Aboriginal communities";*
>
> and
>
> 2 j *"If the plan has been justified to provide the highest level of overall socio-economic benefit to Manitobans, and is justified to be the preferable long-term electricity development option for Manitoba when compared to alternatives."*

In Order 67/13, Parties were invited to provide the Board with a working definition, for NFAT Review purposes, of "socio-economic".

For purposes of the NFAT Review, the Parties and their consultants and expert witnesses are to be bounded by the following definition of "socio-economic" impact and benefits:

> A critical analysis of the socio-economic impacts and benefits of Manitoba Hydro's Preferred Development Plan and alternative Plans. Specifically, a high level summary of potential effects to people in Manitoba, especially Northern and Aboriginal communities, including such things as employment, training and business opportunities; infrastructure and services; personal family and community life; and resource use.

TAB 2

Manitoba Hydro

Needs For and Alternatives To
Appendix 9.1 High Level Development Plan Comparison Table

Development Plan			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			All Gas	K22/Gas	Wind/Gas	K19/Gas24/250MW	K19/Gas25/750MW (WPS Sale & Investment)	K19/Gas31/750MW	SCGT/C26	CCGT/C26	Wind/C26	K22/C29	K19/C31/250MW	K19/C31/750MW	K19/C25/250MW	K19/C25/750MW (WPS Sale & Investment)	K19/C25/750MW
Technical		Fuel Type	Natural Gas	Water & Natural Gas	Air & Natural Gas	Water & Natural Gas	Water & Natural Gas	Water & Natural Gas	Natural Gas & Water	Natural Gas & Water	Air & Water	Water	Water	Water	Water	Water	Water
Technical		Renewable	No	Partially	Partially	Partially	Partially	Partially	Partially	Partially	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Technical		Dispatchability	Yes	Yes	Yes through gas	Yes	Yes	Yes	Yes	Yes	Predominantly	Yes	Yes	Yes	Yes	Yes	Yes
Technical		Mode of Operation	Intermediate & Peaking	Baseload, Intermediate & Peaking	Must Take & Peaking	Baseload, Intermediate & Peaking	Baseload, Intermediate & Peaking	Baseload, Intermediate & Peaking	Peaking & Modified Run-of-River	Intermediate, Peaking & Modified Run-of-River	Must Take, Modified Run-of-River	Baseload, Peaking & Modified Run-of-River	Baseload, Peaking & Modified Run-of-River	Baseload, Peaking & Modified Run-of-River	Baseload, Peaking & Modified Run-of-River	Baseload, Peaking & Modified Run-of-River	Baseload, Peaking & Modified Run-of-River
Technical		Asset Life	30 yrs	67 & 30 yrs	20 & 30 yrs	67 & 30 yrs	67 & 30 yrs	67 & 30 yrs	30 & 67 yrs	30 & 67 yrs	20 & 67 yrs	67 yrs	67 yrs	67 yrs	67 yrs	67 yrs	67 yrs
Technical		Earliest Resource ISD	2022	2022	2022	2019	2019	2019	2022	2022	2022	2022	2019	2019	2019	2019	2019
Technical		Transmission Length	120 Km	118 Km	943 Km	263 Km	349 Km	349 Km	87 Km	87 Km	263 Km	547 Km	692 Km	738 Km	692 Km	738 Km	738 Km
Technical	Capacity at Plant	Total Nominal	2115 MW	2345 MW	3892 MW	2345 MW	2304 MW	2356 MW	2530 MW	2629 MW	2920 MW	2807 MW	2807 MW	2807 MW	2807 MW	2807 MW	2807 MW
Technical	Capacity at Plant	Total Net Winter Peak	2242 MW	2376 MW	2280 MW	2376 MW	2343 MW	2395 MW	2415 MW	2517 MW	2415 MW	2599 MW	2599 MW	2599 MW	2599 MW	2599 MW	2599 MW
Environmental	Air Impacts	Cumulative GHG Operating Emissions	33.2 Mt CO2e	23.1 Mt CO2e	16.0 Mt CO2e	25.4 Mt CO2e	16.3 Mt CO2e	18.7 Mt CO2e	13.0 Mt CO2e	17.5 Mt CO2e	9.8 Mt CO2e	7.8 Mt CO2e	12.0 Mt CO2e	7.4 Mt CO2e	7.8 Mt CO2e	7.5 Mt CO2e	7.5 Mt CO2e
Environmental	Air Impacts	Cumulative Regional GHG Disp. Potential	22.5 Mt CO2e	94.4 Mt CO2e	67.4 Mt CO2e	107.7 Mt CO2e	94.4 Mt CO2e	94.1 Mt CO2e	102.1 Mt CO2e	113.1 Mt CO2e	125.1 Mt CO2e	155.5 Mt CO2e	159.5 Mt CO2e	162.4 Mt CO2e	186.2 Mt CO2e	191.6 Mt CO2e	191.8 Mt CO2e
Environmental	Air Impacts	Cumulative NOx Emissions	13800 t	10800 t	8700 t	11500 t	8900 t	9600 t	7900 t	9100 t	7000 t	6400 t	7600 t	6300 t	6500 t	6400 t	6400 t
Environmental	Land Impacts	GS Footprint	19 ha	229 ha	423 ha	229 ha	228 ha	228 ha	173 ha	174 ha	263 ha	383 ha	383 ha	383 ha	383 ha	383 ha	383 ha
Environmental	Land Impacts	Flooded Area	0 ha	4,463 ha	0 ha	4,463 ha	4,463 ha	4,463 ha	507 ha	507 ha	507 ha	4,970 ha	4,970 ha	4,970 ha	4,970 ha	4,970 ha	4,970 ha
Environmental	Land Impacts	Additional Impacted Area	0 ha	9,302 ha	53,595 ha	9,302 ha	9,302 ha	9,302 ha	1,381 ha	1,381 ha	13,291 ha	10,683 ha	10,683 ha	10,683 ha	10,683 ha	10,683 ha	10,683 ha
Environmental	Land Impacts	Total Impacted Area	19 ha	13,994 ha	54,018 ha	13,994 ha	13,993 ha	13,993 ha	2,061 ha	2,062 ha	14,061 ha	16,036 ha	16,036 ha	16,036 ha	16,036 ha	16,036 ha	16,036 ha
Environmental	Water Impacts	Water Consumption	≈ 900 m³/GW.h for CCGT generation	≈ 900 m³/GW.h for CCGT generation	Domestic Needs Only	≈ 900 m³/GW.h for CCGT generation	≈ 900 m³/GW.h for CCGT generation	≈ 900 m³/GW.h for CCGT generation	Domestic Needs Only	≈ 900 m³/GW.h for CCGT generation	Domestic Needs Only	Domestic Needs Only	Domestic Needs Only	Domestic Needs Only	Domestic Needs Only	Domestic Needs Only	Domestic Needs Only
Environmental	Water Impacts	Water Quality	-	Erosion & Mercury	-	Erosion & Mercury	Erosion & Mercury	Erosion & Mercury	Negligible	Negligible	Negligible	Erosion & Mercury	Erosion & Mercury	Erosion & Mercury	Erosion & Mercury	Erosion & Mercury	Erosion & Mercury
Environmental	Water Impacts	Water Regime	-	Regulated Operating Range	-	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range	Regulated Operating Range
Environmental	Wildlife Species of Interest	Aquatic	-	Lake Sturgeon Habitat	-	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat	Lake Sturgeon Habitat
Environmental	Wildlife Species of Interest	Terrestrial	-	Caribou Habitat	-	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat	Caribou Habitat
Environmental	Wildlife Species of Interest	Avian	-	Nesting Habitat	Bird & Bat Collisions	Nesting Habitat	Nesting Habitat	Nesting Habitat	Negligible	Negligible	Bird & Bat Collisions	Nesting Habitat	Nesting Habitat	Nesting Habitat	Nesting Habitat	Nesting Habitat	Nesting Habitat
Socio-Economic / Provincial	Generic Tech. Rating	Health Concerns	Low	Very Low / Low	Low	Very Low / Low	Very Low / Low	Very Low / Low	Low / Very Low	Low / Very Low	Low / Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
Socio-Economic / Provincial	Generic Tech. Rating	Safety Concerns	High	Medium / High	Very Low / High	Medium / High	Medium / High	Medium / High	High / Medium	High / Medium	Very Low / Medium	Medium	Medium	Medium	Medium	Medium	Medium
Socio-Economic / Provincial		MB Business Opportunities (% of capital spent in MB)	28%	46%	21%	45%	42%	41%	41%	43%	40%	47%	46%	45%	44%	44%	44%
Socio-Economic / Provincial	Cumulative Development Plan Employment	Direct Construction	2,000 Person-Years	6,300 Person-Years	3,100 Person-Years	6,300 Person-Years	5,800 Person-Years	6,000 Person-Years	7,900 Person-Years	8,200 Person-Years	8,300 Person-Years	12,500 Person-Years	12,500 Person-Years	12,500 Person-Years	12,500 Person-Years	12,500 Person-Years	12,500 Person-Years
Socio-Economic / Provincial	Cumulative Development Plan Employment	At Northern Work Sites	0%	69%	0%	69%	73%	72%	86%	84%	82%	89%	89%	89%	89%	89%	89%
Socio-Economic / Provincial	Cumulative Development Plan Employment	Permanent O&M	3,900 Person-Years	4,300 Person-Years	4,700 Person-Years	4,700 Person-Years	3,800 Person-Years	3,500 Person-Years	3,000 Person-Years	4,100 Person-Years	4,200 Person-Years	3,200 Person-Years	2,900 Person-Years	3,400 Person-Years	2,000 Person-Years	2,000 Person-Years	2,000 Person-Years
Socio-Economic / Provincial	Cumulative Development Plan Employment	At Northern Work Sites	0%	35%	0%	32%	40%	44%	45%	33%	32%	84%	53%	86%	77%	77%	77%
Socio-Economic / Provincial	Present Value Royalties / Taxes (2014$)	Water Rentals	$0 M	$125 M	$0 M	$155 M	$149 M	$151 M	$155 M	$157 M	$149 M	$243 M	$263 M	$263 M	$306 M	$314 M	$314 M
Socio-Economic / Provincial	Present Value Royalties / Taxes (2014$)	Capital Taxes	$131 M	$361 M	$312 M	$404 M	$416 M	$425 M	$438 M	$458 M	$519 M	$650 M	$670 M	$698 M	$754 M	$780 M	$794 M
Socio-Economic / Provincial	Present Value Royalties / Taxes (2014$)	Guarantee Fees	$209 M	$577 M	$505 M	$647 M	$666 M	$680 M	$702 M	$733 M	$831 M	$1040 M	$1072 M	$1117 M	$1206 M	$1247 M	$1270 M
Socio-Economic / Provincial	Present Value Royalties / Taxes (2014$)	Other	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Land Rentals, Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Land Rentals, Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes	Grants-in-lieu of taxes
Socio-Economic / Provincial		Nearby Population Centers	Brandon, Southern centre near pipeline	Brandon, Fox Lake CN, Gillam, Southern centre near pipeline, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Brandon, Southern centre near pipeline, Southwest & South-central Manitoba	Brandon, Fox Lake CN, Gillam, Southern centre near pipeline, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Brandon, Fox Lake CN, Gillam, Southern centre near pipeline, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Brandon, Fox Lake CN, Gillam, Southern centre near pipeline, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Brandon, Fox Lake CN, Gillam, Shamattawa FN, Southern centre near pipeline, Tataskweyak CN, War Lake FN, York Factory FN	Brandon, Fox Lake CN, Gillam, Shamattawa FN, Southern centre near pipeline, Tataskweyak CN, War Lake FN, York Factory FN	Brandon, Fox Lake CN, Gillam, Shamattawa FN, Southern centre near pipeline, Tataskweyak CN, War Lake FN, York Factory FN	Fox Lake CN, Gillam, Shamattawa FN, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Fox Lake CN, Gillam, Shamattawa FN, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Fox Lake CN, Gillam, Shamattawa FN, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Fox Lake CN, Gillam, Shamattawa FN, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Fox Lake CN, Gillam, Shamattawa FN, Tataskweyak CN, Thompson, War Lake FN, York Factory FN	Fox Lake CN, Gillam, Shamattawa FN, Tataskweyak CN, Thompson, War Lake FN, York Factory FN
Economic		Incremental NPV Relative to All Gas Plan Reference Scenario (2014$)	$0 M	$887 M	-$775 M	$1346 M	$1097 M	$1091 M	$738 M	$784 M	$531 M	$806 M	$1215 M	$1360 M	$1295 M	$1696 M	$1427 M

Table 13.1 **SUMMARY OF MULTIPLE ACCOUNT FRAMEWORK**

Account	Purpose	Analysis	Indicators
Market Valuation	Net benefit to Manitoba Hydro and project partners.	Incremental revenues from surplus sales less incremental capital and O&M expenditures.	Present value of net revenues or cost (market valuation of investment).
Manitoba Hydro Customer	Consequences for customers in short to medium and long term.	Rate increases required to recover costs and meet MH financial targets. System reliability.	Average annual and cumulative rate increases over the planning period. Load carrying capability and cost of expected unserved load.
Manitoba Government	Net benefit to taxpayers.	Incremental government net revenues. Amount of additional Manitoba Hydro debt guarantee.	Present value of incremental revenues to government, net of incremental costs (including consideration of risk of debt guarantee).
Manitoba Economy	Consequences for the economy.	Employment generated and incremental income earned.	Present value of incremental income.
Environment	Consequences for emissions and natural and bio-physical effects.	Impact on GHGs in Manitoba and elsewhere. Manitoba CAC emissions Biophysical impacts.	Present value of social cost of Manitoba GHGs in excess of carbon charge. Present value of CAC damage costs. Nature and extent of residual biophysical impacts.
Social	Consequences for aboriginal and non-aboriginal communities. Other social impacts not addressed elsewhere.	Benefits to project partners. Impacts on affected communities. Value people place on assets remaining at end of planning period.	Nature and significance of partner benefits. Nature and extent of residual community impacts. Potential bequest value of remaining assets.
Risk	Nature and significance of key assumptions.	Range of possible consequences. Risk mitigation potential.	Probability distribution of system net revenues and rates.

13.2 The Resource Development Plans

The MA-BCA assesses the preferred and three alternative resource development plans. Two of the alternative plans assume no new U.S. interconnection or firm export sales: one based on the development of new gas-fired thermal generation as required to meet growing domestic loads; and one based on hydro – specifically the development of Keeyask G.S. The other

REFERENCE: Chapter 13: Integrated Comparisons of Development Plans - Multiple Account Analysis; Section: 13.3.2; Page No.: 10

PREAMBLE: The Manitoba Economy Account estimates the potential incremental income earned by Manitobans under each Plan.

QUESTION:

Why doesn't the Manitoba Economy Account also consider the impact on the Manitoba Economy of the difference in electricity bills that occur under each of the Plans, since the dollars spent on electricity are not available to spend/invest elsewhere in the economy?

RESPONSE:

Benefit-cost analysis is not economic impact analysis. It focuses on incremental net gains or losses. Consequently for the Manitoba economy the multiple account benefit-cost analysis focuses on direct impacts of the project where there is reason to believe there may be net gains or losses for the affected workers. It doesn't address indirect and induced impacts from project expenditures nor spending impacts related to electricity price increases because it is not clear what, if any, incremental income consequences those impacts would have.

4 Measuring Benefits and Costs Under Each Account

In traditional benefit-cost analysis the consequences of the alternatives are aggregated to a bottom line that reflects the incremental project revenues and expenditures (the market valuation), adjusted for the differences between market prices and social benefits and costs. In multiple account benefit-cost analysis, the market valuation and adjustments for the differences between market prices and social benefits and costs are reported in separate accounts (taxpayer net benefits, user or target-beneficiary net benefits, net benefits from the economic activity generated, and environmental and social externalities) in a summary matrix of results, with the objective of informing the debate as clearly as possible about the advantages and disadvantages or trade-offs of the project or policy alternatives.

However, whether the objective is to estimate a bottom line or to inform the debate, that objective will only be well served if the analysis is done properly, in accordance with the basic concepts and principles of benefit-cost analysis. Some key principles that need to be followed and issues that need to be considered under each of the valuation accounts in multiple account analysis, and in benefit-cost analysis generally, are outlined below.

Market Valuation Account

The market valuation account indicates the net benefit or cost of a project or policy based on market prices, before any adjustment to move to a full social valuation. It measures benefits by what people actually pay for what is provided or produced, and costs by the dollar amounts actually received for the goods and services supplied. It requires estimating the incremental revenues that are generated and the incremental expenditures incurred. Where there are no prices for the project outputs (for example, in the development of non-tolled road capacity or the provision of certain social services), there would simply be the incremental expenditures incurred.

This market valuation is similar to a **cash flow analysis** that an investor would undertake to analyse the private profitability of a project. The perspective, however, is broader. In benefit-cost analysis it is essential to measure *incremental* effects. Thus, while the market valuation would initially address the revenues and expenditures of the project itself, it has to take into account the total system or industry impacts in order to estimate the incremental revenues and expenditures for the system or industry as a whole.

For example, the market valuation of a rapid transit project would generally start with the revenues and expenditures generated by the project itself . However the incremental effects of the project would be measured by the changes in revenues and expenditures for the transit system as a whole, taking the impacts on bus, rail, or other transit service into account.

Similarly, the market valuation of a new convention centre might start with the revenues and expenditures expected for the new facility. However, to determine the incremental revenues and expenditures resulting from the project, one would have to net out the impacts at other convention centre facilities (for example, the revenue losses and reduced expenditures at existing facilities due to any diversion of convention business to the new facility).

The reference area for the analysis is important to consider in this regard. One would only net out the impacts on other facilities within the jurisdiction for which the analysis is being done. It is the incremental revenues and expenditures within the jurisdiction of interest that need to be estimated.

Taxpayer Account

The taxpayer account indicates the net benefit accruing to (or net cost borne by) taxpayers. It requires estimating the incremental taxes and other revenues that the different levels of government would receive as a result of the project in relation to the incremental costs that they would incur.

In terms of traditional benefit-cost analysis, this account captures the social adjustments that have to be made to recognize (i) those

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expenditures included in the market valuation that are in fact transfers to taxpayers, as opposed to real economic costs, and (ii) those real economic costs incurred by taxpayers that are not paid for by the project and therefore are not reflected in the market valuation.

The project expenditures included in the market valuation typically include a wide range of taxes or other payments to government, for example, natural resource, sales, fuel, income, and property taxes. The benefit-cost issue is whether these taxes and other payments constitute incremental government revenues and benefit for taxpayers, that is, whether they are in excess of what government would otherwise have received and are not offset by incremental government expenditures. As discussed below, whether the taxes are incremental will depend primarily on whether the resources, goods, or services on which they are levied would otherwise have been utilized or produced.

Resource Taxes and Charges

Energy, mining, and other resource projects have to pay royalties, taxes, or other charges for the publicly owned resources they use or consume. The amount of these charges that constitute incremental government revenues and benefit for taxpayers will depend on whether, when, or to what extent the resource payments would otherwise be made. Only when the resource payments would not otherwise be made in the same amount or time period will there be incremental resource tax revenues due to the project. And only when the incremental revenues are not offset by incremental government costs will there be a net benefit for taxpayers.

For example, in the benefit-cost analysis of a hydroelectric versus a natural gas-fired power generation alternative, the market valuation will generally include water rentals paid for the hydroelectric project (taxes paid in relation to the hydroelectric capacity and energy production), and natural gas royalties embedded in the price of the natural gas used for the thermal project.

The water rentals would constitute incremental revenues for government to the extent that the water used to generate electricity would not be diverted from other water-rental-paying uses. The water rentals in this case would be a source of revenues that government would not otherwise collect, and they would constitute an incremental taxpayer benefit to the extent that the hydroelectric project did not give rise to any incremental government activity and expense for which taxpayers would have to pay. The water rentals then would simply be a charge by which government, and therefore taxpayers, captured a share of the value of the hydroelectric resource.

The natural gas royalties, however, generally would not constitute incremental revenues and benefit for taxpayers. Even on the assumption that the gas was supplied from within the jurisdiction for which the analysis was being done, the gas royalties would only increase government revenues if the thermal power use of the gas resulted in an increase in total gas production. That would only occur if the demand for gas by the thermal power project was so large that it significantly affected the market price of gas. More likely, the thermal power project use of the gas would simply displace exports or some other use with little impact on the market price. The total amount of gas production and royalties paid would not change.

Sales Taxes

Often included in project expenditures are sales taxes on the goods and services that are purchased. Whether these taxes constitute incremental government revenues and benefit for taxpayers depends on whether the project purchases result in an increase in the total amount of goods and services produced in the economy and, therefore, an increase in the total amount of sales taxes paid. If there is an increase in production levels and sales taxes paid, then there would be incremental government revenues and benefit for taxpayers. However, if the project simply diverts goods from other users, or results in a different mix of goods and services being produced in the economy, with no change in the total value of production and sales taxes paid, then there would be no incremental revenues and benefit. The same amount of sales taxes would have been paid with or without the project.

Another way to think of this is to consider what would be the real economic cost of consuming goods that are subject to sales tax. If they are diverted from other uses, the real cost would be the opportunity cost of the goods – what people would have paid for those goods in the alternative uses. That includes the sales tax. No social adjustment from the actual expenditures would be required. If, however, the goods are newly produced, then their real cost is the value of the resources used in their production. That would not include the sales tax. A social adjustment would be required to recognize that the sales tax in such a case would constitute an incremental revenue and benefit for taxpayers.

Fuel Taxes

Unlike general sales taxes, the taxes on gasoline and other fuel purchases may affect total tax revenues even if there is no change in the total amount of goods and services produced in the economy. A project that affects fuel use may change the amount of household and business expenditures subject to the fuel tax.

For example, a transit project that reduces automobile use and gasoline consumption would cause a shift in expenditures away from purchases that are subject to fuel tax to other purchases that are not. There would likely be a net reduction in tax revenues. A road project that causes fuel use to rise would likely result in an increase in total fuel taxes paid. Only if there were a constraint on total fuel supply (such that an increase in use by some caused a corresponding reduction by others) would there be no change in the total amount of fuel taxes paid.

Of course, projects that result in an increase in fuel use due to increased vehicular travel may not result in an overall net benefit for taxpayers, and projects that cause a reduction in fuel use and related taxes may not result in a net cost. That will depend on the impacts on road and other government expenditures that also take place. And the overall net benefits and costs of the project, going beyond the taxpayer account, will depend on emission, congestion, or other effects. The tax implications are only one part of the analysis.

Income Taxes

Embedded in wages and the prices of the goods and services purchased for the project are income taxes that workers and businesses have to pay. Whether these income tax payments constitute incremental revenues and benefit for taxpayers depends on basically the same question as that concerning sales taxes. Will the project result in an increase in the total amount of employment and economic activity in the economy, and therefore an increase in the total amount of income taxes paid, or will it simply change the location of people's employment and the nature of the economic activity that takes place?

If a project does increase employment and economic activity overall, by employing people who would otherwise be unemployed or underemployed, then there would be an increase in the total amount of taxes paid. There could also be a reduction in unemployment insurance or other government support. However, if the project simply results in the hiring of persons who would otherwise (without the project) have earned comparable income and paid comparable taxes in other activities, then there would be no change in the total amount of income taxes paid.

Most benefit-cost analyses start with the premise that labour and other resources in the economy are limited and fully employed. The focus of the analysis is typically on the advantages and disadvantages of different allocations of resources, not their total utilization, which is a matter better addressed by macroeconomic policy. Assuming that resources are fully employed, projects or policies will not tend to increase the total amount of goods and services produced, and therefore sales taxes paid, or the total amount of employment, and therefore income taxes paid. In these circumstances, sales taxes and income taxes would not constitute incremental government revenues, and no recognition or adjustment for them would be required.

Even in studies for smaller jurisdictions, where projects can serve to increase total employment and production, but do so primarily through in-migration to fill the new jobs, no adjustment for incremental tax benefits is generally required. There will be incremental employment and income taxes paid, but these will in large part be offset by incremental government costs to provide the services needed for a larger population.

The main circumstances where incremental income tax revenues and benefit need to be considered are in analyses that compare alternatives subject to different tax provisions, for example private versus public development strategies, or in analyses for projects or policies targeted to time periods or regions of high unemployment. However, even in these cases care must be taken not to overstate the incremental effects. Ideally, models of the entire economy should be used to determine the extent to which economic activity and employment and related taxes are increased. The overall impact, taking into account the diversion of goods, services, and employment from other industries and sectors, will generally be less than a project impact assessment in itself might suggest.

Property Taxes

Property taxes, or grants paid in lieu of such taxes, will constitute incremental government revenues if the property value or tax rate is different from what it would otherwise be. With new developments this will generally be the case. However, the net benefit for taxpayers will depend on the

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Incremental Government Costs

There will be incremental government costs that need to be taken into account whenever the cost of the government services provided as a result of the project are not fully paid or accounted for in the project expenditures. This will occur when no price is charged for the government services or when the price that is charged does not reflect the incremental costs of their supply. There will also be incremental government expenditures that need to be taken into account when the project is subsidized. From a social perspective, resources are allocated to the project whether they are paid for by the project developers or by the government.

There is a common tendency in the evaluation of local or regional projects to ignore the financial contributions of senior governments, based on the argument that the costs of such contributions are incurred by others and do not involve allocating local or regional resources. That is not entirely correct. First, residents within the locality or region generally pay senior government taxes and therefore bear some of the burden of the contribution. Second, if senior governments try to maintain some equity in their financial spending in different areas, their contributions for any one project will limit what they provide for other projects. In other words, there likely will be a significant opportunity cost to the senior government funds allocated to any particular project that needs to be recognized even in an evaluation from a local or regional perspective.

User or Target-Beneficiary Account

The market valuation indicates the amount that people pay for whatever is provided, that is, the share of the total benefits that are captured by the project developer or implementing authority. The user or target-beneficiary account indicates the net benefit that the users or target beneficiaries derive over and above what they actually pay.

In traditional benefit-cost analysis this net benefit is measured by the estimated consumer surplus – the difference between the maximum amount that the users or target beneficiaries would be willing to pay and what they actually pay. In multiple account benefit-cost analysis, non-monetary indicators might be used, but the objective would be the same – to develop measures or indicators of the potential magnitude or significance of the net benefit that the project or policy generates for the users or target beneficiaries.

Not all projects will affect user net benefits or consumer surplus. Generally, projects will only change the amount of consumer surplus that is derived if there is a change in the price of a good or a service, or a change in its quality.

As shown in figure 4.1, if a project reduces the price that is charged for a good or a service, there will be an increase in consumer surplus (Δcs) as a result of the lower price in itself (*A*) and also because of the increase in the amount of consumption that is induced by the lower price (*B*). If a project increases the quality of what is produced, there will be an increase in consumer surplus because of the increased willingness to pay for the quality improvement (*C*) and the increase in consumption it induces (*D*). If there were no change in price or in quality (in economic terms, if there were no movement along or quality-driven shift in the demand curve), then there would be no change in the user net benefit.

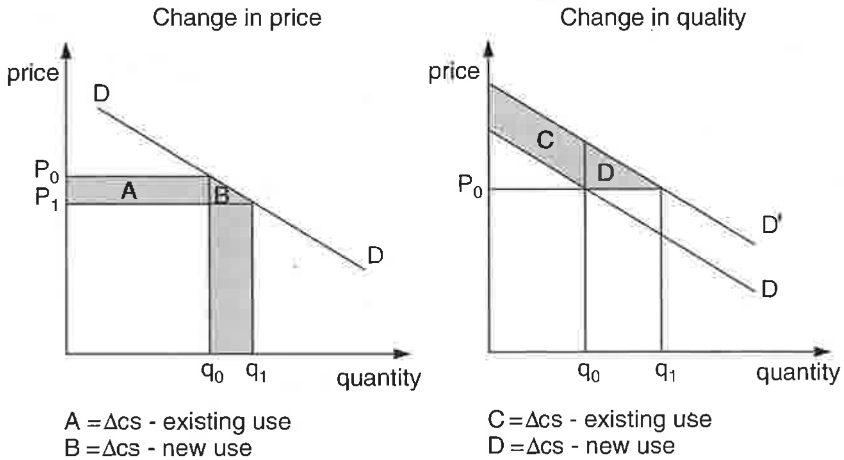
Average Willingness to Pay versus Incremental Willingness to Pay

A common error in the valuation of user net benefits is to use estimates of *average* willingness to pay as opposed to *incremental* willingness to pay when measuring the value of the incremental consumption that would be induced by a reduction in price or an improvement in quality.

For example, it would be a mistake in a benefit-cost analysis of enhanced recreational fishing opportunities to base the willingness to pay for any increased recreational fishing activity on an estimate of the average amount that existing recreational fishers are willing to pay per fishing day. The willingness to pay for the incremental fishing days will be less than for the existing, otherwise those fishing days would already be taking place.[1]

Similarly, it would be a mistake in a benefit-cost analysis of an improvement in transit service to assume that the value of the new transit trips attracted by the improved service would be equal to the amount that existing transit users are willing to pay. The fact that the transit trips are new means they are valued less than the existing trips are (what existing users are willing to pay). It is the incremental net benefit or consumer surplus that needs to be measured. That requires

Figure 4.1: Price and quality impacts on consumer surplus (wtp-p)



using estimates of the **incremental or marginal value** of any incremental use.

Pecuniary Effects versus Real Effects

It is important to recognize that the changes in user net benefits or consumer surplus measured in this account can reflect what economists term ***pecuniary*** (or *distributional*) ***effects*** as well as ***real effects***. An increase in user net benefits or consumer surplus due to a reduction in price itself (the area *A* in figure 4.1) would be a pecuniary effect. Consumers would be better off with the lower price, but the suppliers of the good or the service would be correspondingly worse off. However, the increase in user net benefits or consumer surplus due to an increase in the amount consumed (the area *B* in figure 4.1), or an increase in quality (*C* plus *D*) would constitute real effects. There would be an increase in net benefits without any corresponding loss.

Traditional benefit-cost analysis is concerned with real effects. Only real effects enter the overall bottom line. In multiple account analysis, the user or target-beneficiary account captures pecuniary effects as well as real effects in order to indicate how different interests are affected by the project. The consumer surplus gain due to a reduction in price appears in the user account; the corresponding loss to the supplier is captured in the market valuation account.

Economic Activity Account

The market valuation of expenditures indicates the amount that people and businesses are paid for the goods and services they provide. The economic activity account indicates the net benefit (producer surplus or economic rent) that people and businesses realize when what they are paid exceeds their opportunity or incremental costs (the minimum amount they require to willingly supply the goods and services). It also indicates the net cost when what suppliers are paid is less than their opportunity or incremental costs, where they incur a net loss.

The net benefits measured under this account are not the same as the **economic impacts** that are generated. Economic impacts indicate the direct, indirect, and induced demand for labour and goods and services generated by the project. They are typically estimated with input-output models of the economy that can trace the demand for any one good (or the initial demand for a mix of goods and services in construction or operation) to demands for all other goods in the economy.

Summary measures of economic impact – the total income and employment generated – are commonly reported by government and project proponents as indicators of the net benefits of their project. However, for these impacts to constitute net benefits one has to assume that all of the workers in the affected industries would otherwise be unemployed and all of the factories underutilized.

Economic impacts measure net benefits only if there are no resource or supply constraints. Of course, if there were no such constraints, there would be little need for benefit-cost analysis. Virtually all projects would appear attractive, and all the more so, the more expenditures they entailed. Greater expense would mean greater impact, and greater impact would mean greater benefit for business and labour.

The fact is that there generally are resource and supply constraints, and economic impact estimates do not indicate the *incremental* income or the *net* benefit that workers or businesses derive – the maximum they would be willing to pay or give up for the new employment or business opportunities that might be generated by a project or policy.[2]

For workers, the net benefit of any new employment opportunity depends on what they would otherwise be doing. If they would have been working and receiving roughly comparable wages at other jobs, there would be no net benefit. Their opportunity cost (and therefore the minimum amount of wages they would have to receive to willingly work at the new jobs that would be generated as a result of the project) would be roughly the same as the wages they would receive in the new job opportunity. Only if those hired would otherwise have been involuntarily unemployed or underemployed would there be any significant net benefit. The workers' opportunity cost would then reflect the lower wages that they would otherwise receive or the value of the time that they would be giving up to take the new work. The net benefit would equal the difference between the wages in the new jobs and this lower opportunity cost.

In a simple case where there are only two possibilities for what the workers would otherwise be doing (unemployment or comparable employment elsewhere), the social opportunity cost of labour and net benefit from the employment generated by a project or policy can be expressed as follows:

$$SOCL = p_u * v_u + (1 - p_u) * w$$
$$NB = w - SOCL = p_u * (w - v_u)$$

Where
$SOCL$ is the social opportunity cost of labour,
p_u is the probability of hiring people who would otherwise be unemployed,
v_u is the value of what the unemployed persons would otherwise be doing (the minimum they would have to be paid to willingly work at the new job),
w is the wages that are paid in the new or comparable existing job, and
NB is the net benefit that is realized from the new job.

In this case it can be seen that the net benefit of any employment generated by a project or policy will be greater, the greater is the probability of hiring persons who would otherwise be unemployed (p_u), and the greater is the difference between the wages paid in the new jobs (w) and the value of whatever those hired would otherwise be doing (v_u).[3] Only when the probability of hiring persons who would otherwise be unemployed is near 100 per cent, and the value of what they would otherwise be doing is near zero,[4] would the net benefit of newly created jobs approach the amount of wages paid.

Estimating the net benefits from the employment generated by a project or policy requires detailed consideration of the extent of unemployed resources in the specific occupations and industries that are affected. The more that demands are generated for occupations where there is significant unemployment, the more that net benefits will be provided by the new employment opportunities. There will be a greater probability of hiring persons who would otherwise be unemployed.[5]

The net benefit that businesses derive from new business activity depends on the incremental sales they realize (sales that they would not have otherwise made) and the incremental net income (incremental revenues minus incremental expenditures) that the incremental sales generate. For the economy as a whole, the net benefit depends on whether any incremental income earned by some businesses is offset by losses elsewhere. The development of new sports or rapid transit centres, for example, may generate commercial activity and incremental net income for nearby businesses. However, that can be offset by the loss of business elsewhere. In such a case there would be a distributional impact but no real or overall net gain.

In traditional benefit-cost analyses, distributional effects are not included in the calculation of an overall bottom line. In multiple account analyses, it is important to identify distributional impacts where they are significant and relevant to the policy debate, but it is essential to distinguish them from real effects in order to indicate the overall net benefit from the economic activity that is generated.

In a well-functioning economy, operating near full employment, the overall net benefit from the economic activity generated by the project will be relatively small. The wages paid to labour will generally reflect their opportunity cost. Business activity in the economy as a whole will be constrained by the total capacity in the economy. As discussed in relation to sales and income tax effects, it is generally assumed that projects will affect what goods and services are produced and for whom, but not necessarily how much is produced and earned overall. It is important, therefore, not to overstate the net benefits in this account.[6]

In addition to not overstating the net benefits of the economic activity generated by a project, it is important to recognize that some new economic activity can give rise to net economic costs. This will occur when the prices paid for inputs are less than the opportunity or incremental costs of the supply of those inputs, due to regulation, subsidies, or other price distortions.

For example, the regulated price of electricity that is charged by Canadian hydroelectric utilities is generally much less than the incremental costs of electricity supply because of the very low-cost, largely amortized hydro assets that are dominating the rates. New demands for electricity will consequently impose a net economic cost on the utility and its existing customers that is equal to the difference between what the utility receives for the electricity it supplies and the incremental costs it incurs to meet the new requirements. In the case of new electric-intensive projects, the net cost can be very significant. In traditional benefit-cost analysis a social adjustment is required to reflect the incremental cost of the electricity (as opposed to the price that is paid). In multiple account analysis the difference between the incremental cost and the price paid needs to be recognized as a net cost in the economic activity account.[7]

Environmental Account

The environmental account indicates the nature, magnitude, and significance of the environmental externalities resulting from the project, that is, the enhancement or diminution of the natural resource and environmental attributes that people value for their use or their mere existence.

It is critically important in the valuation or assessment undertaken in this account to distinguish between environmental impacts that are reflected in market prices and those impacts that constitute externalities. Only the externalities – the positive impacts for which people do not pay or the negative impacts for which they are not compensated – are included here. Positive environmental impacts for which people pay or the negative ones for which they are compensated are already captured in the market valuation, and it would be double counting to include them again in this account.

For example, occupational hazards that are known to the workers and reflected in wages that incorporate occupational risk premiums are not externalities.[8] Nor are environmental effects that are fully compensated or offset in an acceptable manner, for example the full offset of air emissions by measures that would not otherwise take place. It is the uncompensated impacts that are measured here.

The environmental account in a multiple account benefit-cost analysis is not intended simply to summarize the environmental externalities identified in an environmental impact assessment or similar document. Although obviously based on such assessments, the intent is to bring some perspective to the magnitude and significance of the externalities.

There are numerous methods by which the willingness to pay or the compensation demanded for different environmental impacts can be estimated in dollar terms, as discussed in chapter 5. However, where dollar measures cannot reasonably be estimated, non-monetary indicators can be used to provide some perspective to the magnitude and significance of the impacts. This could include quantitative measures in physical units (tonnes of emissions per year, hectares of land of a specified nature) or summary descriptions of consequences, along with relevant information on their significance (uniqueness, relative size, potential for offset, and cost).

However the impacts are measured or described, a key objective is to facilitate a clear understanding and assessment of any trade-off between the environmental externalities and the results in the other accounts. Ideally the indicators will facilitate the calculation of meaningful critical values. Critical values are those specific values (or combination of values) that would have to be assigned to the environmental externalities to change the ranking of the alternatives based on the other accounts.

For example, as discussed in the case studies at the end of the previous two chapters, in a benefit-cost analysis of a thermal power plant, one could compute the critical value per tonne that greenhouse gas emissions would have to be assigned for such a plant to be socially more costly than the alternative sources of supply would be. In a benefit-cost analysis of a hydroelectric project one could calculate the critical value of any wilderness or habitat loss at which the plant would be socially more costly than the alternatives would be. In a benefit-cost comparison between the thermal and hydro projects one could compute the combination of greenhouse gas and habitat values that would favour one over the other. One could then consider how the actual costs of greenhouse gas emissions and wilderness loss are likely to compare to the computed critical values.

Willingness to Pay versus Compensation Demanded

One of the issues that arise in the valuation of environmental externalities and the assessment of critical values is whether one should measure (or provide indicators of) people's willingness to pay to reduce or avoid adverse environmental impacts or the compensation they would require to willingly accept the adverse impacts taking place. What is the appropriate measure of compensating variation?

The basic question here is, what assumption should be made about the initial reference point or prior rights to the resource or attribute in question? If the reference point is current conditions, then the compensating variation for any improvement to those conditions is measured by willingness to pay; the compensating variation for any diminution is measured by compensation demanded. If the reference point is some different state, then the gains or losses relative to that point would determine which measure should be used.

In the case of most private goods, the reference point is clear, well defined by ownership or legal entitlement. However, in the case of public goods, the reference point or prior right can be unclear. For example, in the valuation of the adverse impacts that a project is expected to have on wilderness recreation in an undesignated, undeveloped area, should one assume the undeveloped state is the appropriate reference point, in which case the adverse impacts would be measured by the compensation that recreationists would require to willingly accept changes to that undeveloped state? Or should one assume that the lack of any land-use designation means there are no prior rights, and the valuation of the affected recreational opportunity should be based on what recreationists would be willing to pay to maintain the area in the undeveloped state?

In their review of this issue R. Mitchell and R. Carson argue that for public goods that are collectively held – to which there are competing, legitimate interests – one should assume no prior right.[9] In other words, benefit-cost analysis should value public goods on the basis of what different parties or interests are willing to pay for them, not which parties or interests are presumed to have a prior right. J. Knetsch, however, argues that the reference point for benefit-cost analysis should be based on what people feel entitled to, not on what legal or other specific rights they may have. This will determine the gains and losses that people actually feel and the preferences and trade-offs they truly have with respect to different project or policy initiatives.[10]

This issue would not be so significant if the willingness to pay and the compensation demanded for any particular good or attribute were similar in magnitude, which is in fact what traditional economic theory would suggest. In a classic article, R. Willig concluded that in general the difference between the willingness to pay and the compensation demanded for the same good will be small, less significant than the estimation errors to which either measure would be subject in an applied study. Both measures reflect the trade-off that people would willingly make between the one good or attribute and all others, and traditional theory suggests that this trade-off will not be very different unless there is a very strong income or wealth effect.[11]

However, experimental studies and modern behavioural theory have conclusively shown that there are marked differences between what people are willing to pay to acquire a good and what they would have to be compensated to give it up. There is a pronounced endowment effect that greatly increases the value that people attach to what they have, relative to the same good that they must acquire. Based on his own and other studies, Knetsch states that the difference can be a factor of seven or more.[12] Thus, whether one should use willingness to pay or use compensation demanded can have great impact; it can be central to the public policy debate.

There is no correct answer to this issue. What is important to recognize, however, is that the measure one uses will govern what the analysis is actually reflecting – a valuation from a public-good perspective with no assignment of prior rights, or a valuation reflecting the changes in welfare that the affected parties truly feel. From a practical point of view it is generally easier to estimate the willingness to pay than to estimate the compensation demanded; the latter is particularly difficult to discern with survey methods. However, where there is ambiguity, both measures ideally should be considered in the efforts to bracket the range of possible values and significance that the externalities may have to the affected parties.

Social Account

This account indicates the nature and significance of all of the community and other social externalities resulting from the project. As with the environmental account, only the externalities, not all of the impacts, are included, and the objective is to provide some perspective to their significance, not just to list consequences.

In many cases it will be very difficult to measure the magnitude or the significance of the social externalities in dollar terms. In these cases relevant indicators or descriptions will be required, again with a view to facilitating the computation of meaningful critical values. However, there will be some types of externalities where dollar measures of compensating variation can be calculated. For example, as discussed in chapter 5, residential property hedonic price studies can be used to estimate the willingness to pay to avoid noise, crime, or other neighbourhood effects, and provide some perspective to the significance of the impacts.

It is very important, however, not to double count when using changes in property prices to value externalities. For example, if one has included an estimate of the cost of air emissions in the environmental account, it would be double counting to include any consequent reduction in property prices as an additional social cost. Or, if one has included an estimate of the time-savings benefits resulting from a transit or road project in the user account, it would be a mistake to include the

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Other Measure

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consequent increase in property prices here. In these cases the change in property prices would be another measure – in effect, the **capitalized value** – of the same impact. It is not a separate benefit or cost.

It is also important in this social account to distinguish real effects from pecuniary or distributional effects. For example, an increase in traffic or noise in one neighbourhood could constitute a real effect. However, it would be more distributional in nature if accompanied by reductions elsewhere. In a multiple account benefit-cost analysis it is important to identify major distributional impacts, but as stated earlier, they should be explicitly recognized as such. They are different from gains or losses that are not offset in any way, that would affect the overall bottom line in a traditional benefit-cost analysis.

Other Measurement Issues

Scope of Analysis

The consequences of any initiative depend not simply on what a proponent or an agency may be responsible for, but also on all of the activities that are undertaken as a result of it. For example, a benefit-cost analysis of hosting the Olympic Games requires identifying and valuing the consequences of all of the activities arising from it, including the upgrade of highways and public transport, the provision of security, any related increase in expenditures for training and athlete development, and all the other commitments that are made. The scope of activities – the project – can be much greater than what the Olympic organizing committee itself is responsible for or what may be narrowly defined by government or Games proponents as an Olympic-related impact or expense.[13]

Similarly, the consequences of ending a moratorium on offshore oil and gas exploration where such exist go well beyond the oil and gas exploration and development activities themselves. Ending the moratorium can be expected to lead to production and the development and operation of marine- and land-based transportation systems. All of those related consequences need to be considered in a benefit-cost analysis of that policy issue.

The basic question that must be addressed in defining the scope of the analysis is, what will be different if the initiative proceeds? What resources will be allocated or reallocated and what effects will that have? It is the full scope of what will change that should be analysed.

POTENTIAL STAKEHOLDERS IN THE PREFERRED DEVELOPMENT PLAN

1. Manitoba Hydro ratepayers
    - (a) General
    - (b) Low income
2. Manitoba Hydro & Manitoba Hydro employees
3. Manitoba Taxpayers
4. Manitoba Government
5. Manitobans
    - (a) Northern
    - (b) Southern
    - (c) Aboriginal
        - (i) MH Partners
        - (ii) Others
6. Canadians
7. Others not captured?

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ON THE USE AND MISUSE OF INPUT-OUTPUT BASED IMPACT ANALYSIS IN EVALUATION

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Abstract — Estimates of economic activity generated and jobs created that are derived using input-output analysis are often presented in program evaluations and confused with the benefits resulting from die program. Two such cases are presented as examples. We argue that for two main reasons this type of analysis constitutes a misuse of input-output analysis. First, input-output estimates generated using the Keynesian closed versions of input-output models are biased upwards because they ignore the price and financial feedbacks that tend to reduce multipliers in macro-economic models. Second, and more important, it is inappropriate to consider induced effects resulting from a particular program in isolation, because such effects can only be properly considered in the aggregate at the level of overall stabilization policy. In this paper we contend that cost-benefit analysis, with its assumption of full employment, is the most appropriate tool for analyzing the benefits resulting from particular programs. Input-output analysis should be confined to providing estimates of die industrial or regional breakdown of the direct impact of a program or of the employment impacts of program spending. It should not be used to generate Keynesian multipliers.

Resumé — Les estimations de 1'impact sur 1'activité éconononuque et 1'emplois faites avec 1'analyse intrant-extrant se présentent souvent dans les évaluation des programmes et sont confuses avec les bénéfices du programme. Deux examples sont examinés içi. On prétends que ce genre d'analyse fasse un mauvais usage del'analyse intrant-extrant pour deux raisons principales. Premier, les estimations géncrée utilisant les modeles intrant-extrant de version kéynésienne et fermée sont predisposées a la hausse parce-qu'elles ignorent les rétroaction des prix et du secteur financier qui sont dans les modèles macroeconomiques. Deuxieme, et avec plus d'importance, il n'est pas propre a considérer les effect induits qui resultent d'un programme sauf dans Ie contexte de la polidque de stabilization. On soutien que 1' analyse des couts ct bénéfices est le meilleur outil pour analyser les bénéfices d'un programme particulier. L'analyse intrant-extrant ne doit être utilisee que pour faire des estimation de 1'impact régional ou industiel et elle ne doit pas être utilisée pour le calcul des multiplicateur kéynésien.

ESTIMATES OF THE OUTPUT and employment impacts are often an important part of many program and project evaluations. The analytical framework frequently used to prepare these estimates is the family of input-output models developed and maintained by Statistics Canada. The output and employment multipliers derived from input-output models are used to translate the direct impact of a program into its total impact The total impact estimated, using the "closed" version of the input-output model, includes the output and employment generated by subsequent rounds of spending of the income created by the initial program expenditure. It thus reflects the traditional Keynesian multiplier taught in all introductory economic textbooks.

Frequently, the output and employment impacts of a program are treated as though they were "benefits" of the program or project They may be explicitly tabulated as benefits, or they may implicitly be treated as such by bearing labels like "jobs created" or by being compared to the costs of the program.

In this article, we argue that such estimated output and employment impacts in program or project evaluation are often used inappropriately. There are two reasons for this. First, many evaluators are not aware that the multipliers they use make very strong and often untenable assumptions about macroeconomic impacts. The best evidence that is currently available suggests that multipliers derived from input-output models overestimate the impact of changes in government expenditures by ignoring the critical macroeconomic feedbacks that tend to reduce the multiplier over time. This dramatizes the need to separate the analyses of the microeconomic and the macroeconomic impacts of programs and projects.

Second, many evaluators have an inadequate understanding of the principles of cost-benefit analysis. They thus tend to confuse the output and employment impacts of a program with its benefits. This tendency has been exacerbated by the emphasis in current program evaluation guidebooks on procedure, to the virtual exclusion of discussion of the principles of cost-benefit analysis (e.g., Office of the Comptroller General, 1981 a and b).

Section 2 of this article offers two examples of the misuse of output and employment impacts estimated using input-output techniques. Section 3 briefly describes the methodology of input-output models, discusses some of their limitations, and presents estimates of the multipliers derived from.them. Section 4 provides the details, from a macroeconomic point of view, of our criticism of the use of input-output multipliers. The main macroeconomic feedbacks that tend to dampen the response of the economy to government spending shocks are outlined, and estimates of multipliers from the main Canadian macroeconomic models are presented. Section 5 reviews the connection between economic impact analysis and cost-benefit analysis. It emphasizes a number of reasons that employment impacts cannot uncritically be considered benefits of a program or a project Section 6 gives our conclusions.

EXAMPLES OF THE MISUSE OF IMPACT ANALYSIS

As recent examples of the pervasive misuse of economic impact analysis, we consider a provincial position paper on housing policy in Ontario and a published evaluation of benefits from irrigation expenditures in Alberta. These two provincial examples were chosen because they have been published. Federal examples can be found in some of the unpublished program and project evaluations done in federal government departments. Most readers will thus recognize the phenomenon from their own experience.

In a position paper issued in December 1985, the Ontario government introduced a number of initiatives to stimulate the construction of new housing (Ontario Ministry of Housing, 1985). These included interest-free loans to private rental developers, changes to the rent review system, increased social housing, and a strategy to stimulate the building industry. A table in the document "provides an overall picture of the estimated impact of the programs" (Ontario Ministry of Housing, 1985, pp. 29-30). fa aggregate, a provincial expenditure of $480 million was expected to induce $5.2 billion of construction expenditures and to "create" almost 200,000 job-years of employment Footnotes indicated that a multiplier of 2.2 person-years was used throughout the calculation. The table leaves the clear impression that the programs can create employment at a cost to the government of $2,410 per job-year.

As a second example. Kulshreshtha. Russell, Aycrs. and Palmer (1985) report on a study conducted for the Alberta Irrigation Projects Association. Here the goal was explicitly to identify the major beneficiaries of irrigation activity. mput-output calculations showed that capital expenditures of about $348 million over the period 1985-89 would generate "benefits" of $415 million per year (Kulshreshthn et al.. 1985, pp. 7-8). Only 15% of these benefits would be received by water users. The remainder would be distributed throughout the economies of Alberta and the rest of Canada. Taken at face value, these results imply an annual return on investment of about 119%!

What is wrong with these analyses? Our contention is that they, and many like them, confuse economic impacts with economic benefits. Even when this confusion is resolved, they exaggerate the impacts of programs and projects by comparing them to the wrong benchmark and by using excessively high multipliers to compute induced effects. In the next two sections we review how the multipliers are derived and how they compare to those estimated from large macroeconomic models. We then return to the relationship between benefits and impacts.

INPUT-OUTPUT MODELS

Input-output models are designed to trace the impact of changes in final demand, such as consumer expenditures, investment and government spending on the structure of output, and employment by industry, sector, orprovince, Statistics Canada has developed an entire family of input-output models for Canada that can be used for various types of impact analysis (Statistics Canada.1986). These include inter-provincial price and energy models as well as the basic output determination model.

An input-output model can be used to estimate the impact on output and employment by industry of government expenditures on particular programs or projects. For example, the impact on the economy of a construction project such as building a road could be estimated. The input-output model would show the direct impact of initial spending on the project on the final demand category of government expenditures on non-residential construction. The input-output model would then transform this spending into spending on intermediate material inputs such as concrete, steel rods, gravel, and fuel, and into spending on the primary inputs of labor, capital, and indirect taxes. Spending on inputs would in turn be transformed into industry outputs, producing estimates of the indirect impact of the initial increase in spending. Employment/output coefficients are used to transform industry output impacts into employment impacts. The end result would be an estimate of the total (direct plus indirect) impact of the initial increase in spending on output and employment by industry. If the inter-provindal model were used. a regional dimension could be added to the estimates of output and employment by industry.

There are two versions of the output determination model. One is the open model, in which all final demand categories, including consumption, are treated as exogenous. In this model, income generated in the process of production is not assumed to be re-spent. The second version is the closed model, in which income generated by the production process that accrues to the household sector is assumed to be either spent on goods and services or taxes, or to be saved in accordance with average past proportions. These effects are called induced. The closed model exhibits a traditional textbook Keynesian multiplier when subjected to exogenous expenditure shocks. The magnitude of the multiplier varies inversely with the magnitude of me leakages from me expenditure stream for non-wage income, taxes, savings, and imports.

The impact multipliers derived from me open and closed versions of the output determination model are quite different For instance, when subjected to a shock of a $1 million exogenous increase in spending on residential construction, the closed model yields a multiplier of 1.66 (the ratio of the impact on GDP at market prices to the initial expenditure increase), whereas the open version of the model yields only a multiplier of .89 (the difference from unity reflecting import leakages).

There are some features of input-output models of which those concerned with evaluation should be aware. First, input-output models are static. There is no time dimension attached to their impact estimates, which represent equilibrium results. Second, the models arc linear. This entails an assumption of proportionality between inputs and outputs, between total income and its components. and between employment and output. Such an assumption can be particularly inappropriate in making estimates of short-run employment multipliers. As a rule. employment responds much less than one-for-one with output increases, due to the overhead character of some labor and to the occasional prevalence of a certain degree of labor hoarding. Third, input-output models do not incorporate macroeconomic feedbacks, which tend to reduce the impact of multipliers. This tendency is examined in more detail in the next section.

MULTIPLIERS FROM MACROECONOMIC MODELS

The multiplier results derived from a closed input-output system yield exaggerated estimates of the impact of program expenditures on the economy. This is the case because closed input-output models do not take into account the macroeconomic feedbacks that tend to cause the multiplier to decrease over time. The principal feedbacks for government spending programs are the same as for any other type of expenditures. Higher spending raises demand, and hence increases output and employment. Increased capacity utilization and reduced unemployment put upward pressure on prices and wages. Greater real output and a higherprice level result in increased nominal income. This in turn causes interest rates to go up, provided that money growth is fixed. Higher interest rates and prices serve to erode the initial demand stimulus, thus decreasing the multiplier.

The feedback effect of interest rates and the financial sector depend very much on the financing assumption made. The usual assumption is that the increase in government spending is debt financed. Monetary policy can be assumed to be either accommodating ornon-accommodating. This means that the money supply growth is either assumed to be unchanged or allowed to increase in response to the increased spending. If monetary policy is non-accommodating, debt-financed increases in government expenditure will have a greater effect on interest rates. Alternatives to the debt financing assumption are that expenditure increases are financed by tax increases or by reductions in other government spending. The implications of such alternative assumptions are vastly different The only way to take them into account is at the level of overall fiscal policy formulation. This cannot be done at the level of the individual program or project.

We can better appreciate how these macroeconomic factors tend to decrease the value of the multiplier in the longer run by considering the results of simulations with macroeconomic models. Table 1 presents the results of a $1 billion government expenditure shock for the main Canadian macro-economic models that were considered in a Bank of Canada-Department of Finance-sponsored seminar held in Ottawa in July 1982 (0'Reilly, 1983), The models were: the quarterly forecasting and simulation (QFS) model of the Department of Finance; the research department experimental forecasting model (RDXF) of the Bank of Canada; the CHASE econometric model of Chase Econometrics; the DRI model of the Canadian Economy of Data Resources Canada; the forecasting and user simulation (FOCUS) model of the Institute for Policy Analysis, University of Toronto; the Informetrica model of Informetrica Ltd. (TIM); the CANDIDE 2.0 model of the Economic Council of Canada; and the small annual model (SAM) of the Research Department of the Bank of Canada; and the macroeconomic and energy model (MACE) of Professor John Helliwell, University of British Columbia.

The noteworthy feature of these results is the extent to which the multiplier declines over time for almost all the models—the DRI model being the only exception. On average, by the fifth year the multiplier was less than one. and by the tenth year it was not much greater than zero. Some of the models, such as FOCUS, SAM. and MACE, even had negative multipliers. This suggests that in the medium term the indirect effects of government spending are negative and growing.

Table 1
The Impact of a $1 Billion Increase In Federal Current Non-Wage Expenditures Estimated Using Canadian Macro-Econometric Models (Difference between Shocked and Control Simulations)

	QFS	RDXF	CHASE(a)	DRI	MODEL FOCUS	TIM(b)	CANDIDE 2.0	SAM	MACE	AVG.(c)
REAL GNE (%)										
YEAR1	0.32	0.28	0.80	0.33	0.22	0.46	0.55	0.09	0.18	0.28
YEAR 3	0.38	0.14	0.40	0.27	0.24	0.43	0.60	0.07	0.05	0.25
YEARS	0.31	0.07	0.20	0.26	0.01	0.36	0.46	0.06	0.00	0.17
YEAR 10	0.14	0.01	0.00	0.24	-0.06	0.28	0.17	-0.10	-0.18	0.03
EMPLOYMENT (%)										
YEAR1	0.18	na	0.60	0.16	0.15	0.19	0.28	0.00	0.06	0.14
YEAR 3	0.55	na	0.40	0.23	0.35	0.34	0.42	0.03	0.09	0.28
YEARS	0.29	na	0.10	0.18	0.00	0.40	0.37	0.04	0.09	0.16
YEAR 10	-0.03	na	-0.40	0.17	0.12	0.28	0.25	0.02	0.07	0.10
REAL MULTIPLIER										
YEAR1	1.04	1.09	1.10	1.44	1.05	1.67	1.98	0.42	0.75	1.11
YEAR 3	1.31	0.58	0.50	1.23	1.24	1.72	2.25	0.14	0.22	1.00
YEARS	1.11	0.34	0.20	1.25	0.07	1.52	1.85	-0.27	0.00	0.62
YEAR 10	0.64	0.06	0.00	1.48	-0.44	1.41	0.77	-0.23	-1.00	0.18

a Total federal government expenditures.
b Nominal interest rates fixed.
c Only includes strictly comparable model results. Excludes Chase and TIM and variables that are not available.

Note: From Joint Bank of Canada - Department of Finance Comparative Models Seminar. Ottawa. July 1982. See B. O'Rellly, G. Paulin. and P. Smith (1983, p. 48) and papers presented by individual model-builders.

The conclusions to be drawn arc that there is much uncertainty about the medium- to long-run value of multipliers, and that any estimate of the impact of government spending programs based on input-output multipliers that ignore macroeconomic feedbacks is likely to be greatly exaggerated. The indirect effects of government spending programs are more likely to be negative than positive.

The model estimates of the multiplier depend on the degree of capacity utilization assumed for the economy (although not perhaps as much as one might expect). Consequently, it is necessary to consider the overall economic situation and total government expenditures and revenues in order to accurately gauge the impact of government spending on the economy. There is also the issue of the financing of the expenditure increase, which can only be taken into account in the context of the overall formulation of fiscal policy.
Given the great uncertainty concerning the indirect effect of government spending programs and the importance of determining the setting of fiscal policy centrally, the most prudent course for those responsible for evaluating programs and projects would be to confine their estimates of the output and employment impacts to the direct impacts, and to leave the question of the indirect impact to those responsible for stabilization policy.

ECONOMIC IMPACTS AND COST-BENEFIT ANALYSIS

This section comments on the relationship between cost-benefit analysis and economic impact analysis, and restates some long-known but insufficiently heeded objections to the exaggeration of the employment and output gains through the use of multipliers and to the uncritical treatment of impacts as benefits. We do not attempt to replicate the excellent introductions to the theory and practice of cost-benefit analysis that can be found, for example, in the Treasury Board's Benefit-Cost Analysis Guide (1976) or in Mishan (1976).

The economic impact of a program or activity is the change it induces in an economic indicator, such as GNP or employment. To calculate a change, one must compare the results of the program or project to what might reasonably be expected to occur in its absence. This is the benchmark or basis of comparison. In many evaluations, these impacts are implicitly or explicitly treated as "benefits" of the program. For example, the employment impacts of Ontario housing policies in the study mentioned earlier were reported under the heading "Jobs Created" and the Kulshrcshtha et al. (1985) study used the terms "impact" and "benefit" interchangeably.

One difference between cost-benefit analysis and economic impact analysis is that the former places a much stricter interpretation on the term "benefit." The benefit of the program or project is the gain realized by undertaking it. In cost-benefit analysis, benefits are measured by what people are willing to pay for mem. Similarly the negative impacts (costs) of a program or project are valued at what people are prepared to pay to avoid them. Those definitions are consistent with the common sense proposition that a project is worth undertaking only if its benefits exceed its costs.

A second difference lies in the choice of benchmarks. Like economic impact analysis, cost-benefit analysis employs a benchmark for purposes of comparison. When using input-output analysis to assess impacts, the usual benchmark is a worid in which me program or project does not exist and nothing takes its place. It is implicitly assumed that all the labor, capital, and other resources used in activities affected by the program would have otherwise been idle. But the cost-benefit analyst must always explicitly consider the alternative uses of the resources in question. Normally, it is assumed that they could have found other employment at the same wage. but techniques exist to adjust for the presence of unemployment in special cases. The correct treatment of employment gains is considered in the literature on the social opportunity cost of labor (Harberger. 1981). Briefly, the net gain from the creation of permanent jobs is estimated to range from zero to 25% of the wage bill (depending on the rate of growth of the region), and the creation of temporary jobs may actually impose a cost of up to 30-50% of the wage bill by increasing the pool of workers who experience regular bouts of temporary unemployment.

To illustrate these points, consider the impact of the Ontario housing policies. The estimate that 200.000 jobs would be created was made by multiplying by 2.2 the estimated number of housing starts associated with each policy. The multiplier of 2.2 jobs per housing start can be derived from input-output models by adding up all direct, indirect, and induced effects. The benchmark being used, therefore, is an economy in which none of the housing starts occur and in which no other activity takes their place. But this is an unacceptable basis for comparison from the viewpoint of cost-benefit analysis because we know that in the absence of the program other activities would have occurred. For example, the $480 million might have been spent on highway construction or returned to taxpayers by cutting taxes. Either alternative would create jobs and income, and would have induced effects that could be estimated using a multiplier. The true impact of the housing program is the difference between the jobs and income created under it and those created under a reasonable alternative. (These "differential" impacts may be positive or negative.) The benefits of the program, property speaking, should be measured by how much we are willing to pay to achieve these differential impacts. Similarly, the Kulshreshtha ct al. (1985) study calculates the impact of continued irrigation by computing the direct, indirect, and induced impact of the construction expenditures and the associated increase in crops. All of the increase in GDP is counted as a benefit of the project But a .better benchmark would be the pattern of economic activity in Alberta and Canada if the resources used by the irrigation project were used elsewhere in the economy to generate higher outputs in other industries. The value of the output forgone elsewhere can be approximated by the payments formerly made to the labor and other resources now used in irrigation. The benefits of the irrigation project could then be measured by the increased earnings of land, labor, and capital employed in irrigation, rather than in their best alternative uses.

These examples illustrate why the employment changes estimated using input-output analysis or multipliers should never be treated as benefits. More formally, employment changes (impacts) cannot be treated as benefits for at least three reasons.

First, the employment created by a project or program will almost never increase net employment in the region by a corresponding amount, since the employees attracted to the project need not be replaced. Even less will the project reduce unemployment, because the increased demand for labor will cause the labor force to grow through migration and new entry. The creation of temporary jobs may even increase the pool of workers experiencing temporary unemployment

Second, it is both difficult and unwise to use impact analysis to calculate the net increase in employment attributable to a program. Doing so requires an explicit judgement on how public fimds would be expended in its absence and on how macroeconomic feedbacks would affect the final outcome. Even in the best of circumstances, this requires the knowledge and expertise of specialists in macroeconomics, taxation, and fiscal policy. The Canadian government, like most Western governments, has been organized to reflect three goals of government expenditure and taxation: stabilization, allocative efficiency, and income redistribution (Musgrave. 1959). The Department of Finance and the Bank of Canada are responsible for advising the government on stabilization policy, including attempts to influence the levels of output and employment and the rate of inflation. The Treasury Board and the program departments arc responsible for advice on resource allocation and program delivery. Given this division of labor, it is inappropri ate for program departments to evaluate their programs and projects from the point of view of stabilization policy. This is best left to the Department of Finance, where the expertise and information required to carry out the task is concentrated.

Finally, it is not always true that increased employment is an unambiguous good. This point is often expressed by saying that the unemployed and those not in the labor force value their leisure. In this context, leisure means much more than idle time. For example, consider a policy which enables mothers to enter the labor force by providing subsidized day care. The mother incurs a cost both in lost time available for housework, shopping, recreation, and relaxation and in lost satisfaction from caring for her children. This cost, together with the total cost of day care subsidy, may easily outweigh her earnings. Under these circumstances everyone would be better off if she were provided with an income transfer sufficient to allow her to stay at home. In this case, increased employment is not synonymous with increased welfare.

If impact analysis cannot be used to estimate the benefits of a program, what can it be used for? One appropriate role is to identify regions and industries that will be particularly affected by a project or program. Input-output analysis is well suited to this purpose. Note. however, that it is the open model that is appropriate in this case. The induced effects measured by the closed model will be similar regardless of the program analyzed. And even when the open model is used, the analyst must be careful to note that the impacts are not net of offsetting changes induced by forgoing alternative programs. For that reason, it should be unacceptable to use employment impacts to measure job creation.

The preceding discussion indicates that economic impact analysis has many similarities to cost-benefit analysis. The difference is that cost-benefit analysis attempts to place a value on the economic impacts of a project as pan of a systematic evaluation of the benefits and costs of alternative actions. While many reservations have been expressed about the details of cost-benefit analysis and the practicality of reducing all costs and benefits to a common scale of dollars and cents, this should not excuse other analysts from committing fallacies that basic cost-benefit analysis helps to avoid.

CONCLUSIONS

Estimates of the output and employment impacts of government programs and projects prepared using the closed input-output model should not be used in evaluations. It is more important that the evaluators concentrate their efforts on producing the most reliable direct impact estimates and on applying the microeconomic allocative tool of cost-benefit analysis. The measurement of the indirect (macroeconomic) impacts of government spending can, with a few exceptions, be best carried out at a higher level of aggregation, and are best left to those specializing in stabilization policy.

This is not to suggest that the input-output model should be banned entirely from the evaluator's toolbox. There will still be many instances in which it will be appropriate, including use of the open input-output model to provide estimates of the industrial or regional breakdown of the direct impact of a program or of the employment impacts of program spending. In these cases, estimates derived from the input-output model may be either the most reliable or the most cost-effective estimates possible.

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TAB 3

Table 9.1 ECONOMIC EVALUATION – SUMMARY OF REVENUE AND COST INPUTS

Plan-Specific Inputs	Sources of Input for all Development Plans
Revenue:	
• Contract revenue from proposed electricity export sales	Export sale contracts
• Electricity export revenue from surplus power	Manitoba Hydro's consensus electricity export price forecast as used in the generation system model (SPLASH)
Cost:	
• Capital investment	Manitoba Hydro capital cost estimates for each resource option including associated transmission for each development plan and transmission interconnection as applicable
• Fuel	• Water rental rate from *The Water Power Act* • Consensus natural gas price forecasts from Manitoba Hydro's Energy Price Outlook as used in the generation system model (SPLASH)
• Operating & Maintenance (O&M) including capital maintenance	Manitoba Hydro's O&M estimates for each facility in each development plan including capital maintenance items required over the life of the asset.
• Imports	Manitoba Hydro's consensus electricity export price forecast as used in the generation system model (SPLASH)
• Taxes	• Capital taxes based on *The Corporation Capital Tax Act* • Carbon tax on coal from the *Climate Change and Emissions Reductions Act* • Forecast of future carbon adder for Manitoba-based generation (federal/provincial)

While there are a number of direct sources of input into the economic evaluation, a significant source of input is the information provided from the generation system production-costing model, Simulation Program for Long-term Analysis of System

Economic Impact Assessment

Economic Impact Assessment - Overview

Economic impact analysis (EIA) provides an estimate of the total employment impacts as well as estimates of the total Gross Domestic Product, tax revenue impacts, and labour income of a project on the economies of Manitoba and the rest of Canada. It indicates not only the potential impacts generated directly by the project, but also the potential spin-off effects generated as a result of purchases on domestic goods and services and the local recirculation of increased income.

Methodology

The economic modeling framework used for estimating the economic impacts is the Manitoba Bureau of Statistics' Input-Output model. The model is based on statistical information about the flow of goods and services among various sectors of Manitoba's economy. In effect, it allows one to trace the demands placed on one industry resulting from increased activity in another. Thus the model provides estimates of direct, indirect, and induced impacts of the proposed projects on the economy of Manitoba and Canada. In summary, economic impact analysis refers to three different types of impacts:

- **Direct impacts.** These refer to the income and employment generated by the project itself.
- **Indirect impacts**. These refer to the income and employment that develop in other industries as the effects of the initial expenditures for the project work through the provincial and national economies. For example, direct expenditures on vehicles will create an indirect increase in spending on fuel and vehicle repair services.
- **Induced impacts**. As a result of the spending and subsequent re-spending of the direct and indirect income generated by the project, there will be induced impacts /effects upon the consumer goods industries as well as the industries which supply them. This leads to more spending on food, housing, entertainment, transportation, and all of the other expenses that make up a typical household budget.

Economic Impact Analysis are reported with the following data:

- **Employment** is a straightforward measure of the number of person-years of employment (full-time job equivalents) that are generated by the project, including direct employment, indirect employment with suppliers to the main project, and induced employment that is associated with the extra spending by households. **A**

Person-year is defined as one person being fully employed for one year. **Direct employment** is on-site direct employment of Manitoba Hydro (including incremental Manitoba Hydro off-site employees) and contractor employees, which are directly generated by the project; **other direct employment** is employment of **direct** suppliers to support the main project; **indirect employment** is employment of people who supply raw materials, equipment, or services to the initial direct suppliers of the project; and **induced employment** is the employment of people as a result of the spending and subsequent re-spending of the direct and indirect income generated by the project.

- **Labour Income** is the additional income earned by workers as a result of the project. Labour income is an important contributor to economic growth and is a large component of GDP. Availability of labour income enables consumers to buy products and services to support and expand local industry. Total Labour Income represents the sum of wages, supplementary labour income, and net income of unincorporated business.

- **Gross Domestic Product (GDP)**. Also referred to as "value-added," GDP represents the additional value of production that is generated by the project after removing the cost of intermediate inputs. For the purpose of this analysis, GDP at market price is reported. GDP at market price is the total value of goods and services produced in Manitoba's economy.

- **Tax Revenue**. Tax revenue is calculated for all three levels of government – federal, provincial, and local. These government revenues do not include capital tax, water rentals and any greenhouse gas taxes associated with the projects (which are considered in the MA-BCA). Tax revenues are based upon the 2012/13 Manitoba Budget and 2009 income tax data, adjusted to current rates.

The analysis is based on cost estimates as of 2012. Any changes to the cost estimates may lead to changes in the economic impacts presented in this report. The economic impact analysis does not include interest and escalation during construction, costs associated with pre-project planning, design, and training, costs associated with environmental studies, any potential local development payments, and contingency costs.

While economic impact analysis can be a useful component in decision making, it does have some limitations. Economic impact analysis differs from socio-economic benefit-cost analysis in that it is a gross, rather than net, measure of benefits and it only considers the impact of project expenditures. It does not consider the opportunity cost of labour and capital in the project nor does it consider the revenue generated by the project. By itself, it cannot measure the profitability of the project. Thus, the results of this study should be treated as general estimates and never as absolutes.

Potential Economic Impacts for NFAT

The estimated economic impacts for the preferred development plan are summarized in Table 1. A summary of the economic impacts for the Keeyask and Conawapa are also provided in Tables 2 and 3, respectively. Descriptions of the preferred development plan, and the Keeyask and Conawapa projects, can be found in chapter 2 of the NFAT filing. Economic impacts have been calculated separately for construction and operational phases of each project. Impacts during the construction phase include cumulative employment, labour income, GDP, and tax revenue impacts generated over the entire construction period. Impacts during the operating and maintenance phase include the annual impacts (employment, labour income, GDP, and tax revenues) generated for a typical year of operation when the project is at full operation. The total person years of employment during operation and maintenance can be calculated by taking the estimate for a typical year and multiplying it by the operating life of the project.

Table 1. Economic Impacts of the Preferred Development Plan

Manitoba - Economic Impacts of the Preferred Development Plan[1,2]

	Keeyask		Conawapa		North-South Upgrades	750 MW Interconnection	
	Construction	O&M[3]	Construction	O&M[3]	Construction	Construction	O&M[3]
Employment (person years)							
Project Direct	2,436	39	3,238	42	171	119	1
Other Direct	2,175	2	1,831	2	164	124	0
Indirect and Induced	3,736	29	4,234	33	251	255	1
Total Employment (person-years)	8,347	70	9,303	77	586	498	2
Labour Income	$ 635,169	$ 5,921	$ 761,233	$ 6,597	$ 48,627	$ 35,195	$ 123
GDP ($millions)	$ 843,908	$ 6,872	$ 983,334	$ 7,676	$ 67,189	$ 50,209	$ 149
Tax Revenues ($ millions)							
Provincial	204,340	831	$ 256,096	$ 931	$ 13,954	$ 16,069	22
Local	40,915	162	$ 45,807	$ 182	$ 2,186	$ 2,478	$ 5
Federal	161,059	988	195,872	1,099	12,538	10,714	23
Total Tax Revenue ($ millions)	$ 406,314	$ 1,981	$ 497,776	$ 2,212	$ 28,679	$ 29,261	$ 51

Rest of Canada - Economic Impacts of the Preferred Development Plan[1]

	Keeyask		Conawapa		North-South Upgrades	750 MW Interconnection	
	Construction	O&M[3]	Construction	O&M[3]	Construction	Construction	O&M[3]
Employment (person years)							
Project Direct	2,532	-	3,915	-	-	0	-
Other Direct	3,198	1	3,448	1	219	144	0
Indirect and Induced	10,414	16	13,601	18	386	444	1
Total Employment (person-years)	16,144	17	20,964	19	605	588	1
Labour Income	$ 1,021,350	$ 648	$ 1,402,932	$ 734	$ 30,606	$ 24,977	$ 23
GDP ($millions)	$ 1,440,223	$ 1,054	$ 1,997,461	$ 1,184	$ 54,676	$ 39,642	$ 37
Tax Revenues ($ millions)							
Provincial	$ 251,927	$ 117	$ 342,663	$ 132	$ 7,546	$ 7,146	$ 5
Local	$ 66,289	$ 31	$ 90,164	$ 35	$ 1,986	$ 1,880	$ 1
Federal	$ 307,444	$ 128	$ 426,252	$ 144	$ 10,935	$ 12,437	$ 5
Total Tax Revenue ($ millions)	$ 625,660	$ 276	$ 859,080	$ 311	$ 20,467	$ 21,463	$ 12

All of Canada - Economic Impacts of the Preferred Development Plan[1]

	Keeyask		Conawapa		North-South Upgrades	750 MW Interconnection	
	Construction	O&M[3]	Construction	O&M[3]	Construction	Construction	O&M[3]
Employment (person years)							
Project Direct	4,967	39	7,154	42	171	119	1
Other Direct	5,374	3	5,279	4	383	268	0
Indirect and Induced	14,151	45	17,834	50	637	700	1
Total Employment (person-years)	24,491	87	30,267	96	1,191	1,086	2
Labour Income	$ 1,656,519	$ 6,569	$ 2,164,166	$ 7,331	$ 79,233	$ 60,173	$ 145
GDP ($millions)	$ 2,284,131	$ 7,926	$ 2,980,795	$ 8,860	$ 121,865	$ 89,851	$ 186
Tax Revenues ($ millions)							
Provincial	$ 456,268	$ 948	$ 598,759	$ 1,063	$ 21,501	$ 23,215	$ 27
Local	$ 107,204	$ 193	$ 135,972	$ 217	$ 4,172	$ 4,358	$ 7
Federal	$ 468,502	$ 1,116	$ 622,124	$ 1,243	$ 23,474	$ 23,150	$ 29
Total Tax Revenue ($ millions)	$ 1,031,974	$ 2,257	$ 1,356,855	$ 2,523	$ 49,146	$ 50,724	$ 62

[1] 2014 dollars
[2] Total may not add, due to rounding
[3] Average annual expenditures

Table 2. ECONOMIC IMPACTS OF THE KEEYASK PROJECT

Manitoba - Economic Impacts of the Keeyask Project[1]

	Infrastructure		Generation		Transmission[2]		Total[3]	
	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]
Employment (person years)								
Project Direct	277	-	2,014	38	145	1	2,436	39
Other Direct	122	-	1,887	2	166	0	2,175	2
Indirect and Induced	290	-	3,089	28	358	1	3,736	29
Total Employment (person-years)	689	-	6,990	68	668	3	8,347	70
Labour Income	$ 50,054	$ -	$ 532,748	$ 5,708	$ 52,367	$ 212	$ 635,169	$ 5,921
GDP ($millions)	$ 66,408	$ -	$ 706,393	$ 6,618	$ 71,107	$ 254	$ 843,908	$ 6,872
Tax Revenues ($millions)								
Provincial	$ 19,186	$ -	$ 171,154	$ 796	$ 14,000	$ 35	$ 204,340	831
Local	$ 3,454	$ -	$ 34,745	$ 154	$ 2,716	$ 8	$ 40,915	$ 162
Federal	$ 13,340	$ -	$ 135,280	$ 948	$ 12,438	$ 40	$ 161,059	$ 988
Total Tax Revenue ($ millions)	$ 35,980	$ -	$ 341,180	$ 1,898	$ 29,153	$ 83	$ 406,314	$ 1,981

Rest of Canada - Economic Impacts of the Keeyask Project[1]

	Infrastructure		Generation		Transmission[2]		Total[3]	
	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]
Employment (person years)								
Project Direct	69	-	2,463	-	-	-	2,532	-
Other Direct	405	-	2,644	1	149	0	3,198	1
Indirect and Induced	904	-	9,047	15	464	1	10,414	16
Total Employment (person-years)	1,378	-	14,153	16	613	1	16,144	17
Labour Income	$ 69,526	$ -	$ 925,178	$ 617	$ 26,647	$ 31	$ 1,021,350	$ 648
GDP ($millions)	$ 111,145	$ -	$ 1,285,069	$ 1,005	$ 44,009	$ 49	$ 1,440,223	$ 1,054
Tax Revenues ($millions)								
Provincial	$ 19,954	$ -	$ 225,519	$ 111	$ 6,455	$ 6	$ 251,927	$ 117
Local	$ 5,250	$ -	$ 59,340	$ 29	$ 1,698	$ 2	$ 66,289	$ 31
Federal	$ 26,236	$ -	$ 272,249	$ 121	$ 8,959	$ 7	$ 307,444	$ 128
Total Tax Revenue ($ millions)	$ 51,440	$ -	$ 557,108	$ 261	$ 17,113	$ 15	$ 625,660	$ 276

All of Canada - Economic Impacts of the Keeyask Project[1]

	Infrastructure		Generation		Transmission[2]		Total[3]	
	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]
Employment (person years)								
Project Direct	346	-	4,477	38	145	1	4,967	39
Other Direct	527	-	4,531	2	315	0	5,374	3
Indirect and Induced	1,194	-	12,135	43	821	2	14,151	45
Total Employment (person-years)	2,067	-	21,144	84	1,281	3	24,491	87
Labour Income	$ 119,580	$ -	$ 1,457,926	$ 6,325	$ 79,014	$ 243	$ 1,656,519	$ 6,569
GDP ($millions)	$ 177,553	$ -	$ 1,991,462	$ 7,623	$ 115,116	$ 302	$ 2,284,131	$ 7,926
Tax Revenues ($millions)								
Provincial	$ 39,140	$ -	$ 396,673	$ 907	$ 20,455	$ 41	$ 456,268	$ 948
Local	$ 8,705	$ -	$ 94,086	$ 184	$ 4,414	$ 10	$ 107,204	$ 193
Federal	$ 39,576	$ -	$ 407,529	$ 1,069	$ 21,397	$ 46	$ 468,502	$ 1,116
Total Tax Revenue ($ millions)	$ 87,421	$ -	$ 898,288	$ 2,159	$ 46,266	$ 98	$ 1,031,974	$ 2,257

[1] 2014 dollars

[2] Includes: Generation Outlet Transmission, Construction Power T-Line, Construction Power Station, Switching Station

[3] Total may not add, due to rounding

[4] Average annual expenditures

Table 3. ECONOMIC IMPACTS OF THE CONAWAPA PROJECT

Manitoba - Economic Impacts of the Conawapa Project[1]

	Generation		Transmission[2]		Total[3]	
	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]
Employment (person years)						
Project Direct	3,203	42	35	0	3,238	42
Other Direct	1,823	2	9	0	1,831	2
Indirect and Induced	4,191	32	42	0	4,234	33
Total Employment (person-years)	9,217	77	86	0	9,303	77
Labour Income	$ 753,486	$ 6,574	$ 7,748	$ 23	$ 761,233	$ 6,597
GDP ($millions)	$ 973,953	$ 7,648	$ 9,382	$ 28	$ 983,334	$ 7,676
Tax Revenues ($millions)						
Provincial	$ 253,873	$ 927	2,224	$ 4	$ 256,096	$ 931
Local	$ 45,499	$ 181	$ 308	$ 1	$ 45,807	$ 182
Federal	$ 193,934	$ 1,094	$ 1,938	$ 4	$ 195,872	$ 1,099
Total Tax Revenue ($ millions)	$ 493,305	$ 2,202	$ 4,470	$ 10	$ 497,776	$ 2,212

Rest of Canada - Economic Impacts of the Conawapa Project[1]

	Generation		Transmission[2]		Total[3]	
	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]
Employment (person years)						
Project Direct	3,915	-	-	-	3,915	-
Other Direct	3,430	1	18	0	3,448	1
Indirect and Induced	13,542	18	58	0	13,601	18
Total Employment (person-years)	20,887	19	77	0	20,964	19
Labour Income	$ 1,399,571	$ 730	$ 3,362	$ 4	$ 1,402,932	$ 734
GDP ($millions)	$ 1,991,780	$ 1,178	$ 5,681	$ 7	$ 1,997,461	$ 1,184
Tax Revenues ($millions)						
Provincial	$ 341,849	$ 131	$ 814	$ 1	$ 342,663	$ 132
Local	$ 89,950	$ 35	$ 214	$ 0	$ 90,164	$ 35
Federal	$ 424,846	$ 143	$ 1,407	$ 1	$ 426,252	$ 144
Total Tax Revenue ($ millions)	$ 856,645	$ 309	$ 2,434	$ 2	$ 859,080	$ 311

All of Canada - Economic Impacts of the Conawapa Project[1]

	Generation		Transmission[2]		Total[3]	
	Construction	O&M[4]	Construction	O&M[4]	Construction	O&M[4]
Employment (person years)						
Project Direct	7,118	42	35	0	7,154	42
Other Direct	5,253	4	27	0	5,279	4
Indirect and Induced	17,734	50	101	0	17,834	50
Total Employment (person-years)	30,105	96	163	0	30,267	96
Labour Income	$ 2,153,056	$ 7,055	$ 11,109	$ 27	$ 2,164,166	$ 7,331
GDP ($millions)	$ 2,965,733	$ 8,524	$ 15,063	$ 35	$ 2,980,795	$ 8,860
Tax Revenues ($millions)						
Provincial	$ 595,722	$ 1,058	$ 3,038	$ 5	$ 598,759	$ 1,063
Local	$ 135,449	$ 216	$ 523	$ 1	$ 135,972	$ 217
Federal	$ 618,780	$ 1,237	$ 3,344	$ 5	$ 622,124	$ 1,243
Total Tax Revenue ($ millions)	$ 1,349,951	$ 2,511	$ 6,905	$ 12	$ 1,356,855	$ 2,523

[1] 2014 dollars
[2] Includes GOT and Station Upgrades
[3] Total may not add, due to rounding
[4] Average annual expenditures

- removal of expenditures with no provincial economic benefit and other leakages from the provincial economy; and
- treatment of labour.

MH provided detailed costs as inputs into the model, and has for the most part, allocated cost input data to the corresponding IO expenditure categories based on an understanding of the expenditures involved. MH has removed expenditures with no provincial economic benefit and identified leakages from the provincial economy. The results of which are also reflected in the treatment of labour.

It is observed however, that the treatment of many purchases as leakages may tend to understate the impact of the PDP in Manitoba, while overstating the impact in the rest of Canada. This is due to the fact that the margins embedded in the purchase cost of these goods and services (treated as leakages), may not have been attributed to Manitoba producers who may be providing services such as transportation or wholesaling.

The extent of the leakages can be explained by a number of factors such as the relatively small manufacturing base of Manitoba economy compared to the rest of the provinces in Canada (Ontario and British Columbia), as well as the extensive experience of MH regarding recently constructed projects that would verify the of out-of-province purchases.

The extent of the out of province expenditures may be reasonable, but MH should have explicitly commented on this as part of reporting.

The issue pertaining to whether the impacts to the rest of Canada are overstated, whereas the impacts to Manitoba are understated remains, and is discussed below.

Canadian vs. Provincial Benefits

A generally accepted principle of input output modelling is that the "direct" benefits of any project are incurred in the jurisdiction in which the project is located. The approach used in the Statistics Canada Interprovincial Input-Output Economic Impact Simulation model (catalogue no. 15F0009XDB) focused on the expenditures (purchase of goods and services) and the location where these expenditures took place. This approach ensures that the results generated from the model show the entire direct impact in Manitoba. It should be noted however that when the expenditure approach is used with the Statistics Canada model, the model estimates where the goods and services purchased are supplied from.

The key difference in the MH IOM approach was that MH made decisions, based on local experience and knowledge, on where the goods and services originated from. Although such an approach is reasonable, one must be careful in how to interpret the direct and indirect impacts, as the production (supply) of goods and services might generate a direct impact in the jurisdiction where the production took place, but in reality, this production should be interpreted as indirect impact, because these goods and services were produced to satisfy the demand associated with the project.

The results of both the MH IOM and the Statistics Canada Interprovincial model are presented for comparison purposes in the main body of the report for the Keeyask Generating Station.

Exhibit 6: Cost Estimate Classification System

69R-12: Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Hydropower Industry 3 of 14

January 25, 2013

COST ESTIMATE CLASSIFICATION MATRIX FOR THE HYDROPOWER INDUSTRY

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of technology, availability of applicable reference cost data, and many other risks affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Table 1 – Cost Estimate Classification Matrix for the Hydropower Industry

Source: Manitoba Hydro Appendix 7.2 - Range of Resource Options: Appendix C AACE Cost Estimate Classification System

MH construction costs derived from this methodology were subsequently utilized to populate the commodity tables in the IOM.

Observations:

The construction costs defined by MH for the PDP are based on the Association for Advancement of Cost Engineering International (AACEI) practices and represent standard practice in industry. For the KGP they represent between a Class 2 and Class 3 estimate. The CGP is based on a Class 2 estimate. The construction cost estimates developed by MH for the purpose of economic impact are reasonable. The identification of operating and maintenance, and other costs related to both the Keeyask and Conawapa within the IOM fall within normal boundaries.

3.2.3.2 Allocation of cost input data into IO categories

The next step in impact modeling is to allocate project expenditures (above) to specific expenditure categories in the IOM. Proper categorization of expenditures to IO commodities can have a significant impact on the modeling results. The allocation of cost input data into the IO expenditure categories is dependent upon MH's and the modellers' understanding of how construction costs are allocated to the expenditure categories.

A review of the allocations indicates that a number of capital cost allocations may have been miscoded, and clarification from MH would be required.[12]

[12] Examples cited include (specific to Conawapa per dollar breakdowns as provided by MH): Sheet: CGOT – Construction, "Construction" coded to: "568 Gas & Oil facility construction" (given this is a dam, this does not appear to represent appropriate coding); "Anchors &

Table 5: Comparison of Manitoba Hydro Results vs. Statistics Canada Closed Model Keeyask Generating Station

IOM Results by Category	Manitoba Hydro Results			Statistics Canada Closed Model		
	Manitoba	ROC	Total	Manitoba	ROC	Total
Employment						
Project direct (#)	2,014	2,463	4,477	12,792	0	12,792
Other direct (#)	1,887	2,644	4,531	4,345	3,826	8,171
Indirect and Induced (#)	3,089	9,047	12,136	8,360	7,023	15,383
Total employment (#)	6,990	14,153	21,144	21,152	7,023	28,175
Labour income	532,748	925,178	1,457,926	996,575	357,620	1,354,195
GDP ($ millions)*	706,393	1,285,069	1,991,462	1,456,863	703,309	2,160,172
Tax Revenues ($ millions)*	171,154	225,519	396,673	147,993	29,306	177,299
Provincial ($ millions)	34,745	59,340	94,085	107,375	18,090	125,465
Local ($ millions)	135,280	272,249	407,529	955	72	1,027
Federal ($millions)	341,180	557,108	898,288	39,663	11,144	50,807
Average Wage (calculated)($)	76,216	65,370	68,952	47,115	50,924	48,064
Total employment estimate using average wage assumed by MBS	6,990	14,153	21,144	13,076	5,471	19,640

* Statistics Canada tax revenues only include commodity taxes
ROC: Rest of Canada

Based on the information provided in table 5 the following comments are provided.

Overall, the Stats Canada model validates the total economic benefits derived by MH IOM results. There are however, important differences in the distributions between the benefits in Manitoba and the rest of Canada (ROC) between the two approaches used.

The Statistics Canada model estimated total employment to be about 28,175 jobs based on an average employment income of $48,064. The MH IOM model estimated total employment to be about 21,144 jobs based on an average employment income of $68,952. The average employment income generated from the Statistics Canada model is thought to be underestimated (and hence the number of jobs to overestimated) because the income estimate is based on the overall average employment income for the Electric power engineering construction industry as shown in the Input-Output Tables, whereas the average employment income generated by the MH IOM model is more reflective of the fact that the project takes place in a remote region of the province where one would expect the average employment income to be higher (thus generating a lower number of jobs). As such, it is assumed that the total number of jobs estimated by the MH IOM study is more accurate than the estimate generated by the Statistics Canada model.

The Statistics Canada model estimated all the direct jobs as well as 75% of all jobs to be in Manitoba. The MH model estimated that 43% of direct jobs and 33% of all jobs to be in Manitoba. The MH distribution of jobs is not reasonable, given that all direct jobs should take place on Manitoba. As well, the overall percentage of jobs in Manitoba appears to be very low given the significant investment taking place in Manitoba. If one were to allocate all the direct jobs from the MH IOM study to Manitoba, the overall percentage of jobs in Manitoba would increase from 33% to 57%, which seems to be a more reasonable estimate.

The Statistics Canada and MH IOM models provide consistent estimates of GDP and labour income generated from this project, suggesting that these estimated values are reasonable. The two models, however, show very significant differences of these impacts in the province of Manitoba and the rest of Canada. The proportion of the

APPENDIX C

Statistics Canada Interprovincial Input-Output Model 2009: Impact of Keeyask Generating Station

Simulation options selected by the user:

Table 1.1a Summary of original shock
(Thousands $)

Commodities (Detailed level)			Quebec	Ontario	Manitoba	Saskatchew	Alberta	British Colu	Total
45	ENE221100	Electricity	0	0	34,488	0	0	0	34,488
116	MPG321102	Softwood lumber	0	0	11,496	0	0	0	11,496
119	MPG321201	Veneer and plywood	0	0	22,771	0	0	0	22,771
140	ENE324111	Gasoline	0	0	1,326	0	0	0	1,326
141	ENE324112	Diesel fuel	0	0	124,689	0	0	0	124,689
147	MPG3241B0	Lubricants and other petroleum and coal products	0	0	2,432	0	0	0	2,432
159	MPG325500	Paints, coatings and adhesive products	0	0	5,306	0	0	0	5,306
162	MPG325900	Chemical products not elsewhere classified	0	0	10,391	0	0	0	10,391
175	MPG327301	Cement	0	0	46,206	0	0	0	46,206
177	MPG327303	Concrete products	0	0	4,643	0	0	0	4,643
182	MPG327A09	Non-metallic mineral products, not elsewhere classified	0	0	6,190	0	0	0	6,190
183	MPG331100	Iron and steel basic shapes and ferro-alloy products	0	0	2,874	0	0	0	2,874
184	MPG331201	Iron and steel pipes and tubes (except castings)	0	0	19,234	0	0	0	19,234
185	MPG331202	Rolled and drawn steel products including wire	0	0	28,961	0	0	0	28,961
192	MPG331502	Non-ferrous metal castings	0	0	6,411	0	0	0	6,411
196	MPG332301	Prefabricated metal building and components	0	0	63,008	0	0	0	63,008
197	MPG332302	Fabricated steel plates and other fabricated structural metal	0	0	167,358	0	0	0	167,358
199	MPG332309	Other ornamental and architectural metal products	0	0	884	0	0	0	884
213	MPG333200	Other industry-specific machinery	0	0	177,085	0	0	0	177,085
217	MPG333500	Metalworking machinery	0	0	5,306	0	0	0	5,306
220	MPG333901	Pumps and compressors	0	0	10,391	0	0	0	10,391
221	MPG333902	Material handling equipment	0	0	68,535	0	0	0	68,535
222	MPG333909	Other miscellaneous general-purpose machinery	0	0	442	0	0	0	442
232	MPG334409	Other electronic components	0	0	15,697	0	0	0	15,697
237	MPG335301	Transformers	0	0	26,530	0	0	0	26,530
238	MPG335302	Electric motors and generators	0	0	222,406	0	0	0	222,406
239	MPG335303	Switchgear, switchboard, relays and industrial control apparatus	0	0	32,499	0	0	0	32,499
246	MPG336120	Medium and heavy-duty trucks and chassis	0	0	76,494	0	0	0	76,494
248	MPG336202	Motor vehicle bodies and special purpose motor vehicles	0	0	1,105	0	0	0	1,105
287	MPS481001	Air passenger transportation services	0	0	30,288	0	0	0	30,288
291	MPS482002	Rail freight transportation services	0	0	47,090	0	0	0	47,090
293	MPS483002	Water freight transportation services	0	0	9,949	0	0	0	9,949
295	MPS484002	General freight truck transportation services	0	0	21,666	0	0	0	21,666
385	MPS541909	Other professional, scientific and technical services	0	0	181,507	0	0	0	181,507
423	MPS722001	Prepared meals	0	0	20,560	0	0	0	20,560
439	FIC130000	Office supplies	0	0	2,653	0	0	0	2,653
467	PRM500000	Wages and salaries	0	0	702,150	0	0	0	702,150
Total			0	0	2,211,021	0	0	0	2,211,021

Simulation options selected by the user:

Table 1.2 Impact on GDP
(Thousands $)

	Quebec	Ontario	Manitoba	Saskatchew	Alberta	British Colu	Total	
Total impact, open model								
Expenditure-based								
Final domestic expenditures on commodities	0	0	2,211,021	0	0	0	2,211,021	0
International imports (intermediate inputs)	-13,182	-34,697	-627,855	-5,524	-23,145	-10,628	-717,883	-90,028
Interprovincial imports (intermediate inputs)	-7,582	-18,941	-513,879	-18,340	-30,104	-11,834	-606,456	-92,577
Inventories and other commodity leakages	-3,116	-4,177	-12,372	-710	-8,015	-1,939	-31,263	-18,891
Interprovincial exports	56,670	179,438	4,138	65,683	207,086	75,115	606,456	602,319
Total	32,790	121,623	1,061,054	41,108	145,823	50,714	1,461,875	400,821
Income-based								
GDP at market prices	32,790	121,623	1,061,054	41,108	145,823	50,714	1,461,875	400,821
Taxes on products (intermediate inputs)	468	2,454	75,805	1,457	1,040	1,620	82,974	7,169
Taxes on products (import duties)	34	89	1,688	15	64	38	1,933	244
Subsidies on products	-639	-1,083	-3,085	-228	-455	-1,012	-6,666	-3,581
GDP at basic prices	32,926	120,163	986,645	39,866	145,173	50,069	1,383,634	396,989
Subsidies on production	-214	-76	-136	-19	-17	-33	-508	-372
Taxes on production	1,189	4,433	10,425	921	4,135	1,603	22,958	12,533
Wages and Salaries	17,140	66,541	846,843	11,264	64,080	27,780	1,038,880	192,037
Supplementary labour income	2,739	10,729	18,554	1,883	8,653	4,684	47,810	29,255
Mixed income	980	4,166	8,594	448	1,269	1,704	17,276	8,681
Other operating surplus	11,092	34,372	102,364	25,369	67,052	14,331	257,219	154,855
Total impact, closed model								
Expenditure-based								
Final domestic expenditures on commodities	21,870	79,414	2,892,920	12,432	59,675	32,284	3,104,594	211,674
International imports (final expenditures)	-3,014	-10,602	-98,501	-1,766	-8,754	-4,313	-127,660	-29,159
International imports (intermediate inputs)	-20,251	-53,239	-647,448	-7,587	-29,567	-14,126	-776,400	-128,953
Interprovincial imports (final expenditures)	-2,059	-4,973	-114,708	-2,314	-7,590	-3,366	-136,180	-21,472
Interprovincial imports (intermediate inputs)	-13,326	-30,630	-567,213	-24,833	-41,314	-16,749	-701,903	-134,690
Inventories and other commodity leakages	-3,799	-5,636	-16,113	-1,339	-9,944	-2,434	-40,362	-24,249
Interprovincial exports	89,530	265,687	7,925	87,605	264,950	96,703	838,083	830,158
Total	68,950	240,019	1,456,863	62,199	227,456	87,999	2,160,172	703,309
Income-based								
GDP at market prices	68,950	240,019	1,456,863	62,199	227,456	87,999	2,160,172	703,309
Taxes on products (final expenditures)	2,105	6,404	62,616	1,072	3,983	2,530	79,315	16,699
Taxes on products (intermediate inputs)	966	4,562	81,685	1,897	1,606	2,359	93,324	11,639
Taxes on products (import duties)	125	361	3,692	59	271	129	4,660	968
Subsidies on products	-1,741	-2,085	-7,370	-694	-1,188	-1,503	-14,873	-7,503
GDP at basic prices	67,494	230,778	1,316,239	59,866	222,784	84,484	1,997,745	681,506
Subsidies on production	-451	-177	-228	-40	-26	-68	-1,015	-787
Taxes on production	3,445	11,197	36,847	1,930	7,551	3,339	64,892	28,045
Wages and Salaries	31,575	116,535	962,670	17,879	95,227	42,625	1,274,938	312,267
Supplementary labour income	4,995	18,085	33,905	2,729	11,919	6,625	79,257	45,352
Mixed income	2,042	8,121	16,909	892	2,502	2,727	33,468	16,558
Other operating surplus	25,888	77,016	266,137	36,476	105,611	29,236	546,206	280,069
Total supply	0	0	2,211,021	0	0	0	0	-2,211,021
Total interprovincial imports	7,582	18,941	513,879	18,340	30,104	11,834	0	-513,879
International imports	13,182	34,697	627,855	5,524	23,145	10,628	0	-627,855
Total supply	42,710	133,533	3,838,875	47,260	178,803	55,233	606,456	-3,232,419
Manitoba	595	2,647	3,206,243	1,457	2,120	982	7,925	-3,198,319
Total interprovincial imports	15,386	35,604	681,920	27,146	48,904	20,115	0	-681,920
International imports	23,265	63,842	745,949	9,353	38,321	18,438	0	-745,949
Total supply	97,299	302,771	4,634,113	77,955	294,939	109,198	838,083	-3,796,030
Manitoba	595	2,647	3,206,243	1,457	2,120	982	7,925	-3,198,319
Total interprovincial imports	15,386	35,604	681,920	27,146	48,904	20,115	0	-681,920
International imports	23,265	63,842	745,949	9,353	38,321	18,438	0	-745,949
Total supply	97,299	302,771	4,634,113	77,955	294,939	109,198	838,083	-3,796,030
Jobs								
Total	0	0	12,792	0	0	0	12,792	0
Total	415	1,436	17,137	242	968	633	20,962	3,826
Total	828	2,735	21,152	467	1,673	1,089	28,175	7,023
Industry output								0
Total	75,500	255,156	2,688,908	88,368	324,626	105,948	3,560,683	871,775
Total	144,380	463,375	3,198,055	127,722	462,721	164,913	4,597,181	1,399,125

Provincial Input-Output Multipliers, 2009
Industry Accounts Division / Statistics Canada

Manitoba

Multipliers and ratios per $1 of exogenous industry output shock
Jobs effects per million dollars of output

Direct effect – Within province

Industries (Detailed level) No.	Code	Title	Output	GDP basic price	Labour income	Jobs	International imports	Export shares
22	BS221100	Electric power generation, transmission and distribution	1.000	0.758	0.349	3.6	0.030	0.235
26	BS23B000	Non-residential building construction	1.000	0.335	0.282	5.1	0.143	0.000
27	BS23C100	Transportation engineering construction	1.000	0.498	0.415	8.0	0.076	0.000
28	BS23C200	Oil and gas engineering construction	1.000	0.297	0.154	2.3	0.162	0.000
29	BS23C300	Electric power engineering construction	1.000	0.553	0.303	5.5	0.104	0.000
31	BS23C500	Other engineering construction	1.000	0.434	0.338	6.3	0.075	0.000
75	BS332300	Architectural and structural metals manufacturing	1.000	0.403	0.321	6.4	0.132	0.157

Simple multipliers (direct and indirect)

No.	Within province					All provinces				
	Output	GDP basic price	Labour income	Jobs	International imports	Output	GDP basic price	Labour income	Jobs	International imports
22	1.189	0.870	0.428	5.1	0.041	1.315	0.940	0.470	5.7	0.051
26	1.337	0.515	0.401	7.4	0.166	1.775	0.735	0.544	9.6	0.212
27	1.241	0.626	0.493	9.5	0.091	1.668	0.828	0.601	11.1	0.127
28	1.242	0.436	0.244	4.0	0.178	1.808	0.700	0.460	7.1	0.245
29	1.214	0.668	0.383	6.9	0.118	1.513	0.815	0.480	8.4	0.151
31	1.283	0.588	0.443	8.2	0.094	1.742	0.831	0.597	10.5	0.137
75	1.250	0.530	0.401	7.9	0.156	1.730	0.728	0.535	9.9	0.240

Total multipliers (direct, indirect and induced)

No.	Within province					All provinces				
	Output	GDP basic price	Labour income	Jobs	International imports	Output	GDP basic price	Labour income	Jobs	International imports
22	1.387	0.999	0.482	6.317	0.088	1.681	1.157	0.570	7.873	0.118
26	1.529	0.640	0.453	8.558	0.212	2.212	0.994	0.664	12.099	0.292
27	1.487	0.785	0.560	11.035	0.149	2.167	1.124	0.737	14.027	0.219
28	1.350	0.505	0.273	4.630	0.203	2.161	0.909	0.557	9.100	0.309
29	1.432	0.809	0.442	8.296	0.170	1.957	1.077	0.601	10.962	0.232
31	1.509	0.735	0.505	9.603	0.147	2.249	1.131	0.736	13.474	0.230
75	1.458	0.665	0.458	9.190	0.205	2.185	0.997	0.659	12.533	0.323

Jobs per million dollars of output in:	Direct: Manitoba	Direct, indirect & induced: Manitoba	Rest of Canada	All provinces
Provincial Input-Output Multipliers, 2009 (Statistics Canada)				
Electric power engineering construction	5.5	8.3	2.7	11.0
Other engineering construction	6.3	9.6	3.9	13.5
Keeyask Construction				
Total construction expenditures ($million):	2,285			
Jobs	2,436	8,347	16,144	24,491
Jobs per million dollars of expenditure	1.1	3.7	7.1	10.7
Conawapa Construction				
Total construction expenditures ($million):	3,396			
Jobs	3,238	9,303	20,964	30,267
Jobs per million dollars of expenditure	1.0	2.7	6.2	8.9
North-South Upgrades				
Total construction expenditures ($million):	142			
Jobs	171	586	605	1191
Jobs per million dollars of expenditure	1.2	4.1	4.3	8.4
750 MW Interconnection				
Total construction expenditures ($million):				
Jobs	119	498	588	
Jobs per million dollars of expenditure	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Construction

	Keeyask			Conawapa			N-S Upgrades			750 MW Interconnection		
Keeyask	Manitoba	ROC	Total	Manitoba	ROC	Total	Manitoba	ROC	Total	Manitoba	ROC	Total
Employment												
Project Direct	2,436	2,532	4,967	3,238	3,915	7,154	171	0	171	119	0	119
Other Direct	2,175	3,198	5,374	1,831	3,448	5,279	164	219	383	124	144	268
Indirect and Induced	3,736	10,414	14,151	4,234	13,601	17,835	251	386	637	255	444	700
Total Employment	8,347	16,144	24,491	9,303	20,964	30,267	586	605	1,191	498	588	1,086
Labour income	635,169	1,021,350	1,656,519	761,233	1,402,932	2,164,166	48,627	30,606	79,233	35,195	24,977	60,173
GDP ($millions)	843,908	1,440,223	2,284,131	983,334	1,997,461	2,980,795	67,189	54,676	121,865	50,209	39,642	89,851
Tax Revenues ($million)	204,340	251,927	456,268	256,096	342,663	598,759	13,954	7,546	21,501	16,069	7,146	23,215
Provincial	40,915	66,289	107,204	45,807	90,164	135,972	2,186	1,986	4,172	2,478	1,880	4,358
Local	161,059	307,444	468,502	195,872	426,252	622,124	12,538	10,935	23,474	10,714	12,437	23,151
Federal	406,314	625,660	1,031,974	497,776	859,080	1,356,855	28,679	20,467	49,146	29,261	21,463	50,724

Keeyask Generating Station, Comparison of Results

	MBS Results			Statistics Canada Closed Model			% Difference		
Employment	Manitoba	ROC	Total	Manitoba	ROC	Total	Manitoba	ROC	Total
Project Direct	2,014	2,463	4,477	12,792	0	12,792	-535.1	100.0	-185.7
Other Direct	1,887	2,644	4,531	4,345	3,826	8,171	-130.2	-44.7	-80.3
Indirect and Induced	3,089	9,047	12,136	8,360	7,023	15,383	-170.6	22.4	-26.8
Total Employment	6,990	14,153	21,144	21,152	7,023	28,175	-202.6	50.4	-33.3
Labour income	532,748	925,178	1,457,926	996,575	357,620	1,354,195	-87.1	61.3	7.1
GDP ($millions)	706,393	1,285,069	1,991,462	1,456,863	703,309	2,160,172	-106.2	45.3	-8.5
Tax Revenues ($million)*	171,154	225,519	396,673	147,993	29,306	177,299	13.5	87.0	55.3
Provincial	34,745	59,340	94,085	107,375	18,090	125,465	-209.0	69.5	-33.4
Local	135,280	272,249	407,529	955	72	1,027	99.3	100.0	99.7
Federal	341,180	557,108	898,288	39,663	11,144	50,807	88.4	98.0	94.3
Average wage (calculated)	76,216	65,370	68,952	47,115	50,924	48,064			
Total Employment, estimated using average wage assumed by MBS	6,990	14,153	21,144	13,076	5,471	19,640	87.1	-61.3	-7.1

*Statistics Canada tax revenues only include commodity taxes

	Keeyask			Conawapa			N-S Upgrades			750 MW Interconnection		
Employment												
Project Direct	39	0	39	42	0	42				1	0	1
Other Direct	2	1	3	2	1	4				0	0	0
Indirect and Induced	29	16	45	33	18	50				1	1	1
Total Employment	70	17	87	77	19	96				2	1	2
Labour income	5921	648	6569	6597	734	7331				123	23	145
GDP ($millions)	6872	1054	7926	7676	1184	8860				149	37	186
Tax Revenues ($million)	831	117	948	931	132	1063				22	5	27
Provincial	162	31	193	182	35	217				5	1	7
Local	988	128	1116	1099	144	1243				23	5	29
Federal	1981	276	2257	2212	311	2523				51	12	63

REFERENCE: Chapter 13: Integrated Comparisons of Development Plans - Multiple Account Analysis; Section: 13.3; Page No.: 33-36

QUESTION:

Please provide a table of data points in support of the line graphs in Figure 13.4, 13.5 and 13.6.

RESPONSE:

The data points for Figures 13.4, 13.5 and 13.6 are in the attachment.

Figure 13.4 –Annual Capital Expenditures

Year	All Gas	K22/Gas	K19/Gas24/250	Preferred
	Millions of 2014$			
2014	73.1	115.2	247.2	278.8
2015	9.9	42.8	509.2	601.0
2016	9.9	39.2	675.5	871.6
2017	9.9	238.8	826.3	1058.1
2018	0.0	421.4	609.5	951.0
2019	0.0	688.4	459.8	792.7
2020	71.5	777.5	179.7	1044.9
2021	106.9	652.6	55.9	1257.8
2022	14.8	403.1	72.2	1062.8
2023	72.5	165.4	107.9	780.6
2024	172.4	57.2	15.0	579.6
2025	15.0	0.0	0.0	425.1
2026	73.6	0.0	0.0	227.2
2027	100.6	74.0	74.0	39.3
2028	168.6	110.4	174.4	0.0
2029	221.5	15.3	169.4	0.0
2030	108.5	75.1	222.6	0.0
2031	7.3	331.6	109.0	0.0
2032	75.9	240.4	7.3	0.0
2033	165.3	110.0	0.0	0.0
2034	173.7	7.4	0.0	0.0
2035	228.2	158.8	158.8	0.0
2036	102.2	229.4	229.4	0.0
2037	167.9	102.7	102.7	0.0
2038	231.7	168.7	168.7	0.0
2039	103.8	232.8	232.8	78.6
2040	7.6	166.0	166.0	116.6
2041	163.6	7.7	7.7	16.3
2042	236.3	164.4	164.4	79.8
2043	167.5	237.5	237.5	118.2
2044	7.8	106.4	106.4	97.1
2045	35.6	7.8	7.8	183.3
2046	48.6	0.0	0.0	16.7

Figure 13.5 - Annual Employment for Project Construction

Year	All Gas	K22/Gas	K19/Gas24/250	Preferred
	Person /Years			
2014	0	0	207	244
2015	0	1	406	433
2016	0	1	965	966
2017	0	209	973	1356
2018	0	405	836	1293
2019	0	962	588	1108
2020	39	970	309	1128
2021	48	827	100	1109
2022	39	579	39	862
2023	39	300	48	680
2024	101	100	39	505
2025	39	0	0	516
2026	39	0	0	382
2027	39	39	39	95
2028	121	48	101	0
2029	82	39	121	0
2030	92	39	82	0
2031	82	183	92	0
2032	39	121	82	0
2033	91	92	0	0
2034	121	82	0	0
2035	82	82	82	0
2036	82	82	82	0
2037	165	82	82	0
2038	82	165	165	0
2039	82	82	82	39
2040	82	134	134	48
2041	82	82	82	39
2042	82	82	82	39
2043	134	82	82	48
2044	82	82	82	77
2045	22	82	82	101
2046	22	0	0	39

Figure 13.6 - Annual Employment for Project Operations and Maintenance

Year	All Gas	K22/Gas	K19/Gas24/250	Preferred
	Person Years			
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0
2018	0	0	0	0
2019	0	0	58	58
2020	0	0	58	58
2021	0	0	58	58
2022	26	58	58	58
2023	26	58	58	58
2024	26	58	84	58
2025	52	58	84	119
2026	52	58	84	119
2027	52	58	84	119
2028	77	58	84	119
2029	77	84	110	119
2030	77	84	110	119
2031	124	84	110	119
2032	124	110	157	119
2033	124	110	157	119
2034	150	157	157	119
2035	150	157	157	119
2036	150	157	157	119
2037	197	157	157	119
2038	197	204	204	119
2039	197	204	204	119
2040	244	204	204	119
2041	244	251	251	145
2042	244	251	251	145
2043	244	251	251	145
2044	291	251	251	171
2045	291	298	298	171
2046	291	298	298	196

REFERENCE: Chapter 13: Integrated Comparisons of Development Plans - Multiple Account Analysis; Section: 13.3; Page No.: 35; Figure 13.5, Table 13.6 - Economic Impacts - Leakages

QUESTION:

Please indicate to which extent the forecasted construction labour in Figure 13.5 and Table 13.6 will relate to Manitoba sourced labour providing incremental economic benefit to Manitoba vs. Canada.

RESPONSE:

Table 13.5 shows the estimated gross wages for all workers on the projects. Table 13.6 shows the estimated incremental income or net benefit to Manitoba workers, netting out the wages earned by all non-Manitobans and the estimated opportunity cost of Manitoba workers.

REFERENCE: Chapter 13: Integrated Comparisons of Development Plans - Multiple Account Analysis; Section: 13.3 and Table 13.6; Page No.: 40-41

QUESTION:

Please file a copy of the footnoted references 27, Manitoba Hydro, Wuskwatim G.S. employment, November 2012 monthly report and Keeyask Hydropower Limited Partnership, Environmental Impact Statement.

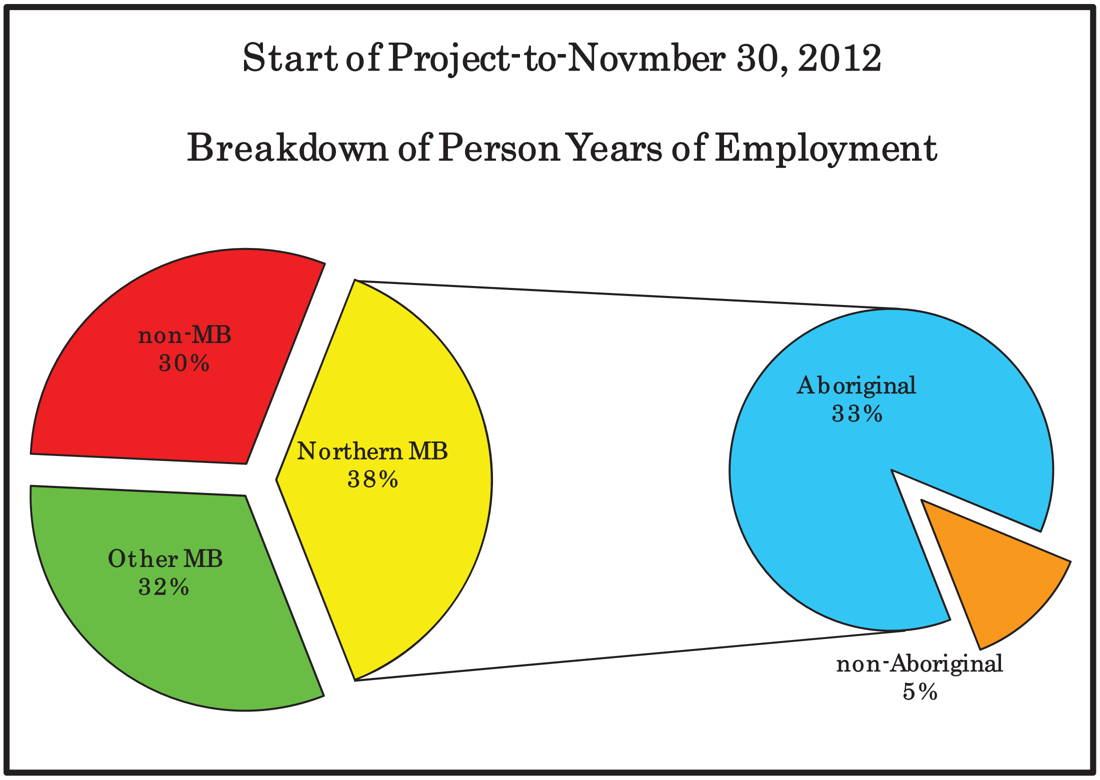
RESPONSE:

The referenced pages of the Wuskwatim G.S. Employment November 2012 Monthly Report and Keeyask Hydropower Limited Partnership EIS are attached.

3. Person Years of Employment

A person-year of employment is defined as a full-time equivalent or one full-time job for one year. This typically represents about 2000 hours of work. From the start of construction to the end of November 30, 2012, direct employment created on the project amounted to 2,839 person-years of employment.[4] Approximately 70 per cent or 1981 person-years represent Manitoba employment. Total northern Manitoba employment represents approximately 38 per cent (1081 person-years) and northern Manitoba Aboriginal employment represents 33 per cent (943 person-years), respectively, of total employment. Figure 4 provides a breakdown of total person-years of employment.

Figure 4: Project-to-November 30, 2012 Breakdown of Person Years of Employment



[4] Person-years data does not include management, salaried, and employees "out of scope" of the BNA.

Results of the employment analysis, showing the estimated person years of employment for the KCNs and the Regional Study Area Aboriginal workforce by occupational category for both high and low employment estimates are presented in Table 6-31 below.

Table 6-43: Estimated Participation by Keeyask Cree Nations Members and the Regional Study Area Aboriginal Workforce in Project Employment Opportunities

Job Category	Person Years of Employment by KCNs Members		Person Years of Employment by Regional Study Area Aboriginal Workforce[1]	
	High Estimate (number)	**Low Estimate** (number)	**High Estimate** (number)	**Low Estimate** (number)
Construction Support	325	125	750	225
Non-Designated Trades	170	45	535	115
Designated Trades	95	55	310	105
Manitoba Hydro and Contractor Supervisory	10	10	105	105
TOTAL	*600*	*235*	*1,700*	*550*
Percent of Total Available Person Years	14%	6%	40%	13%

Source: InterGroup Consultants: Analysis prepared by InterGroup Consultants Ltd. Based on Keeyask Generation Project workforce demand supplied by Manitoba Hydro. Details are in the SE SV Section 3.4.1.

Notes:

1. Regional Study Area includes the KCNs and Churchill Burntwood Nelson area[1].

Numbers are subject to rounding.

The Project is projected to generate an estimated 235 to 600 person years of construction employment for KCNs Members, for between 6% and 14 % of the total construction workforce. These percentages are strongly influenced by the relatively small number of qualified KCNs Members who could work on the Project relative to the large number of Project construction jobs that are available. While the percentage of the total appears to be relatively small, the absolute amount of employment is substantial for the KCNs as the Project is expected to involve a large percentage of available workers from the KCNs. If these were full-time positions, approximately 30 to 70 KCNs Members would be working throughout the eight and a half-year construction phase. However, much of the Project construction work would be seasonal and therefore, a person year of work would be spread over several individual jobs. For example, assuming two jobs per person year, the number of KCNs Members working during a given year could be between 60 and 140 persons, which would be substantial in these high

[1] CBN refers to areas (including communities) along the Churchill, Burntwood and Nelson (CBN) river systems that have been affected to some degree by past hydroelectric development. The boundaries of this area are defined in Section 12.1.1.3 of the BNA, which is the collective agreement governing the Project.

Tab 4

- Section 8.7 – Appendix 7 – Sensitivity Analysis (quantitative information provided).

In a number of cases, material assumptions were identified to have inherent limitations regarding the availability and/or potential accuracy of supporting data. In these cases, as well as with all LCA components determined to be material, the Pembina Institute performed sensitivity analysis to gauge the potential impact of differing driving factors. MNP also conducted a materiality assessment of LCA component calculations and performed sensitivity testing, as summarized in the following sections. A high-level scan of immaterial assumptions and inputs included in the LCA report was also carried out. We do not note any unusual or disconcerting assumptions, inputs or sources applied by MH or Pembina Institute.

Under each of the following analyses, a brief overview of the reported sensitivity information from the LCA is provided, followed by our assessment of the reasonableness of the impacts to overall life cycle emissions estimates of the project.

In our assessment and quantification, MNP was constrained by the lack of transparency regarding the LCA report's assumed activity-based emissions factors, or how they were derived for both the base case and sensitivity analyses. All of the sensitivities below required MNP to estimate reasonable emissions factors in order to calculate impacts on total emissions. Where possible, we have recalculated the base case using the information throughout the LCA report. In other cases, we have utilized emissions factors based on credible and independent sources of publicly-available information. These sources include, but are not limited to, the International Energy Agency (IEA), the Environmental Protection Agency (EPA), the Clean Environment Commission (CEC), the Organization for Economic Cooperation and Development (OECD), IHS CERA, ICF International and the UNFCCC.

Sensitivity #1: Transportation Distances

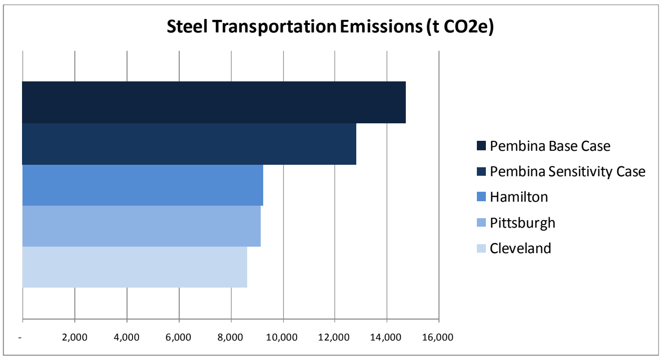
Transportation distances of materials and equipment required for construction and operation of the Keeyask and Conawapa projects can have material impact on the total life cycle emissions estimates. Specifically, the sources of steel materials and components may come from many different global suppliers. Differences in sourcing locations may result in significant differences in transportation-based emissions due to the high emissions intensity of transporting steel. At the time of this NFAT review, MH has not fully contracted suppliers for all materials and equipment. Therefore, an inherent limitation of the analysis is that all transportation related emissions can only be quantified based on estimated distances travelled. The transports of other materials are deemed to be more trivial and are therefore not tested with sensitivity analysis.

Limitation Identified:	Transportation Distance
LCA Approach	MH provided some insight on the expected distances of key transported materials. However, the final sources of many materials, such as steel, are unknown. In place of actual data, the assessment uses plausible and conservative transport distances based on previous MH experience. A list of all transport distances is available in Appendix 2 of the NFAT– Scoping.
MNP Impact Assessment & Conclusion	MNP reviewed the transportation distances assumptions. Based on our review, the distances assumed are conservative and estimate plausibly considerable distances based on MH's previous experience building hydroelectric generating stations. **Overall, we are satisfied that this limitation will *not* result in a *material understatement* of life cycle emissions for preferred plan projects.**

The LCA report analyzes the percentage reductions in life cycle emissions by life cycle phase if steel is transported from a plant in North America instead of China[16].

Assumption Category:	Transportation Distance
LCA Base Case Assumptions	Base case assumes all steel used in the manufacture of the generating station to come from China. Steel transportation route includes: • Ocean transport from Shanghai to Vancouver (9,797 km). • Rail transport from Vancouver to Winnipeg (2,202 km). Truck transport from Winnipeg to Keeyask (1,071 km).
LCA Sensitivity Assumptions	Some steel will come from North American sources. This sensitivity *reduces* life cycle emission intensity. 13% decrease in transportation emissions during the construction phase when shipping from China is removed.
MNP Sensitivity Assumptions	• All steel is assumed to be produced in North America in either Pittsburgh, Hamilton or Cleveland.[17] • Transportation distances assumed are 3,199 km for Pittsburgh, 3,231 km for Hamilton, and 3,013 km for Cleveland.[18] • Trucking emission factor used for all three = 71.6 tons of CO_2 per million ton-miles.[19] • Conversion factor of 0.621371[20] for kms to miles.
MNP Conclusion	Across the three cities assumed, we calculated an average 30% reduction in steel transportation emissions by sourcing all steel from North America vs. China. Our analysis indicates that Pembina's sensitivity case is at the low end of the range of potential transportation emissions reductions. Based on the results of both analyses, the range of possible transportation emissions reductions is approximately 13% to 30% if some or all of steel is sourced from North America. **Overall, a further reduction beyond the 13% in transportation emissions within the LCA sensitivity analysis could be realized if all steel is sourced from Pittsburgh, Hamilton, or Cleveland.** ***The figure below provides summary of the transportation emissions across the various cases. These findings indicate that the Base Case calculations, assuming steel transportation from China, is sufficiently conservative and provides the panel with a view of the highest level of emissions likely possible, as associated with this factor.***

Figure 3.1: Steel Transportation Emissions



[16] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. (*Appendix 7, Table 28). 16 February 2012. Accessed in 2013.
[17] Selected based on proximity to Winnipeg.
[18] Calculated based on Google Maps driving distances between the city and Winnipeg plus truck transport distance of 1,071 km from Winnipeg to Keeyask, consistent with the base case.
[19] Texas Transportation Institute. *Sustainability and Freight Transportation in North America*. Prepared for the Commission on Environmental Cooperation. March 2010. Accessed in 2013.
[20] Conversion factor according to Google.

Sensitivity #2: Steel Source and Emissions Factor

Offsite steel production is the most energy-intensive and therefore emission-intensive activity associated with the construction of the hydro generating stations. The steel components used are produced in many different countries including South East Asia, Eastern Europe, South America and North America.

Limitation Identified:	Steel Production Emissions Factor
LCA Approach	Pembina assumes all steel is produced in China so that transportation related emissions are as conservative as possible (particularly with transportation distances and described above). However steel production emission factors for China are known to be uncertain and non-transparent. Pembina has therefore opted to use a generic North American steel emissions factor based on typical steel production and forging including mining, transportation of raw materials, processing and steel production. Although this emission factor is likely representative of emissions from steel facilities it may be different than the actual emissions factor from the facilities used to produce the final components and is likely different than those facilities in China where the materials are assumed to derive from. For average global steel production, up to 67% of iron in steel comes from recycled sources. The LCA analysis assumes 100% virgin material. This assumption ensures the analysis is *conservative*.
MNP Impact Assessment & Conclusion	The following two conflicting assumptions used with respect to steel production create the potential for flawed estimation: 1. All steel is assumed to come from China. 2. Steel production emissions are based on a North American emission factor. The scale of the potential misstatement in life cycle emissions depends on the following factors: 1. Difference between China steel emissions factor and North American steel emissions factor (tested below). 2. Transportation distances (discussed in a separate section below). 3. Specific company contracted to provide steel for construction due to facility-specific nature of steel making emissions intensity (i.e. percentage of virgin vs. recycled iron used in production). In assuming 100% of iron in steel is virgin material, the potential impact of this key assumption can only be to *reduce overall life cycle emissions*. Since this is a *conservative* approach by MH in their assumptions, we have not quantified the potential reductions in overall life cycle emissions intensity as this only serves to *improve* the economics of the project. **The inconsistency results in the *potential* for life cycle emissions to be *materially erroneous*. However, overall, we are satisfied that this limitation will *not* result in a *material understatement* of total life cycle emissions.**

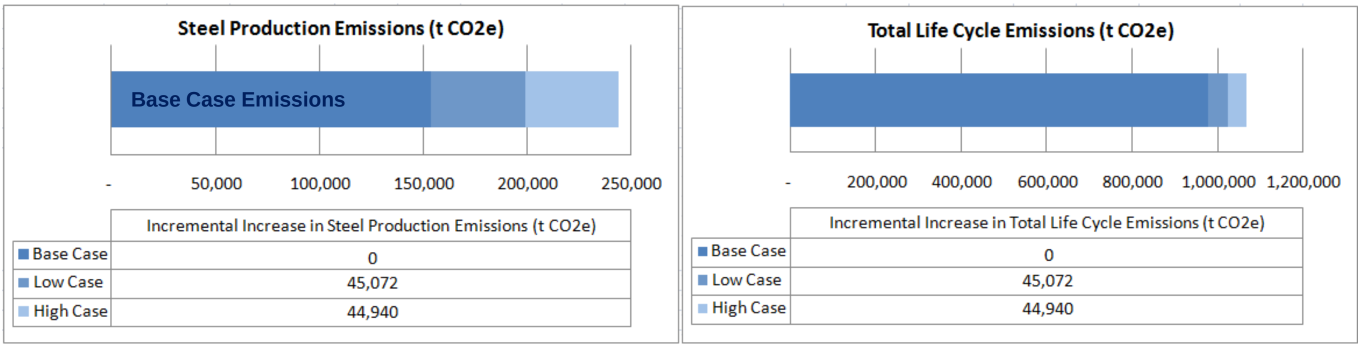
The LCA analyzes the percent increase in life cycle emissions assuming 30% more intensive steel production as a sensitivity case[21] to proxy typical Chinese producers. Other factors impact steel making emissions and some data limitations are addressed as below.

Assumption Category:	Steel Production Emissions Factor
LCA Base Case Assumptions	• Emission factor used is for North American steel production. • Total amount of steel required to build Keeyask = 64,200 tonnes. • Total emissions from steel production = 153,948 tonnes of CO_2e.
LCA Sensitivity Assumptions	Steel is assumed to come from China. Assumes 30% more intensive steel production as a sensitivity case to proxy typical Chinese producers. This sensitivity *increases* life cycle emission intensity.

[21] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. (*Appendix 7, Table 29). 16 February 2012. Accessed in 2013.

Assumption Category:	Steel Production Emissions Factor
MNP Sensitivity Assumptions	- Implied US emission factor of 2.40 t CO_2e/tonne of steel in base case. - Chinese emission factor between 3.1 and 3.8 t CO_2e/tonne of steel in sensitivity case. - Low case scenario assumed 3.1 t CO_2e/tonne of steel emission intensity. - High case scenario assumed a 3.8 t CO_2e/tonne of steel emission intensity. [22]
MNP Conclusion	The low case scenario resulted in a *29% increase in steel production emissions (consistent with the LCA report findings)*, with a *5% increase in total life cycle emissions* for the Keeyask project. Overall, it is a *reasonable sensitivity result,* but on the low end of the range. The high case scenario resulted in a *58% increase in steel production emissions*, with a *9% increase in total life cycle emissions* for Keeyask. **Overall, producing steel in China could increase total life cycle emissions between 5 and 9%, which is material to the LCA calculation. However, it is immaterial in comparison with other generation technologies included in development plans reliant on gas generation.** ***The figure below provides a visual summary of the low, base and high case life cycle emissions.***

Figure 3.2: Impact of Steel Sensitivity Cases on Steel Production & Total Life Cycle Emissions



These graphs demonstrate that steel production emissions could be at least 45 Kt, or as much as 90 Kt greater if emissions factors representative of Chinese steel production are applied. This could represent a material change in the total life cycle emissions of the Keeyask project. However, when compared to the emissions produced by alternative project types in gas plans, the amount becomes immaterial.

Sensitivity #3: Cement Emission Factor

Emissions from cement production are significant contributors to total life cycle emissions of Keeyask. However, individual cement production facilities experience significant variability in their emissions intensities. This is also the case from state to state and country to country cement production emissions intensities.

Limitation Identified:	Cement Supplier
LCA Approach	MH has not contracted cement suppliers at this design stage. The base case assumes that all cement is produced in Edmonton and transported to the construction sites by truck. MH has, in the past, sourced cement from Edmonton for the construction of hydro facilities.
MNP Impact Assessment &	There are 2 key considerations in this assumption, which are both dependent on the supplier contracted to provide cement:

[22] Global Carbon Capture and Storage Institute. *CCS for Iron and Steel Production*. 23 August 2013. Accessed in 2013. (http://www.globalccsinstitute.com/insights/authors/dennisvanpuyvelde/2013/08/23/ccs-iron-and-steel-production)

Limitation Identified:	Cement Supplier
Conclusion	1. Emission intensity of production. 2. Emission intensity of transportation. Other plausible locations for cement suppliers could include: 1. Southern Ontario. 2. Illinois. 3. Wisconsin. Production and transportation of cement represents 7.03% and 1.39% of total life cycle CO_2 emissions, respectively. Therefore, the risk of material error comes from production rather than transportation. In the LCA calculation, Pembina applied the assumption that cement used by MH is produced in a manner similar to the average Portland cement manufacture in the US. This assumption is plausible as the majority of large cement producers in Canada and the US manufacture Portland cement. **The selection of a cement supplier will impact the actual cement emissions factor as it varies by plant. See conclusion and results of the sensitivity assessment in the table below.**

The LCA report analyzes the percentage increase in life cycle emissions by life cycle phase if cement manufacturing is 30% more emission intensive than the base case[23] as a proxy for a more intensive supplier.

Assumption Category:	Cement Emissions Factor
LCA Base Case Assumptions	The base case analysis uses a generic concrete emissions factor for the average emissions intensity of producing cement in the United States. • Total amount of cement required to build Keeyask = 124,100 tonnes. • Total emissions from cement production = 68,805 tonnes of CO_2e.
LCA Sensitivity Assumptions	Individual cement production facilities may have higher or lower emissions. This sensitivity assumes emission intensity from cement production is 30% higher. This sensitivity *increases* life cycle emission intensity.
MNP Sensitivity Assumptions	• Base Case Implied US emission factor of 0.55 t CO_2/tonne of cement. • US Average Cement Emission Intensity = 0.95 t CO_2/tonne of cement.[24] • High Case Cement Emission Intensity (Kansas) = 1.4 t CO_2/tonne of cement.[25] • Low Case Cement Emission Intensity (Michigan) = 0.75 t CO_2/tonne of cement.[26]
MNP Conclusion	The low case scenario resulted in a *35% increase in cement production emissions*, with a *2% increase in total life cycle emissions* for the Keeyask project. Our *low* case emission factor is 0.20 t CO_2/tonne *higher* than the emission factor applied in the Pembina report. We feel the use of 0.55 t CO_2/tonne is questionable. The high case scenario resulted in a *58% increase in cement production emissions*, with a *11% increase in total life cycle emissions* for Keeyask. **Overall, the cement emission factor could increase total life cycle emissions between 2 and 9%, which is material to the LCA calculation. However, it is immaterial in comparison with with other generation technologies included in development plans reliant on gas generation.** ***The figure below provides a visual summary of the low, base and high case life cycle emissions.***

[23] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. (*Appendix 7, Table 31). 16 February 2012. Accessed in 2013.
[24] Loreti Group. *Greenhouse Gas Emissions Reductions from Blended Cement Production*. 19 December 2008. Accessed in 2013.
[25] Ibid.
[26] Ibid.

SUBJECT: Socio-economic impacts: personal, family and community life

REFERENCE: MMF/MH 1-001a; MMF/MH 1-001b;

PREAMBLE: "Worker interaction with local residents" is listed under the "Personal, Family, and Community Life" component/topic of the "Socio-economic Comparison of Resource Options" table (CAC/MH 1-231a). The text on p.26 of 29 (CAC/MH 1-231a) describes measures to address adverse effects of worker interaction (i.e. camps, and committees established to address issues) yet concludes that "...some adverse effects are expected." There is concern that these effects will be greatest for current Northern and Aboriginal residents. It is presently not known whether construction schedules for Keeyask and Conawapa will overlap, but in the case that they do, it is anticipated that these effects will be of a greater magnitude. It is also understood that each project will undergo a separate environmental review process; however, there is an additional concern that these separate review processes will fail to consider the combined effects of the separate PDP components.

QUESTION:

Please estimate the combined effects of the Keeyask and Conawapa projects on "personal, family, and community life", particularly in terms of "worker interaction with local residents", and indicate the communities in which these effects are estimated to be greatest, and during which years of project construction.

RESPONSE:

The Cumulative Effects Assessment Summary for the Keeyask Generation Project Environmental Impact Statement sets out eight mitigation actions regarding public safety and worker interaction, including a series of strategies to keep workers at the camp, a multi-party committee to provide a coordinated approach to address issues across all Manitoba Hydro projects, and regular dialogue with the RCMP regarding policing matters. The cumulative effects summary concludes:

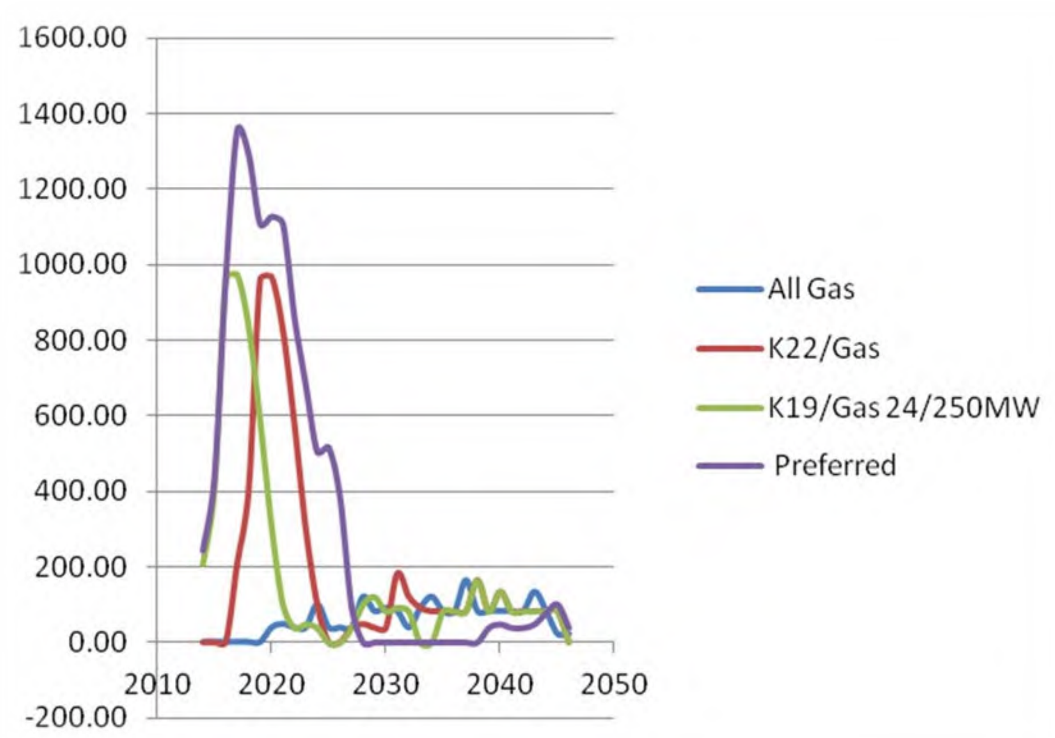
> There is a potential for adverse effects during the construction of the [Keeyask] project due to potential workers interactions. Future projects will further increase the number

of non-local, temporary construction workers in Gillam, increasing the potential for adverse effects. As many as 2,300 local and non-local workers will be required at the peak of the proposed Conawapa construction.

The residual adverse effects of the Keeyask Project on public safety and worker interaction may interact cumulatively with adverse effects of other projects and activities planned during the Keeyask construction phase. A collaborative and cooperative mitigation program is proposed to mitigate these potential effects.

Figure 13.5 ANNUAL EMPLOYMENT FOR PROJECT CONSTRUCTION

(PERSON YEARS)



The demand for labour in operations and maintenance (O&M) is different. Figure 13.6 shows the total annual O&M employment directly required for the projects developed in the preferred and the alternative plans. All of the plans generate an increasing amount of annual O&M employment. Toward the end of the planning period, however, the three alternatives without Conawapa G.S. generate more annual employment than the Preferred Development Plan because of the need to add more thermal plants to meet growing load.

TAB 5

REFERENCE: Question CAC/MH I-022b

QUESTION:

Does the non-controlling interest shown in the financial statements in Appendix 11.4 only reflect the preferred dividends projected to be paid to the KCN or does it include other items as well?

RESPONSE:

The non-controlling interest shown in the financial statements in Appendix 11.4 also includes NCN's share of the projected net income or loss from the Wuskwatim Power Limited Partnership.

SUBJECT: Partnership Agreements

REFERENCE: CAC/MH I-022 b)

QUESTION:

If other items are included what are they and how will their values vary under the various scenarios?

RESPONSE:

The attached schedule shows the breakdown of non-controlling interest between NCN's 33% share of WPLP income and losses and preferred distributions to the KCN.

Development Plan **K19 Sales C25 750 MW**
Scenario **Economics:REF Rev:REF Cap:REF**

Fiscal Year Ending March 31	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
NCN's Share (33%) of WPLP Net Income	(14)	(24)	(23)	(17)	(14)	(13)	(9)	(9)	(7)	(4)	(2)	2	4	0	2	4	5	8	10	11	13	15	17	18	19
KCN's Preferred Distributions before repayments	-	-	-	-	-	-	-	-	-	5	5	5	5	5	5	6	6	6	6	7	7	7	7	7	7
Non-Controlling Interest	(14)	(24)	(23)	(17)	(14)	(13)	(9)	(9)	(7)	1	3	7	9	5	7	9	11	14	16	18	20	22	24	25	26

Development Plan **K19 Sales C25 750 MW**
Scenario **Economics:REF Rev:HIGH Cap:REF**

Fiscal Year Ending March 31	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
NCN's Share (33%) of WPLP Net Income	(14)	(24)	(19)	(12)	(10)	(7)	(4)	(3)	1	3	6	9	11	11	13	15	17	20	22	24	26	28	29	32	37
KCN's Preferred Distributions before repayments	-	-	-	-	-	-	-	-	-	7	7	8	8	9	9	9	9	10	10	11	11	11	12	13	13
Non-Controlling Interest	(14)	(24)	(19)	(12)	(10)	(7)	(4)	(3)	1	10	13	17	19	20	22	25	27	30	32	35	37	39	41	44	50

Development Plan **K19 Sales C25 750 MW**
Scenario **Economics:REF Rev:LOW Cap:REF**

Fiscal Year Ending March 31	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
NCN's Share (33%) of WPLP Net Income	(14)	(24)	(27)	(21)	(19)	(18)	(13)	(14)	(16)	(13)	(11)	(6)	(4)	(11)	(10)	(8)	(7)	(4)	(3)	(1)	1	3	5	4	0
KCN's Preferred Distributions before repayments	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	4	4	4	4	4	3	3
Non-Controlling Interest	(14)	(24)	(27)	(21)	(19)	(18)	(13)	(14)	(16)	(10)	(8)	(3)	(1)	(8)	(7)	(5)	(3)	(1)	1	3	5	7	9	8	4

Development Plan **K19 Sales C25 750 MW**
Scenario **Economics:REF Rev:REF Cap:REF**

Fiscal Year Ending March 31	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**
NCN's Share (33%) of WPLP Net Income	20	22	24	26	27	29	31	33	35	37	38	38	39	40	41	41	42	43	45	46	48	49	51	53	55
KCN's Preferred Distributions before repayments	8	8	8	8	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	13	13	14	14	14
Non-Controlling Interest	28	30	32	34	36	38	41	43	45	47	49	49	50	51	53	53	54	55	57	59	61	63	64	66	69

Development Plan **K19 Sales C25 750 MW**
Scenario **Economics:REF Rev:HIGH Cap:REF**

Fiscal Year Ending March 31	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**
NCN's Share (33%) of WPLP Net Income	40	43	45	49	52	54	57	60	62	65	67	67	69	70	72	74	75	76	78	80	82	84	87	89	92
KCN's Preferred Distributions before repayments	13	13	15	15	15	16	17	17	18	18	18	19	19	19	20	20	21	21	22	22	22	23	23	24	24
Non-Controlling Interest	53	56	60	64	67	70	74	77	80	83	85	86	88	90	92	94	96	97	99	102	105	107	110	113	116

Development Plan **K19 Sales C25 750 MW**
Scenario **Economics:REF Rev:LOW Cap:REF**

Fiscal Year Ending March 31	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**
NCN's Share (33%) of WPLP Net Income	(0)	1	2	2	3	4	5	7	8	9	9	8	8	9	9	10	10	11	12	12	13	14	15	16	18
KCN's Preferred Distributions before repayments	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	6
Non-Controlling Interest	3	4	5	6	7	8	9	10	11	13	13	12	13	13	14	14	15	15	16	17	19	20	21	22	23

Joint Keeyask Development Agreement – Benefits Summary

The following is a summary of the various benefits to the Keeyask Cree Nations (KCNs) as per the Joint Keeyask Development Agreement (JKDA).

Adverse Effects

Adverse Effects Agreements have been negotiated with the KCNs. These agreements provide for mitigation measures, community based programming and cash compensation to avoid, offset or compensate for anticipated project effects. Compensation agreements are also negotiated in advance of project construction for any potential commercial losses.

Community specific Adverse Effects Agreements are filed on the Keeyask Hydropower Limited Partnership website[1].

Pre-Project Training

To prepare Northern Aboriginal people for jobs on the proposed Wuskwatim and Keeyask hydroelectric projects, Manitoba Hydro along with the Provincial and Federal Governments, funded a $60 million pre-project training initiative. During the period 2001 to 2010, the KCNs received $33.75 million of these funds to train their members. Various training activities were undertaken, including designated and non-designated trades, construction support and non-occupational programs.

On-the-job Training

On-the-job training (OJT) opportunities have been identified for contracts throughout the project. As the KCN reside within the first hiring tier of the BNA hiring preferences, the first preference for OJT opportunities is given to KCN members. Currently, there are eight OJT programs with 87 trainee opportunities for Keeyask Infrastructure Construction

[1] http://keeyask.com/wp/the-partnership

Business Opportunities during Construction

The KCNs have the opportunity to negotiate up to $203.1 million of direct negotiated contracts (DNC) related to the Keeyask project. Currently, Manitoba Hydro has identified DNC opportunities for the following areas of work, including: Catering; Camp Maintenance Services; Security Services; Employee Retention and Support Services; First-Aid Services; Start-Up Camp – Site Preparation & Development; Main Camp – Decommissioning; North Access Road Construction (Part A); North Access Road Construction (Part B); South Access Road Construction; Forebay Clearing; Painting and Architectural Finish; Rock and Unclassified Excavation; Crushing; Septic; Material; Worksite Area Site Development; Bridge Install; and, KIP Construction Power Clearing. In addition, to these identified work packages, as the planning for the project progresses, where reasonable, Manitoba Hydro will continue to assess the feasibility of further work packages.

Open competitive tenders include the provision of a bid depository mechanism that permits each KCN and/or KCN Business to submit a subcontract bid for consideration by interested Proponents; providing additional opportunity to participate in the work related to the planning or construction of the Keeyask Project.

All successful proponents of open competitive tender work packages are provided a listing of Keeyask Cree Nations and KCN Businesses available to do sub-contract work on the Keeyask project within 10 days of the award of a contract.

Employment during Construction

Preference measures are included in the Burntwood-Nelson Collective Agreement for employing qualified KCN members. KCN members will have opportunities to work for Manitoba Hydro directly, for contractors on the project site and within the communities in various capacities. The construction target agreed to in the JKDA is 630 person years of employment.

Individual job seeker Managers, in each of the KCN communities, assists in facilitating with the registration and recruitment of their community members under the Job Referral System (JRS). The JRS is funded by Manitoba Hydro and managed by the Government of Manitoba Entrepreneurship, Training and Trade.

An Advisory Group on Employment, with participation from each of the KCN communities, to monitor and address concerns about the referral and hiring process for jobs on the work site, will be established.

Employment in Manitoba Hydro Operations

Manitoba Hydro and the KCNs have agreed to a 20 year target for the employment of 182 members of the KCNs in Manitoba Hydro's ongoing operations. The funding quantum agreed to in the JKDA for this initiative is $20 million and the 20 year period is 2009 – 2029.

Transition and Implementation Funding

Process funding is provided to the KCNs to enable them to participate in the planning and construction phases (design and development) of the projects. It is a benefit to the communities as it funds salaries for KCN members, participation costs for members serving on project and partnership committees and communication activities that help keep members apprised of project progress, activities and issues.

Transition funding commenced upon the signing of the JKDA (2009) and continues until construction of the Keeyask Generating Station begins (anticipated to be mid-2014). Transition funding amounts are determined based upon the project schedule and associated activities. Implementation funding commences when construction of the Keeyask Generating Station begins (anticipated to be mid-2014) and concludes when the project is complete. The Implementation funding quantum negotiated as part of the JKDA is $11.23 million, adjusted annually for inflation.

Project Revenue

The KCNs have the opportunity to own up to 25% of the Keeyask Partnership, either as common or preferred equity owners. Project revenue will be based upon the type and percentage of ownership and a number of other factors, including project capital costs and energy export prices.

Keeyask Governance

The Keeyask HydroPower Limited Partnership (KHLP) has been established to carry on the business of the Partnership. Decisions of the KHLP are decisions taken by the Board of Directors (the Board) of a wholly-owned Hydro subsidiary General Partner corporation. The General Partner enters into various agreements and contracts with Hydro on behalf of the KHLP. Each KCN will be entitled to have the following number of representatives appointed to the Board: Tataskweyak Cree Nation(2),War Lake First Nation (1), York Factory First Nation (1) and Fox Lake Cree Nation (1). For so long as a KCN has representation on the Board, Hydro agrees to cause meetings of the Board to be called at least quarterly during the construction period and at least twice every year at all other times, unless the KCNs and Hydro otherwise agree.

Several committees will be established for the Keeyask Project, all of which include representatives of the KCNs. The committees are the Construction Advisory Committee (CAC), Monitoring Advisory Committee (MAC) and Advisory Group on Employment (AGE). The MAC and CAC report to the KHLP and the AGE reports to Hydro acting as Project Manager Through these committees the KCNs will be kept apprised of Project construction and monitoring activities as well as employment related matters. They will also have opportunities to provide input into Project related activities, including adaptive management and public and regulatory reporting materials. The meeting frequency for the committees will range from monthly to quarterly.

TAB 6

SUBJECT: Socio-economic impacts: business opportunities

REFERENCE: MMF/MH 1-001a; MMF/MH 1-001b

PREAMBLE: The "Socio-economic Comparison of Resource Options" table (CAC/MH 1-231a) provides a figure of $200 million for Northern and Aboriginal Local Business Opportunities. The text that follows (p.23 of 29) states that "Total value of the contracts to the four Cree Nations will total over $200 million, which is substantial for these communities with limited experience."

QUESTION:

Please confirm whether the $200 million in contracts in the Socio-economic Comparison of Resource Options table in CAC-MH I-231a is entirely planned for the KCNs.

RESPONSE:

Yes, the $200 million in contracts identified in the aforementioned table are entirely planned for the KCNs and were negotiated as part of the Joint Keeyask Development Agreement (JKDA). Please see the response to PUB/MH II-499b for more information.

SUBJECT: Socio-economic impacts: business opportunities

REFERENCE: MMF/MH 1-001a; MMF/MH 1-001b;

PREAMBLE: The text on p.23 (CAC/MH 1-231a) refers to concerns raised by the MMF regarding the difference in business opportunities between the KCNs and other Northern and Aboriginal groups and communities, to which Manitoba Hydro states that "The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding business opportunities are the subject of review in the environmental review process." The PUB process defers to the CEC process for socioeconomic assessment information, however, the Metis have not been identified as a distinct and separate group in the CEC process, and Metis-specific effects have not been identified and assessed as such.

QUESTION:

Please indicate the dollar amount of contracts in relation to the PDP that are anticipated to be filled by Northern and Aboriginal businesses other than the KCNs.

RESPONSE:

On the Keeyask project, all contracts not designated as Direct Negotiation Contracts with the KCNs will be procured through an open-tender–process and as such, it is not possible to estimate the dollar amount of contracts that may be filled by northern and Aboriginal businesses other than the KCNs. All northern and Aboriginal businesses, other than the KCNs, will have the opportunity to submit tenders on this work as well as sub contracting opportunities on a number of different contracts. The KCNs will have an opportunity to bid on subcontracting opportunities via the bid depository process as outlined in the Joint Keeyask Development Agreement.

Manitoba Hydro's Northern Purchase Policy encourages participation in business and employment opportunities for Aboriginal northern communities within the Northern Affairs boundary. Regarding the procurement process, Manitoba Hydro maintains a Vendor Database which is populated based on vendor input via Vendor Registration (see website http://www.hydro.mb.ca/selling_to_mh/vendor_information.shtml). Vendors are asked to self declare status of being a Northern Aboriginal Contractor. Definitions are:

i. Northern Aboriginal: A First Nations, Non-status Indian, Métis or Inuit person who has resided in Manitoba, north of the Northern Affairs Boundary, for a cumulative period of 5 years or more.

ii. Northern Aboriginal contractor: a Northern business (including Aboriginal Joint Venture, partnership or corporation) that is:

- at least 51 per cent owned and controlled by a Northern Aboriginal; and
- if the business has 6 or more full-time staff, at least one-third of them are Aboriginal people.

Project Development Agreements for Conawapa are currently under negotiation and dollar amounts are not yet determined.

SUBJECT: First Nations

REFERENCE: CAC/MH I-231a Page 23

PREAMBLE: "Although the Conawapa ownership structure is not yet finalized, Manitoba Hydro is committed to achieving long-term, sustainable benefits for First Nations in the vicinity of the project with a focus on income, training, employment and business opportunities. The broader regional communities will have access to project benefits, which may include some form of income sharing; these plans are still being developed."

QUESTION:

Please provide a breakdown and description of the $200 million in Northern First Nations business opportunities related to the Keeyask Infrastructure Project.

RESPONSE:

Article 13 and Schedule 13.1 of the Joint Keeyask Development Agreement (JKDA), which can be found on Manitoba Hydro's website, outlines the Directly Negotiated Contracts (DNC) that will be made available to the Keeyask Cree Nations (KCNs). It should be noted that the $200 million in DNCs with the KCNs referenced in the Socio-economic Comparison of Resource Options table in CAC/MH I-231a is a minimum aggregated value and includes DNCs related to both the Keeyask Infrastructure Project and the Keeyask Generation Project. The following table indicates the contracts that have been negotiated and those that remain to be negotiated.

Infrastructure or G.S.	DNC	KCN Allocation	Contract Negotiated
Both	Catering	FLCN[1] and YFFN[2]	Yes
Both	Camp Maintenance Services	CNP[3]	Yes
Both	Security Services	FLCN and YFFN	Yes
Both	Employee Retention and Support Services	FLCN and YFFN	Yes
Both	Emergency Medical Services	CNP	Yes
Infrastructure	Start-Up Camp Site Development and Install	CNP	Yes
Infrastructure	Work Areas Site Development	CNP	Yes
Infrastructure	North Access Road Construction	CNP	Yes
Infrastructure	Installation of Bridge Over Looking Back Creek	CNP	Yes
G.S.	Main Camp – Decommissioning	CNP	No
G.S.	South Access Road Construction	CNP	No
G.S.	Forebay Clearing	CNP	No
G.S.	Painting and Architectural Finish	CNP	No
G.S.	Rock and Unclassified Excavation[4]	CNP	No

[1] FLCN = Fox Lake Cree Nation

[2] YFFN = York Factory First Nation

[3] CNP = Cree Nation Partners

[4] Rock and unclassified excavation for channel improvements upstream of the Powerhouse

$390 million?

MR. ED WOJCZYNSKI: The -- there's -- first of all, Mr. Bowen will be in a better position to speak about the DNCs. The first -- the first interrogatory on 171 was referring to the -- what was in the JKDA. And -- and Mr. Bowen can speak more to the details of those if -- if you're -- that's what you want to talk about.

And then on the next one, the -- the question there was -- was, as I understand it, not -- not exactly the same question. This isn't necessarily just what was promised in the -- in the JKDA, but a more general one. But I think Mr. Bowen is in a better position to deal with those DNCs.

MR. BOB PETERS: Well, Mr. Bowen, since you're still near a microphone, your colleague, Mr. Wojczynski, has indicated that the -- the joint development on the Keeyask project had a commitment of $200 million that would be -- would be spent on directly negotiated contracts with First Nations.

Is that a correct understanding?

MR. DAVE BOWEN: Yes.

MR. BOB PETERS: And was that amount increased from 200 million up to 390 million?

MR. DAVE BOWEN: For the Keeyask

infrastructure project we -- the -- and on page 172, that provides a list of the -- the contracts in the infrastructure phase for -- for KIP and the generating station portion of the project.

MR. BOB PETERS: I'm sorry, I missed the -- the infrastructure. There's four (4) projects shown. What -- what do those relate to?

MR. DAVE BOWEN: So on page 172, on the left side, it says, the very top left corner, "Infrastructure or generating station." The -- the two (2) projects that it's referring to is -- is the infrastructure project, so the Keeyask Infrastructure Project. And the -- the GS, that's referring to the generating station, so that's the Keeyask generating station phase of the project.

The -- the -- this -- this excerpt is from the JKDA, and it lists the -- the planned direct negotiating contracts, which there was a $200 million commitment in the JKDA. The -- the $390 million that's referred to on the next page, on page -- or pardon me, on page 176, those contracts have not been all awarded to date, but they include -- for example, there's a catering contract, so there's catering required for both the infrastructure project and the generating station project.

So -- so if -- if we proceed with DNCs with that part of the -- wi -- with that contract, that's included in the $390 million. The same thing goes for the -- the camp maintenance services and the security service contracts and the employee retention and support service contract.

So if -- basically, prices have been negotiated for those contracts. If -- if the next part of the -- if we receive approval to proceed with the generating station, the -- the intent is to -- to go ahead with those contracts as direct negotiated contracts.

MR. BOB PETERS: And you're telling the -- this Board that the difference between the 200 million that's been itemized in Tab 42 to increase it to the 390 million referenced in Tab 43 on page 176 -- excuse me, those additions relate to catering, camp maintenance, security, and employee retention?

MR. DAVE BOWEN: Not exactly. What -- what I was trying to communicate was that in the JKDA Manitoba Hydro made a commitment of providing $200 million of directly negotiated contracts to the First Nations. To date, we -- we are -- we're currently projecting that there'll be approximately $390 million in contracts that will be directly negotiated.

TAB 7

ARTICLE 12

TRAINING AND EMPLOYMENT

12.1 PRE-PROJECT TRAINING

Training Initiative

12.1.1 The **Training Initiative** is aimed at facilitating the training of **Northern Aboriginals** to take advantage of employment opportunities generated by the **Keeyask Project** and the **Wuskwatim Project**.

Responsibility for Training Delivery

12.1.2 Each of the **Aboriginal Training Partners** is responsible for the design, delivery and implementation of community-based training to **Northern Aboriginals** in accordance with the proposal for the **Training Initiative** and in their respective **Contribution Sub-Agreements**.

Funding for the Training Initiative

12.1.3 Subject to the provisions of the **Contribution Agreements**, a number of parties agreed to contribute to the **Training Initiative Funds** in amounts not to exceed the following contributions:

(a)	Human Resources and Skills Development Canada	$22 million;
(b)	**Hydro**	$20 million;
(c)	**Manitoba**	$10 million;
(d)	Western Economic Diversification	$5.0 million;
(e)	Indian and Northern Affairs Canada	$3.3 million; and
(f)	**Aboriginal Training Partners** (in-kind)	$1.7 million.

Hydro Contribution

12.1.4 The contribution of **Hydro** to the **Training Initiative** set out in subsection 12.1.3 will form part of the **Pre-Closing Liabilities**.

Training Initiative Funds for the Keeyask Project

12.1.5 A total of up to forty-five million ($45,000,000) dollars of **Training Initiative Funds** has been allocated for pre-project training for **Members** and **Northern Aboriginals** (other than **Members**) for jobs on the **Keeyask Project** and the **Wuskwatim Project**, as follows:

(a) a total of up to seventy-five (75%) per cent of this amount, or thirty-three million, seven hundred and fifty thousand ($33,750,000) dollars, comprise the **KCN Training Funds**, available to the **Keeyask Cree Nations** for the pre-project training of **Members** in accordance with the **Contribution Agreements** or the **Keeyask Cree Nations'** respective **Contribution Sub-Agreements**, as the case may be; and

(b) a total of up to twenty-five (25%) per cent of this amount, or eleven million, two hundred and fifty thousand ($11,250,000) dollars, is available for the pre-project training of **Northern Aboriginals** other than **Members**.

Apportionment of KCN Training Funds

12.1.6 Pursuant to their respective **Contribution Sub-Agreements**, the **KCN Training Funds** have been apportioned among the **Keeyask Cree Nations** as follows**:**

(a)	**TCN**	$18.63 million;
(b)	**War Lake**	$1.62 million;
(c)	**York Factory**	$6.75 million; and
(d)	**Fox Lake**	$6.75 million.

Early Advances of KCN Training Funds

12.1.7 In order to provide funding for the pre-project training of **Members** prior to the establishment of the **Training Consortium**, **Hydro** provided the **Keeyask Cree Nations** with early advances of **KCN Training Funds** in the aggregate sum of three million, six hundred and twenty one thousand, one hundred and ninety-three ($3,621,193) dollars in respect of **CNP,** seven hundred and eight-five thousand, seven hundred **(**$785,700) dollars in respect of **Fox Lake** and six hundred and sixty-eight thousand, five hundred ($668,500) dollars in respect of **York Factory**. All such early contribution amounts are included within the amounts set out in subsection 12.1.6

Terms of Early Advances of KCN Training Funds

12.1.8 Under the terms of **Hydro's Contribution Agreement** with **WKTC**:

(a) all early advances of **KCN Training Funds** by **Hydro** are deemed to be contributions by **Hydro** to **WKTC**; and

(b) the **Early Contribution Agreements** are assigned by **Hydro** and each of **CNP** and **Fox Lake** to **WKTC** and are supplanted and replaced by the **Contribution Sub-Agreements** between each of the **Keeyask Cree Nation** and **WKTC**, such that the amount of such early contributions in respect of each **Keeyask Cree Nation** shall be governed by the terms of its **Contribution Sub-Agreement** with **WKTC**.

Identification of Training Opportunities

12.1.9 Under the terms of the **UMA**, **Manitoba** and **Hydro** each acknowledged that, in accordance with the terms of a funding proposal known as the "ASEP Proposal", they would, among other things, identify training and employment opportunities on existing and planned infrastructure or other projects of which trainees under the **Training Initiative** could take advantage.

No Additional Access to Training Initiative Funds

12.1.10 Access by the **Keeyask Cree Nations** or their respective **Members** to **Training Initiative Funds** shall be limited to the **KCN Training Funds**. None of **the Keeyask Cree Nations** or their respective **Members** will be entitled to access **Training Initiative Funds** allocated for pre-project training for members of **NCN** or for other **Northern Aboriginals** without first obtaining the consents of the contributors referred to in subsection 12.1.3.

Revenue Advances

12.1.11 Prior to the **Date of this JKDA**, **Hydro** provided each of **TCN**, **War Lake** and **Fox Lake** with **Revenue Advances** related to the funding of certain training activities, which were repayable to **Hydro**, together with interest. Each of **CNP** (on behalf of **TCN** and **War Lake**) and **Fox Lake** agrees to enter into, and agree to cause its **KCN Investment Entities** to enter into, its **Revenue Advance Agreement** set out in Schedules 12-1 and 12-2, as applicable, on the date it signs this **JKDA**.

SUBJECT: Socio-economic impacts: personal, family and community life

REFERENCE: MMF/MH 1-001a; MMF/MH 1-001b;

PREAMBLE: "Worker interaction with local residents" is listed under the "Personal, Family, and Community Life" component/topic of the "Socio-economic Comparison of Resource Options" table (CAC/MH 1-231a). The text on p.26 of 29 (CAC/MH 1-231a) describes measures to address adverse effects of worker interaction (i.e. camps, and committees established to address issues) yet concludes that "...some adverse effects are expected." There is concern that these effects will be greatest for current Northern and Aboriginal residents. It is presently not known whether construction schedules for Keeyask and Conawapa will overlap, but in the case that they do, it is anticipated that these effects will be of a greater magnitude. It is also understood that each project will undergo a separate environmental review process; however, there is an additional concern that these separate review processes will fail to consider the combined effects of the separate PDP components.

QUESTION:

Please estimate the combined effects of the Keeyask and Conawapa projects on "personal, family, and community life", particularly in terms of "worker interaction with local residents", and indicate the communities in which these effects are estimated to be greatest, and during which years of project construction.

RESPONSE:

The Cumulative Effects Assessment Summary for the Keeyask Generation Project Environmental Impact Statement sets out eight mitigation actions regarding public safety and worker interaction, including a series of strategies to keep workers at the camp, a multi-party committee to provide a coordinated approach to address issues across all Manitoba Hydro projects, and regular dialogue with the RCMP regarding policing matters. The cumulative effects summary concludes:

> There is a potential for adverse effects during the construction of the [Keeyask] project due to potential workers interactions. Future projects will further increase the number

of non-local, temporary construction workers in Gillam, increasing the potential for adverse effects. As many as 2,300 local and non-local workers will be required at the peak of the proposed Conawapa construction.

The residual adverse effects of the Keeyask Project on public safety and worker interaction may interact cumulatively with adverse effects of other projects and activities planned during the Keeyask construction phase. A collaborative and cooperative mitigation program is proposed to mitigate these potential effects.

SUBJECT: Macro-Economic

REFERENCE: PUB/MH I-92a

QUESTION:

Please provide a schedule on First Nation employment by community on the Keeyask construction project, showing actual and forecast employment through completion of the project.

RESPONSE:

Please see Table 1 below for actual Aboriginal employment by community for the Keeyask project up to September 30, 2013.

1 **TABLE 1**

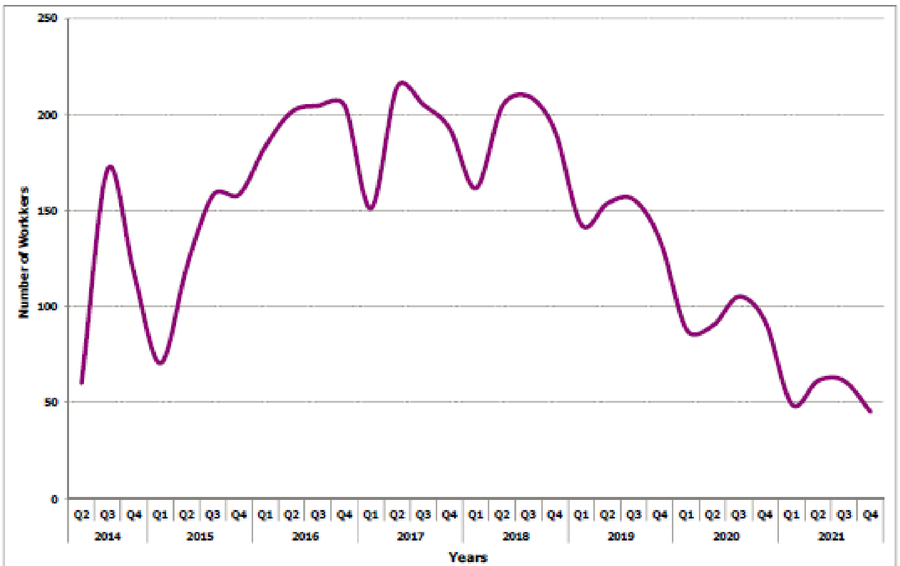
Aboriginal Community/Group	Hires	% of Total Project Hires
Barren Lands First Nation	12	1%
Bunibonibee (Oxford House) Cree Nation	6	0%
First Nation Located Outside of Manitoba	20	1%
Fisher River Cree First Nation	14	1%
Fox Lake Cree Nation	88	6%
God's Lake First Nation	5	0%
Mathias Colomb First Nation	11	1%
Métis	97	7%
Mosakahiken Cree Nation	9	1%
Nisichawayasihk Cree Nation	17	1%
Norway House Cree Nation	29	2%
Opaskwayak Cree Nation	21	1%
Peguis First Nation	12	1%
Pimickamak Cree Nation (Cross Lake)	31	2%
Pinaymootang First Nation	9	1%
Pine Creek First Nation	8	1%
Sapotaweyak Cree Nation	18	1%
Sayisi Dene First Nation	10	1%
Skownan First Nation	12	1%
Tataskweyak Cree Nation	396	28%
War Lake First Nation	48	3%
York Factory First Nation	75	5%
Other *(Communities/groups with less than 5 hires)**	*18*	1%
Aboriginal Hires	**966**	**68%**
Non-Aboriginal Hires	**463**	**32%**
Total Project Hires**	**1429**	

**18 hires are representative of 10 communities*

**The number of hires to date does not reflect the number of employees on site at a given time. The total number of employees is less than the number of hires because the same individual may have been hired more than once (i.e. an individual may have moved to work on a different contract or may be separated and rehired at a later date. Figures 3-28 and 3-20 illustrate the estimated number of employees, not hires on site on a quarterly basis.

2

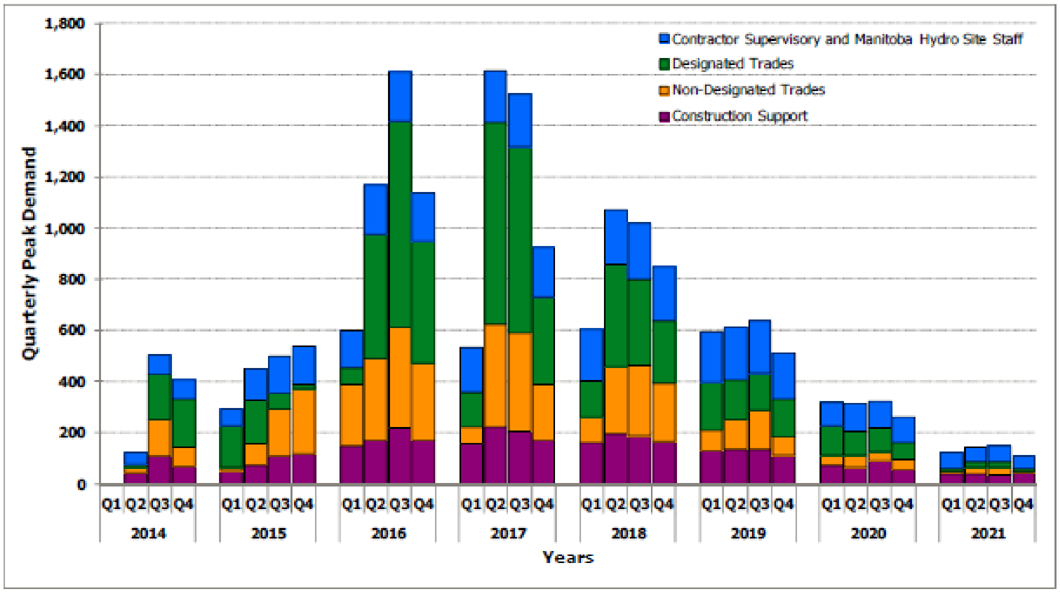
On the Keeyask Generation Project, participation by Aboriginal workers from the Regional Study Area as a whole was estimated to range between 13% (low estimate) and 40% (high estimate) of total Project construction employment, representing between 550 and 1,700 person-years of employment (see table 3-28 and 3-29 in Socio-economic Supporting Volume (SE SV) Section 3.4.1.7.2). See below Figure 3-28 (SE SV Section 3.4.1.7.2) for the estimated average Aboriginal employment from the regional study area.



Source: Analysis prepared by InterGroup Consultants Ltd.

Figure 3-28: Construction Phase Average Estimated Employment of the Regional Study Area Aboriginal Workforce in the Keeyask Generation Project

While an aggregate estimate can be made on Aboriginal employment on the Keeyask project, it is not possible to forecast Aboriginal employment by community. Hiring is governed by the Burntwood Nelson Agreement (BNA) which defines hiring preferences for the construction phase of the Project. Under the BNA, priority is given to qualified northern Aboriginals living within the Churchill/Burntwood/Nelson River region and surrounding areas as defined in the BNA. Figure 3-20 (below), from the SE SV Section 3.11.1.2.2, shows the estimated construction phase workforce requirements.



Source: Derived from data provided by Manitoba Hydro in 2010.

Figure 3-20: Construction Phase Estimated Workforce Requirements (Quarterly Peak) for the Keeyask Generation Project

TAB 8

Specifically, the MA-BCA assesses the preferred and alternative plans in terms of the following criteria or evaluation accounts:

Market Valuation

This account assesses the net benefit or cost of the preferred and alternative plans to Manitoba Hydro and its project partners. It analyzes the incremental revenues generated by the surplus electricity supply in the different plans, relative to the incremental capital and operating expenditures incurred. The present value difference between the incremental revenues and expenditures measures the net market value or cost of the investment in new electricity supply in each plan.

This market valuation account relies on the assessment of the economics of the different plans from a Manitoba Hydro perspective as presented in previous chapters. The same annual revenue and expenditure cash flows and residual asset values as estimated for the resource plan analysis are used here.

In this MA-BCA, however, the present values of the incremental revenues and expenditures are different. Present values are calculated here by applying a real discount rate that reflects the social opportunity cost of capital. A real rate of 6% is used, based on recent research on discounting in cost-benefit analysis.[7] In the previous resource planning economic analysis, a

[7] In their recent study, Burgess and Zerbe calculated a discount rate range of 6.6% to 7.3% real based on their estimates of the social opportunity cost of capital in the U.S. M. Moore *et. al.* argue that rate is too high, and estimate the social opportunity cost of capital to be 5% real. The 6% rate used in this study is roughly mid-point between these estimates. Also, the 6% rate is more consistent with a provincial Manitoba perspective than the somewhat higher rate that Burgess and Zerbe might suggest. The social opportunity cost of capital is calculated by weighting and then summing the cost of the different potential sources of capital: savings, borrowing from outside

somewhat lower discount rate was used to reflect the estimated weighted average cost of capital from a corporate perspective.[8]

Manitoba Hydro Customer

This account assesses the consequences of the different plans for Manitoba Hydro customers. It relies on the financial analysis in Chapter 11 that provides estimates of the rate increases in the short to medium and long term that would be required to recover net system costs and meet corporate financial targets. It also addresses the extent and significance of differences in the reliability of supply under abnormal weather, water condition and other contingencies because of the different mix of assets and interconnection capacity in the different plans.

To provide consistency in the assessment of rates in the preferred and alternative plans, revenue requirements were calculated to achieve common financial targets. The even annual rate increases required to achieve a 75:25 debt/equity ratio by the 20th year of the planning period were calculated for each plan. After year 20 the rates were adjusted each year to maintain an interest coverage ratio of 1.2.

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the jurisdiction, and displacement of other investment. The weights reflect the relative importance of each source. From a provincial perspective there will tend to be more outside borrowing than displacement of other investment within the provincial economy. The greater the weight of outside borrowing relative to displacement of other investment, the lower will be the discount rate. See D. Burgess and O. Zerbe, "Appropriate discounting for benefit-cost analysis", *Journal of Benefit-Cost Analysis*, 2(2), 2011 and M. Moore et al, "More appropriate discounting: the rate of social time preference and the value of the discount rate, *Journal of Benefit Cost Analysis*, 4(1), 2013.

[8] In Manitoba Hydro's financial analysis of rate impacts, a discount rate based on time preference is used. This time preference rate is lower than the social opportunity cost of capital used in this MA-BCA and Manitoba Hydro's weighted average cost of capital used for resource planning. The time preference rate is used in the rate analysis because the purpose of the discount rate in that analysis is simply to assign weights (discount factors) to present versus future rate impacts based on the trade-offs people would willingly make (e.g., as they do when they save, deferring present consumption for future consumption opportunities). It is important to note that in the financial analysis, the cost of capital is already reflected in the calculation of revenue requirements and rates; therefore it would in effect be double counting to apply a cost of capital-based discount rate.

Different Discount Rates for Different Perspectives

Perspective	Discount Rate	Discount Rate Value
Market Valuation Economics CH9-10,12,	WACC	5.05% (5.40% 2013) (Real)
	Low Case	3.35% (Real)
	High Case	6.5% (Real)
Social Benefit Cost Ch 13	Social Discount	6.0% (Real)
MH Customer (Cumulative present value of consumers general revenue) CH 11 & PUB/MH I-149a	Social Time Preference & Opportunity Cost of Capital	1.86% (Real)

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Mark A. Moore*, Anthony E. Boardman and Aidan R. Vining

More appropriate discounting: the rate of social time preference and the value of the social discount rate

Abstract: Recently, a number of authors, including Burgess and Zerbe, have recommended the use of a real social discount rate (SDR) in the range of 6–8% in benefit-cost analysis (BCA) of public projects. They derive this rate based on the social opportunity cost of capital (SOC) method. In contrast, this article argues that the correct method is to discount future impacts based on the rate of social time preference (STP). Flows in or out of private investment should be multiplied by the shadow price of capital (SPC). Using this method and employing recent United States data, we obtain an estimate of the rate of STP of 3.5% and an SPC of 2.2. We also re-estimate the SDR using the SOC method and conclude that, even if analysts continue to use this method, they should use a considerably lower rate of about 5%.

Keywords: benefit-cost analysis; social discount rate; social opportunity cost of capital; social time preference.

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1 Introduction

The choice of the real social discount rate (SDR) is one of the most important decisions in benefit-cost analysis (BCA). It is especially critical for projects that have high net costs in early years and high net benefits in later years. Recent publications (Burgess and Zerbe, 2011; Zerbe et al., 2010, 2011) argue that the SDR should be based on the social opportunity cost of capital (SOC) method and conclude that the value of the real SDR for the United States (US) should be about 7% with a range of 6–8%. Zerbe et al. (2010, 2011) is an important document because it aspires to provide "principles and standards" for the conduct of BCA. However, the section concerning the SDR is controversial. Indeed, Cole (2010), originally a member of the Scientific Committee reviewing these principles and standards notes that "not one of those three [commissioned white papers] supports the high discount rates recommended in Professor Zerbe's report." Perhaps partly as a result of such criticisms, this section of the report has been revised. However, the current version (Zerbe et al., 2011, p. 84) still concludes "we recommend discounting using the SOC approach (and thus using the 6–8% SDR rate…)."[1]

While Burgess and Zerbe (2011), Harberger (1972), Jenkins (1973), Zerbe et al. (2010, 2011) and some others continue to advocate the SOC method, many, if not most, economists argue that the appropriate way to discount the impacts of a public-sector project is to discount consumption or "consumption equivalents" using an SDR based on the rate of social time preference (STP). This approach goes back many years; key contributors include Eckstein (1958), Marglin (1963), Feldstein (1972), Bradford (1975) and Lind (1982).[2] Furthermore, over the last decade a number of governments have switched from using a SOC-based recommended value of the SDR to an STP-based value. In each country, this has resulted in a reduction in their recommended discount rates. For example, the UK lowered its recommended rate from 6% to 3.5% for most government projects in 2003, Germany lowered its recommended rate from 4% to 3% in 2004 (European Commission, 2008) and France lowered its recommended rate from 8% to 4% in 2005.

Surprisingly, in contrast to most other developed countries, there is neither a single overarching US federal recommended approach nor a single specified value for the SDR. (For a review of US federal discounting practices, see Boardman, Greenberg, Vining and Weimer, 2011, pp. 263–265.) Without a consistent and appropriate SDR approach, and without a consistent and appropriate value of the SDR, there is potential for a misallocation of resources across federally-funded projects.

In this article, we explain the STP approach and present new estimates of all significant parameters. Using the STP method and these new estimates, we derive a value of the SDR for the US of about 3.5%. Our discussion also facilitates sensitivity analysis of the key parameters.

A secondary purpose of this article is to show that, even if one uses the SOC method, the 7% rate proposed by Burgess and Zerbe (2011) is too high. Based on what we regard as better estimates of the returns used in the SOC method, we arrive at an estimate of the SDR of approximately 5%. One might ask why we make the effort to recalculate the SDR using the SOC method given that we do not think it

1 Zerbe et al. (2011, p. 84), accessed 29 August, 2012.
2 For a recent review and discussion in a BCA context see Boardman, Moore and Vining (2010).

is the best approach. Our rationale is purely pragmatic. Our estimate of approximately 5% for the SOC method is considerably lower than Burgess and Zerbe's 7% estimate and, obviously, quite a bit closer to our STP-based recommended rate of 3.5%. Given that most government-based and academic BCA practitioners (quite reasonably) use one of the recommended rates, closeness matters, just as in horseshoes (e.g., Belfield, Nores, Barnett and Schweinhart, 2006; Rothstein and Rouse, 2011).

The outline of this article is as follows. Section 2 explains and justifies the STP method. Section 3 estimates parameters for the STP method based on comprehensive US data (mostly based on the 1947–2011 period) and derives our recommended value of the SDR. Section 4 explains and critiques the SOC method, and presents new and more appropriate estimates of the key SOC parameters based on US financial market data. Section 5 briefly discusses how to discount very long-term, inter-generational projects. Section 6 concludes the article.

2 The STP method

The STP method is based on the idea that the fundamental goal in welfare economics is to maximize the utility (or "happiness") of society (or of a representative individual), where utility depends on per capita consumption in present and future time periods. Consumption includes all goods and services, both private and public. Thus, it includes non-market goods, such as a hike in a national park, as well as market goods, such as a restaurant meal. Future consumption can be increased at the expense of current consumption, either through savings that lead to investment in human or physical capital, or in the generation of new ideas.

Given that society's well-being is a function of consumption, the SDR should reflect the weights that society puts on present and future consumption flows. In order to derive these weights, starting with Ramsey (1928), numerous economists (for example, Marglin, 1963; Mirrlees and Stern, 1972; Cline, 1992; Arrow, 1995; and Stern, 2007) have postulated that policy makers should act as though they are maximizing a social welfare function that equals the present (discounted) value of current and future utilities from consumption:

$$\int_0^{\infty} e^{-\rho t} U(c_t)\,dt \tag{1}$$

Here, $U(c_t)$ is the utility that society (or a representative individual) derives from public and private per-capita consumption during period t, $e^{-\rho t}$ is the discount factor (or weight) that applies to the *incremental utility* from more consumption in period t, e is the exponential function and ρ is the rate at which future utility is discounted. ρ reflects impatience. It is the rate of decrease in the utility of incremental consumption just because it is in the future, sometimes called the pure rate of time preference. It is normally assumed to be constant over time.

To determine the discount *rate* that society should apply to *incremental consumption*, we first compute the discount *factor* that society should apply to incremental consumption, given the objective is to maximize equation (1). Let *W* denote the integrand in equation (1), then the derivative of *W* with respect to consumption in period t can be interpreted as the social present value of more consumption in period t. It is the discount factor that society should apply to incremental consumption in period t.[3] The social discount *rate* equals the proportionate rate of decrease in this discount factor over time, which can be shown to equal:[4]

$$r = \rho + g\varepsilon \tag{2}$$

where, g is the percentage change in per capita consumption and ε is the absolute value of the elasticity of the marginal utility of consumption with respect to consumption.

In principle, ρ, g or ε could vary over time periods. However, we will assume that they are constant and, therefore, r is constant, at least within a generation. We refer to r as the *rate* of STP. It is the rate at which consumption should be discounted in order for society to maximize the present value of utility from its current and future per capita consumption flows. If investment continued until the real return to investment were equal to this rate, society would achieve the optimal growth rate of consumption. For this reason, this method of deriving the SDR is sometimes referred to as the “optimal growth rate model”.

3 The discount factor that society should apply to consumption in period t is given by $\frac{dW}{dc_t} = U'(c_t)e^{-\rho t}$. It equals the product of $U'(c_t)$, the derivative of $U(c_t)$ with respect to c_t, which is the marginal utility of consumption, and the discount factor for utility of consumption, $e^{-\rho t}$.

4 Given that $\frac{d\left(\frac{dW}{dc}\right)}{dt} = U''\frac{dc}{dt}e^{-\rho t} + U'e^{-\rho t}(-\rho) < 0$, then the rate of change of the absolute value of the discount factor, which equals $-\frac{d\left(\frac{dW}{dc}\right)}{dt}$ divided by $\frac{dW}{dc}$, is $\rho + g\varepsilon$, where, $g = \frac{dc/dt}{c}$, is the rate of change in per capita consumption, and $\varepsilon = -\frac{dU'}{dc}\frac{c}{U'}$, which is the absolute value of the elasticity of the marginal utility of consumption with respect to consumption. We drop the time subscript on c for simplicity.

The second term in equation (2) incorporates the idea that society prefers more equality in per capita consumption over time than would otherwise occur (i.e., consumption smoothing), given that consumption will be higher in the future due to economic growth. It is the product of two parameters: g, the future growth rate of per capita consumption, and ε, the percentage reduction in the marginal utility of per capita consumption as per capita consumption increases by 1% (i.e., the absolute value of the elasticity of the marginal utility of per capita consumption). If the growth rate in consumption is higher, or if society has more preference for reducing inequality over time, then the rate of STP will be higher.

The parameter ε is a measure of society's preference for reducing inequality in per capita consumption over time. Its value could be anywhere between zero and infinity. In principle, it could vary with the level of consumption, but it is usually treated as constant. If ρ were zero (no preference for present over future happiness) and ε were zero, then society would value each unit of consumption received in the future as equal to the value of a unit of consumption in the present, thus reflecting a complete lack of concern for temporal inequality in consumption. In contrast, as ε approaches infinity, society would completely discount each unit of consumption received in the (richer) future, reflecting an overwhelming desire to equalize per capita consumption over time. When ε equals one, the marginal utility of society's per capita consumption in each time period is equal to the inverse of its per capita consumption.[5]

Some public projects displace some private investments that would yield higher returns than r and, therefore, would result in higher increases in future consumption. In order to ensure that society is better off through a public sector investment, increases or decreases in private-sector investment should be converted into consumption equivalents by multiplying them by the shadow price of capital (SPC) prior to discounting.

In order to calculate the SPC, suppose that a private sector investment of \$1 yields a return on investment, which is net of depreciation, of ROI. Further suppose that f is the fraction of this return that is reinvested, while the fraction $1–f$ is consumed. In the next period, \$(1+fROI) is invested which yields a return of ROI(1+fROI). Again suppose that fraction f of this return is reinvested and $1–f$ is consumed. If this process is repeated it yields a consumption stream of: $(1–f)$

5 If $U(c)=\ln(c)$, then $U'=1/c$ and $\varepsilon=1$. In this case, the marginal utility of consumption equals the inverse of per capita consumption. Therefore, a 10% reduction in the per capita consumption of the current generation (for example, from \$50,000 to \$45,000) is equivalent to a 10% reduction in the per capita consumption of a richer future generation (for example, from \$100,000 to \$90,000).

ROI, (1–f)ROI(1+f)ROI, (1–f)ROI[(1+f)ROI]^2,.... The SPC is the present value of this consumption stream discounted at the SDR and is denoted s:[6]

$$s = \frac{(1-f)ROI}{r - f\,ROI} \tag{3}$$

Admittedly, this is a simple model because individuals do not always save a constant fraction of their returns. However, it does not require strong assumptions about the ability of private agents to foresee the impacts of government policy and to adjust their savings and consumption accordingly. Furthermore, as we argue later, shadow pricing is rarely necessary in practice.

3 Estimating the STP and the SPC

3.1 The value of the rate of STP

The values of ρ, g and ε can be derived in a number of ways. Consider first ρ, the pure rate of time preference. For intra-generational project evaluation, there is little disagreement that ρ should be positive for two major reasons. One is that people are impatient and, even if they thought they would live forever, they would rather consume sooner than later. A second is that they will not live forever and, therefore, would rather consumer sooner than later because they may not be here later.[7] For inter-generational projects, there has been considerable debate about the value of ρ since Ramsey (1928, p. 543). He argues that it is "ethically indefensible" to use a positive value, as this devalues future generations' utility relative to that of the present generation. However, Arrow (1995) shows that if ρ were equal to zero – weighting all generations' welfare equally – extremely high rates of savings would be required in every time period. For example, using our best estimate for ε of 1.35 (discussed below), setting ρ equal to zero in a simple model of economic growth would imply a savings-to-income ratio of nearly 75%. It seems unreasonable for the current, lower-consuming individuals to save such high amounts. Furthermore, one does not observe anything close to these rates of

6 We would like to thank an anonymous referee for pointing out an error in this formula in a draft of this article.

7 Such considerations have led Kula (1984) and the European Commission (2008) to suggest that ρ can be inferred from the population's annual death rate, which is an estimate of a representative individual's instantaneous probability of death. While this might make sense for individuals who discount the future since they may not be around to enjoy it, it is not compelling from a societal perspective.

saving. Arrow, therefore, suggests ρ should be around 1%. Given the above logic and the absence of plausible alternatives, we use a value of 1% for ρ.

The future growth rate of per capita consumption, g, can be derived by extrapolating past growth rates. Many researchers currently propose 2% as an approximate estimate for the future growth rate in per capita consumption in the US (Prescott, 2002; Evans and Sezer, 2004; Moore, Boardman, Vining, Weimer and Greenberg, 2004; Nordhaus, 2007; Weitzman, 2007) although other authors propose lower rates for the US and for other countries. Our predicted growth rate is derived from Shiller's (2005) data on US real per capita consumption. This data series is updated on his website to 2009.[8] While the annual growth rate averaged approximately 2.2% over 1947–2009, it has been trending down.[9] For the most recent decade for which data are available (1999–2009), it averaged only 1.63% per annum. Recent growth rates have been even lower. There are several explanations for this lower growth rate, including the combination of government and consumer debt (Reinhart and Rogoff, 2009; Checherita and Rother, 2010). Pessimistically, Gordon (2012) presents several reasons why the US growth rate might fall further in the future. While we think (and hope) that the long-term future growth rate will exceed 1.63% due to technological progress, we do not expect it to revert to the post-war average of 2.2%, and use 1.9% (the average of 2.2% and 1.6%) as our estimate of future growth in consumption per capita.

One way to obtain a value for ε, the absolute value of the elasticity of the marginal utility of consumption, is to base it on observations of individual behavior. Doing so, Arrow et al. (1996) argue that ε is between 1 and 2 for individuals. Evans and Sezer (2004) use an alternative approach based on society's revealed preference for reducing inequality. They infer ε from the progressivity built into the federal income tax schedule and calculate values for ε of 1.43 for the US using OECD tax data.[10] Evans (2005) uses US data on federal tax rates and calculates ε as 1.15 for low-income earners, 1.45 for high-income earners and uses 1.35 overall. We adopt this approach and use new OECD (2010) tax data for the US that combines federal and local taxes for the wage income of a single, full-time employee, including social security contributions. We calculate ε annually for 2000–2010 at 0.67, 1.00 and 1.67 of the average production wage. Averaging over these three wage levels and these 11 years, we estimate that ε equals 1.38. For the average pro-

8 Data source: http://www.econ.yale.edu/~shiller/data/chapt26.xls (accessed June 30, 2011).
9 We computed this average in two ways. One method regresses the natural logarithm of real per capita consumption on time and the other computes the average annual growth rate based on the per capita consumption in 1947 and 2009.
10 Evans and Sezer (2004) assume an iso-elastic utility function and that tax rates are set such that each tax payer sacrifices an equal absolute amount of utility. Based on this model, they infer that $e=\ln(1-t)/\ln(1-T/Y)$, where t=marginal tax rate and T/Y=average tax rate.

duction wage during this period, ε averaged 1.30, although it has been trending up and the most recent estimate is 1.34. We use 1.35 as our estimate.

Using g=1.9%, ε=1.35, and ρ=1% implies that r equals 3.565%, which we round to 3.5%. Sensitivity analysis with ε ranging between 1 and 2 and with g varying between 1.6% and 2.2% suggests r ranges between 2.6% and 5.4%. Thus, we recommend using a value of 3.5% for the SDR with sensitivity analysis at 2.6% and 5.4%.

3.2 The value of the SPC

Estimation of the SPC requires an estimate of the value for the SDR, r, an estimate of the ROI, and of the proportion of this return that is reinvested, f. We discuss these parameters in turn and then derive the SPC.

A profit-maximizing firm will not make an investment unless the expected net present value is positive. This decision normally requires the expected after-tax nominal ROI to be greater than or equal to the nominal weighted average cost of capital (WACC).[11] Thus, the nominal WACC provides a means of estimating the nominal marginal ROI. To estimate the nominal WACC, one needs estimates of the nominal cost of equity, the nominal cost of corporate debt, the marginal corporate tax rate, and the proportion of debt and equity to assets. The real ROI can then be computed from the nominal WACC using estimates of inflation and the corporate tax rate.[12]

Using Shiller's (2005) data, we calculate that the geometric average of the nominal annual return on equity was 10.38% for the post-war period.[13] We calculate that the geometric average nominal annual return on long-term (20–30 year) AAA corporate bonds during this period was 6.43% per annum.[14] We obtained the proportions of equity to assets and debt to assets from the Wharton Research Data Services (WRDS) database. We sampled all active US corporations (n=4459) with book values of assets greater than $100 million that reported their results in US

11 That is, $(1-t)\geq WACC$, where the weighted average cost of capital is computed as: $WACC=w_e k^e+w_d(1-t)k^d$, where, k^e is the cost of equity, k^d is the cost of debt, w_e is the proportion of equity, w_d is the proportion of debt, and t is the corporate tax rate.

12 That is, $real\,ROI=\left(\frac{nominal\,WACC}{1-t}-i\right)/(1+i)$, where i is the actual rate of inflation.

13 This estimate measures total returns to the S&P 500, that is, dividends plus capital appreciation from 31 Dec 1947 to 31 Dec 2010. The returns are lower in more recent time periods. For example, the average return is 9.11% for 1987–2011, and only 1.17% for the most recent decade.

14 Federal Reserve Bank of St. Louis Economic Research (FRED) using Moody's "Seasoned Aaa" corporate bonds (AAA) for 1948–2011, available at http://research.stlouisfed.org/fred2/data/AAA.txt (accessed July 26, 2011).

dollars for the 2010 fiscal year. We compute the debt to assets ratio by dividing the book value of total long-run liabilities for all corporations by total long-run liabilities plus the book value of owners' equity. This ratio equals 56%. Using Chen and Mintz's (2011) effective marginal US corporate tax rate of 34.6% yields a nominal WACC equal to 6.92% and marginal nominal ROI of 10.58%. Finally, converting this return to a real rate using the geometric average of the actual inflation rate of 3.55% during this period[15] yields a real marginal ROI equal to 6.79%.[16]

The gross investment rate provides a rough estimate of f, the fraction of the return that is reinvested. Using data from the Federal Reserve Bank of St. Louis Economic Research database (FRED), we calculate that the average ratio of real gross private domestic investment to real GDP for 1947–2011 is 12.8%.[17]

We can now determine the SPC for the US using equation (3). The computed value of the SDR, r, equals 3.565%; the pre-tax marginal return on investment, ROI, equals 6.79%; and the reinvestment rate, f, equals 12.8%, which yields a measure of the SPC, s, equal to 2.2. This implies that one dollar of private sector investment would produce a stream of consumption benefits with a present value (PV) equal to $2.2. For sensitivity analysis, if the SDR equals 2.6%, then the SPC equals 3.42, and if the SDR equals 5.4%, then the SPC equals 1.31.

4 The SOC method

Many BCA analysts appear to acknowledge that in principle the STP method is preferable to the SOC method. However, some may still favor the SOC method because it does not require the shadow pricing of investment (e.g., Burgess and Zerbe, 2011). Here we briefly describe the SOC method and then we compare and contrast it with the STP method.

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15 Federal Reserve Bank of St. Louis Economic Research (FRED) using Consumer Price Index for All Urban Consumers: All Items for 1947–2011, available at: http://research.stlouisfed.org/fred2/data/CPIAUCSL.txt (accessed July 27, 2011).

16 This estimate is consistent with previous estimates of the pre-tax ROI in the US, which range between 5% and 8% (Cline, 1992; Nordhaus, 1999; Portney and Weyant, 1999). Nonetheless, we should point out that our estimate is sensitive to the tax rate and the debt to assets ratio. Damodaran computes the actual average US corporate tax rate (by dividing taxes paid for 5891 firms by the taxable income as reported to shareholders) as 15.48% (See "Cost of Capital by Sector" on http://pages.stern.nyu.edu/~adamodar/, accessed 28 August 2012). Using this lower tax rate, results in a much lower ROI of 5.27%. The estimated ROI increases as the debt to assets ratio decreases and vice versa.

17 See FRED: www.research.stlouisfed.org/fred2/categories/106 (for GDP) and www.research.stlouisfed.org/fred2/categories/112 (for investment), accessed July 28, 2011.

The SOC method assumes that the marginal source of funds for any government project is from borrowing in the capital market. When government adds to the demand for loanable funds, it increases the interest rate, which will displace private sector investment and personal consumption and, in an open economy, will increase foreign lending. Thus, the SOC method computes the SDR as a weighted average of the opportunity costs of these funds: the real, marginal before-tax return on displaced private-sector investment (ROI); the real, after-tax return to saving (CRI); and the real marginal cost of incremental foreign borrowing (FB):

$$SDR = \alpha ROI + \beta CRI + \gamma FB \tag{4}$$

where, α, β and γ denote the proportion of funds from displaced private sector investment, from forgone consumption, and from foreign borrowing, respectively.

We argued above that the STP method is the conceptually correct approach for discounting government projects. The SDR should reflect the rate at which society should trade-off consumption in one period versus another. As we explained above, the STP method correctly accounts for displaced private investment by shadow pricing. Instead, the SOC method tries to account for displaced private sector investment by adjusting the discount rate, with a high weight placed on the ROI. Since both methods appear to take into account displaced investment, one might suppose that they would result in the same government investment decisions. But this is not the case except under very restrictive assumptions (Spackman, 2004).

As discussed above, a central assumption of the SOC method is that each and every government project should be evaluated as if it were funded by borrowing. If this were the case then government debt would quickly become unsustainable with either observed or plausible growth rates. While the government debt as a share of GDP has increased at times, especially during wars, it has (thus far) returned to a manageable level. In fact, the government share of GDP has stayed fairly consistently between 20 around 25%, except for periods of war.[18] Although government debt has been increasing recently, both major political parties seem to agree that something has to be done about the level of government debt as a percentage of GDP. Government borrowing (as a percentage of GDP) cannot increase indefinitely. A more realistic assumption is that increased government spending is funded by increased taxes. While some projects at the margin might

18 Based on Federal Reserve Bank of St. Louis Economic Research (FRED) Real Government Consumption Expenditures and Gross Investment, available at http://research.stlouisfed.org/fred2/categories/107 and Real GDP, available at www.research.stlouisfed.org/fred2/categories/106 (accessed August 23, 2012).

be financed by debt, all projects are *ultimately* funded by taxes. Furthermore, taxes primarily reduce current consumption rather than private investment for the simple reason that consumption is much larger than investment (typically five times as large) and, therefore, taxes on investment cannot yield as much as taxes on consumption.

A further implication of the assumption that government projects are funded mainly by taxes is that, if one uses the STP method, there is little need to shadow price private-sector investment. Under these circumstances discounting becomes easy: analysts should simply discount using the rate of STP. In fact, one would also not have to shadow price if all costs and benefits are government expenditures and revenues. The same shadow price would apply to all quantities being discounted, which would only affect the magnitude and not the sign of the net present value.

To recap, the STP method argues that the SDR should reflect society's preferences for future versus present consumption. Using this method one might decide to pursue a particular government project because it yielded a higher return than the rate of STP. But, advocates of the SOC method might argue that if there were a private sector project that would yield an even higher rate of return then it would be a potential Pareto improvement to do that project instead. However, as Bradford (1975) points out, this is not the relevant comparison because, for practical purposes, government does not have the option of investing in the private sector. In practice, government has the choice between investing in a government project and funding it by taxes or not doing the project and not raising taxes. Implicitly, the SOC method assumes that the government can do the project and issue debt to finance it or it can choose not to do the project and not to raise debt. Thus, they might conclude that the government project is not worth doing because it crowds out higher-yielding private investments. However, as we discussed above, government projects are ultimately tax funded. In response, SOC advocates might argue that if the project were tax funded, then the government has a choice of either doing the project or using the taxes to pay down the debt. In our view, governments make decisions about the debt level first and subsequently decide whether or not to do various projects that are financed through taxes.

Another important issue concerns the use of market rates of return. In a world with perfectly rational agents and perfect markets, rates of return on investments, borrowing rates, lending rates and the SDR would all be equal. Even though markets are not perfect, market rates are still a potential source for the SDR. Indeed the SOC method computes the ROI, CRI and FB using market rates of return. This is particularly problematic for the CRI, which measures after-tax returns to savers, because there is abundant evidence that individuals do not make rational borrowing and lending choices over time (Frederick, Loewenstein and O'Donoghue, 2002). The myriad number of market returns on borrowing and savings, which reflect often inconsistent individual borrowing and lending behaviors, do not provide a satisfactory estimate of a single CRI.

Despite our criticisms of the SOC method, some analysts may continue to use it. In our view, Burgess and Zerbe (2011) overestimate the SOC. As discussed above, our best estimate for the ROI is 6.79%. Using the average real, expected after-tax return to 10 year US Treasury bonds from 1953 to 2011 as a measure of the real, after-tax return to savers, we estimate the CRI as 1.19%.[19] Finally, we measure the real marginal cost of foreign borrowing, FB, by the real, expected pre-tax return on 10 year Treasury bonds, which averaged 2.59% from 1953 to 2011. Using Burgess and Zerbe's weights, this yields an estimate for the SOC of 4.72%, or approximately 5%.

5 Intergenerational projects

Recently, there has been considerable attention on the discounting of projects with long-term impacts, such as climate change (Stern, 2007; symposium in the *University of Chicago Law Review Winter* 2007). Weitzman (2001), Cropper (2012) and Gollier, Koundouri and Pantelidis (2008) discuss the reasons why analysts might want to use time-declining discount rates. Many scholars and practitioners, including HM Treasury (2003) and the European Commission (2008), now accept Weitzman's (2001) argument that uncertainty about the future values of the parameters underlying the SDR implies a time-declining schedule of SDRs with only the lowest possible rates applying in the very long term.

In contrast to the growing acceptance of the use of time-declining rates for very long-term discounting, the earlier version of the "principles and standards" asserts: "[h]yperbolic [i.e., time-declining] rates are inconsistent with the SOC recommended rate, and thus are not recommended" (Zerbe et al., 2010, p. 76).

19 Federal Reserve Bank of St. Louis Economic Research (FRED) using 10 year constant maturity US Treasury Bond rates for 1953–2011, available at http://research.stlouisfed.org/fred2/data/GS10.txt (accessed July 26, 2011). The nominal, pre-tax average monthly yields on bonds are converted to real, after-tax rates by adjusting for taxes and inflation. Shoven and Topper (1992) calculate that the personal tax rate on savings is 30%, which we use in our calculations. To measure the rate of inflation that consumer/savers expected, we use the implicit forecasts of 1-year ahead expected inflation from the Federal Reserve Bank of Philadelphia Livingston survey, http://www.philadelphiafed.org/research-and-data/real-time-center/livingston-survey/, accessed July 24, 2011. For details on our procedure, see Moore et al. (2004, pp. 800–801).

It recommends a constant, non-zero discount rate, apparently on the basis that the use of time-declining discount rates would result in time inconsistent social choices: choices that might be changed simply because of the passage of time. However, time-declining rates result from uncertainty about the future rather than from inconsistent preferences (Hepburn and Koundouri, 2007). If choice reversals occur, it will be because of resolution of this uncertainty. Zerbe et al. (2011) appear less dogmatic on this question, but do not explicitly recommend any procedure. In our view uncertainty about the future does justify the use of time declining rates.[20]

6 Conclusion

Burgess and Zerbe (2011) and Zerbe et al. (2010, 2011) argue that the correct approach is to discount future impacts using the SOC method and suggest a value of the SOC of about 7%. In contrast, this article argues that the correct approach is to discount future impacts based on the STP method and suggests a discount rate of about 3.5%. Flows in or out of private investment should be shadow-priced at about 2.2.

There are two fundamental differences between the two methods. The first difference concerns the source of funding of the government project. The STP method presumes that taxes are the ultimate source of funding for any project. In contrast, the SOC method treats all government projects as debt-financed. We think that the former assumption is more realistic because governments tend to make decisions about the overall debt level before they consider whether or not to do specific projects. The second difference between the two approaches concerns the relevant alternative to the government project. The STP method compares the effect on an explicit measure of social welfare of a tax-financed government project with the counterfactual of no project (with no increase in taxes). In contrast, the SOC method implicitly assumes that the government raises a certain amount of taxes and then either uses these funds to pay for the project or to reduce the government debt. It does not seem sensible to evaluate government projects under the assumption that the counterfactual to the tax-financed project is to raise an equivalent amount of taxes, pay down the government debt by this amount, and therefore to crowd in an equivalent amount of private investment.

20 For a schedule of US-derived declining rates, which are based on Newell and Pizer (2003), see Moore et al. (2004).

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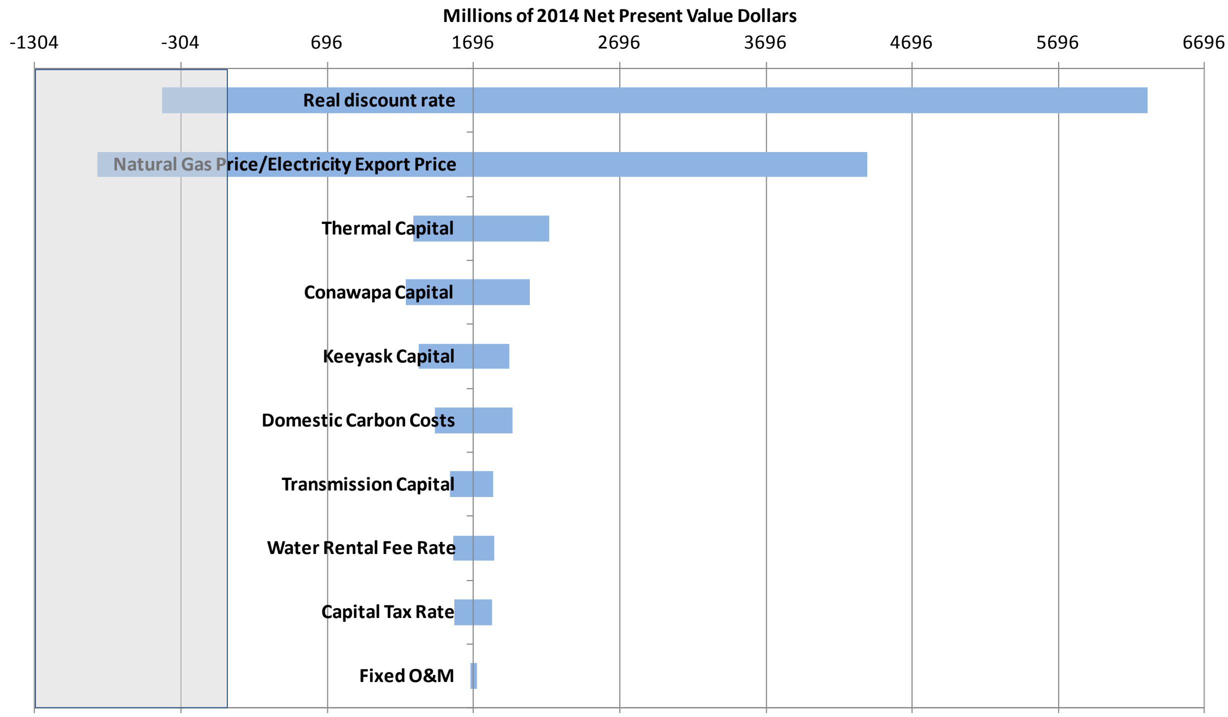
Figure 10.1 Tornado Diagram of Highest Impact Factors



10.1.1.2 Combinations of Highest Impact Factors

The high impact factors are grouped into three sets: Energy Prices, Capital Costs and Economic Indicators.

Energy Price factors consist of natural gas, electricity and carbon prices. Electricity export prices are a key factor in evaluating Manitoba Hydro's development plans. As described in ***Chapter 3 – Trends and Factors Influencing North American Electricity Supply***, natural gas is a significant factor in the determination of electricity prices in the North American market. The effect of natural gas prices on electricity export prices is embedded in Energy Prices as is the effect of carbon. Carbon prices are reflected in Energy Prices from two perspectives. One is the impact of carbon policy on electricity export prices in the Midcontinent Independent System Operator, Inc. (MISO) market and the other is the impact of a potential carbon adder on Manitoba based fossil fuel-fired generation.

social opportunity cost of capital to be in the order of 4.5 per cent.[6] However, that rate does not include any premium for risk, an important component of the return on equity investment, nor does it include any provision for tax or other social benefits that private sector investments can provide.

In a 2007 update of his earlier work, Jenkins and colleague C. Kuo estimated that the social opportunity cost of capital has ranged between 10 and 14 per cent over the past fifty years. They concluded that a reasonable value to use would still be 11.5 per cent.[7]

Although there is a wide range in estimates of the social opportunity cost of capital, it is generally agreed that whatever the precise rate is, it is significantly higher than the time preference rate. Moore et al.'s 4.5 per cent estimate of the social opportunity cost of capital, for example, is three times greater than their 1.5 per cent estimate of the time preference rate. Jenkins and Kuo's 11.5 per cent estimate of the social opportunity cost of capital is also roughly three times their 4.0 per cent estimate of the time preference rate. The U.S. OMB's 7 per cent estimate of the social opportunity cost of capital is more than double their 3.1 per cent estimate for the time preference rate.

There are two reasons for this marked difference in rates. First, the social opportunity cost of capital is based on pre-tax rates of return, whereas the time preference rate is measured by after-tax interest rates. Taxes on the return on investment create a wedge between the social opportunity cost of capital and the time preference rate. Second, the rate of return on investment includes some compensation for risk. The average premium that investors require to compensate for risk creates a further wedge between the time preference and social opportunity cost rates.[8]

If one were estimating the social opportunity cost of capital by the rate of return that could be earned on risk-free investments (for example, secure government bonds), then there would not be this additional wedge between the time preference rate and the social opportunity cost of capital. However, it is more common to include the average premium required to compensate for risk as part of the social opportunity cost of capital. It is part of the return that would in fact be earned.

Time Preference versus the Social Opportunity Cost of Capital

Time preference and the social opportunity cost of capital are both important and valid reasons for discounting, but they imply using quite different discount rates. This creates a problem because the different

Table 6.2
Net benefits at time preference rate vs social opportunity cost rate (*millions of dollars*)

	Time preference rate (4%)	**Social opportunity cost (11.5%)**
Present value benefit	13.5	6.7
Present value cost	10.0	10.0
Net present value	3.5	-3.3

rates can generate significantly different results, as the following simple example shows.

Suppose a $10 million maintenance project would eliminate the need for $20 million in major refurbishment expenditures in ten years' time. For illustrative purposes, assume the time preference rate is 4 per cent and the social opportunity cost of capital is 11.5 per cent.

As shown in table 6.2, the present value cost of the project, occurring in year zero, would be $10 million for both the time preference and the social opportunity cost rate. (The discount factor in year zero, $[1/(1+r)]^0$, is one, regardless of the discount rate.) However, the present value of the benefit – the $20 million avoided cost in ten years' time – would be quite different depending on the discount rate. At a 4 per cent time preference rate, the present value of the benefit would be approximately $13.5 million. At an 11.5 per cent social opportunity cost of capital, the present value of the benefit would be only $6.7 million.

In terms of people's time preference, the maintenance project appears to offer positive net benefits. The $13.5 million present value of the benefit in ten years' time is $3.5 million more than the initial $10 million cost. In terms of the social opportunity cost of capital, however, the project appears to result in a net loss. At $6.7 million, the present value of the benefit is $3.3 million less than the initial cost.

The result with the time preference rate indicates that the future benefits are valued more than is the initial cost, based on the trade-off that people are willing to make between present and future consumption. The result with the social opportunity cost of capital indicates that people could have had even greater benefit if the $10 million initial cost were invested elsewhere. At an 11.5 per cent rate of return, the initial $10 million could have yielded almost $29.7 million of benefits in ten years' time, or $9.7 million more than the benefits from the maintenance project. That is why the maintenance project appears to generate a net loss when one discounts at the social opportunity cost rate.

The issue therefore arises about which basis for discounting one should use – the rate at which people are willing to trade off present for future consumption opportunities or the rate at which consumption opportunities can grow through investment. U.S. government guidelines call for both to be used – a base case 7 per cent, representing the social opportunity cost of capital, and sensitivity results at 3 per cent to reflect the time preference rate. If the project or policy is expected to displace corporate business investment, then sensitivity at a higher than 7 per cent opportunity-cost-of-capital rate is called for, reflecting the forgone rate of return in that sector.[9]

The problem with using such a wide range of discount rates is that they can provide quite different results, as the simple example above illustrates. To settle on a single rate or discounting procedure, the two main alternatives are to apply either a **weighted average social opportunity cost of capital** or a hybrid shadow pricing approach in which a time preference rate is used to discount the potential consumption opportunities created or forgone by alternative projects.

Weighted Average Social Opportunity Cost of Capital

Applying a weighted average social opportunity cost of capital is a standard approach in benefit-cost analysis. The weighted average rate is based on estimates of how the economy would respond to a hypothetical increase in the demand for capital required for any given project. More specifically, it is a discount rate that reflects the extent to which an increase in the demand for capital would be met by an increase in saving (the deferral of current consumption) as opposed to the crowding out (displacement) of other investments.

The opportunity cost of saving is measured by the trade-off that people would willingly make between present and future consumption – the time preference rate. The opportunity cost of displacing other investment is measured by the rate of return that is forgone – the social opportunity cost of capital. The overall cost and therefore rate at which future benefits should be discounted is the weighted average, that is, the proportion of capital that is met by increased saving, times the time preference rate, plus the proportion of capital that is met by displacing other investment, times the social opportunity cost of capital.

$$r = a_1{*}r_s + a_2{*}r_I$$

Where:
r is the weighted average social opportunity cost of capital,
r_s is the time preference rate,
r_I is the social opportunity cost of capital,
a_1 is the proportion of capital that is met by increased saving,
a_2 is the proportion of capital that is met by displacing other investment, and
$a_1 + a_2 = 1$.

This formulation of the weighted average social opportunity cost of capital assumes that there are only two ways by which an increase in the demand for capital can be met – an increase in savings or the displacement of other investment. In an open economy or from the perspective of smaller jurisdictions within larger economies, there is a third source. An increase in the demand for capital can be met by inflows of capital to the country or the region from foreign or outside investors. The cost of this source of capital is the after-tax rate of return that flows back to those investors. The weighted average social opportunity cost of capital in this more general case includes the proportion of capital that is met by this source, times its cost.[10]

$$r = a_1{}^*r_s + a_2{}^*r_I + a_3{}^*r_{FB}$$

Where:
r_{FB} is the after-tax rate of return to foreign investors,
a_3 is the proportion of capital that is met by increased foreign investment, and
$a_1 + a_2 + a_3 = 1$.

The weighted average discount rate typically used in benefit-cost analysis is therefore based on the estimated impact that any incremental demand for capital will have on saving, domestic investment, and inflows of foreign capital, and their respective costs.

As summarized in table 6.3, in his seminal study Jenkins estimated that the principal impact of an increase in the demand for capital in Canada (75 per cent of the total impact) would be to displace domestic investment, and the opportunity cost of that is quite high (a forgone return of 11.45 per cent). Jenkins estimated that savings would only meet 5 per cent of the incremental demand for capital, and foreign

Table 6.3
G. Jenkins's estimate of the weighted average social opportunity cost of capital

	Savings	Displaced investment	Inflows of foreign investment	Total
Proportion of capital	0.05	0.75	0.20	1.00
Opportunity cost	4.14	11.45	6.11	
Weighted cost	**0.21**	**8.59**	**1.22**	**10.02**

investment 20 per cent. Overall, Jenkins estimated that the real (inflation-adjusted) weighted average social opportunity cost of capital in Canada was approximately 10 per cent.[11]

Based on Jenkins's analysis, the Canadian Federal Treasury Board Secretariat recommended that a 10 per cent real discount rate be used as the 'base case' discount rate in benefit-cost analyses.[12] However, there were concerns that a 10 per cent real discount rate was too high and would result in the excessive discounting of the benefits of conservation and other projects or policies with long-term benefits. In his critique of Jenkins's seminal study, Burgess argued that there were a number of reasons a 10 per cent real discount rate was too high.

As noted earlier, Burgess argued that Jenkins overestimated the social opportunity cost of capital, that is, the pre-tax social rate of return that could have been earned on alternative investment. He also argued that Jenkins's estimate of the proportion of capital financed from increased savings (5 per cent) was too low, and the estimated cost of that (4.11 per cent) too high. Most important, he argued that Jenkins's estimates did not properly reflect the extent to which an increase in the demand for capital in an open economy like Canada attracts foreign investment. The more foreign capital that is attracted, the less will be the displacement of alternative investment and the lower will be the weighted average social opportunity cost of capital.

Burgess presented a range for the weighted average social opportunity cost of capital, depending on the responsiveness of foreign investment to demands for capital in Canada. He suggested that a real discount rate in the order of 7 to 7.5 per cent should be used.[13]

For an open economy such as in Canada, and certainly from the perspective of an individual region or province, one could argue that the weighted average social opportunity cost of capital is likely to be no more than the cost of foreign investment. That would suggest that a 'base case' discount rate of 6 per cent would probably be more appropriate than the 10 per cent rate established by the Canadian Treasury Board in the 1970s.

There is a problem, however, in assuming that all demands for capital can be met by increased foreign investment with no crowding out of alternative investment or other economic activity. There are limits to the amount of labour, material, and equipment available in an economy, and this can constrain the total amount of real investment that takes place. A low discount rate based solely on the cost of foreign investment or foreign borrowing does not take real resource constraints into account.[14] It also does not recognize the impact that increased foreign borrowing for any one project can have on the cost of foreign borrowing for all others. Generally one can expect the cost of foreign borrowing to increase, the greater the amount of foreign borrowing that takes place.

In their update of the weighted average social opportunity cost of capital, Jenkins and Kuo acknowledge that an incremental demand for capital would induce more foreign capital and displace less alternative investment than estimated in Jenkins's seminal work. They also conclude that there would be a greater savings response than that originally estimated by Jenkins. Overall, they conclude that the weighted average social opportunity cost of capital in Canada – the social discount rate one should use in Canada – is approximately 8 per cent.[15] This is lower than Jenkins's earlier 10 per cent estimate and more consistent with the 7 per cent rate recommended by the U.S. OMB, but it is still higher than the cost of foreign borrowing.

Hybrid Shadow Pricing Approach

The weighted average social opportunity cost of capital is well suited to projects or policies that entail an incremental demand for capital, thereby putting upward pressure on interest rates and, in so doing, having a typical impact on savings, investment, and foreign borrowing in the economy. However, benefit-cost analysis can be applied to a wide range of issues, and not all of them fit that description; some may not entail any demand for capital at all.

For example, an initiative to reduce recreational fishing activity in order to conserve fish stocks need not have impacts on savings, alternative investment, and foreign borrowing in the manner assumed in the estimation of the weighted average social opportunity cost of capital. The initial public investment in this case would be the forgoing of fishing

TAB 9

Table of Contents

13 Integrated Comparisons of Development Plans – Multiple Account Analysis

13.0 Chapter Overview

The Terms of Reference (TOR) of the Needs For and Alternatives To (NFAT) review of the Preferred Development Plan call for an assessment of its justification and its alignment with Manitoba Hydro's mandate, Manitoba's Clean Energy Strategy and the principles for sustainable development. The TOR also includes a call for an assessment of whether "the Plan has been justified to provide the highest level of overall socio-economic benefit to Manitobans and is justified to be the preferable long-term electricity development option for Manitoba when compared to the alternatives".[1]

The purpose of this chapter is to present the results of a multiple account benefit-cost analysis (MA-BCA) of Manitoba Hydro's Preferred Development Plan as compared to alternative plans with and without new U.S. interconnection capacity and new export sale commitments; and with and without new hydro generating capacity to meet domestic load growth. These alternatives, which are set out in detail in Section 13.2 below, were chosen to enable an assessment of the full range of consequences and benefits and costs to Manitobans of the key components of the Preferred Development Plan:

(i). relying on hydro to meet growing domestic load and

(ii). taking advantage of the current opportunity for new export sales agreements and the development of additional interconnection capacity with the U.S. power market.

[1] Manitoba Order in Council 00128/2013, Scope of the NFAT Review 2(f), p.3.

As explained in the next section, MA-BCA extends Manitoba Hydro's economic evaluation of the preferred and alternative development plans to take into consideration consequences for Manitobans that are not reflected in the revenues and expenditures facing Manitoba Hydro. It uses a set of evaluation accounts to move from a Manitoba Hydro perspective to a broader Manitoba social perspective. The objective is to provide a systematic, comprehensive assessment of all of the benefits and costs to Manitobans in a manner that can assist the NFAT panel address the question of overall socio-economic benefit.

13.1 Multiple Account Benefit-Cost Analysis

13.1.1 Basic Objective and Approach

Traditional cost-benefit analysis is a standard method economists use to assess the net benefits of alternative plans, projects or policies from a broad social perspective.[2] It is intended to take into account the positive and negative consequences of the alternatives being analyzed to everyone (with standing in the analysis)[3] that is affected. These would include not only commercially-valued consequences – those with well-defined market prices – but also the social and environmental consequences that people value.

[2] For a summary of the purpose and rationale of cost-benefit analysis, see Marvin Shaffer, *Multiple Account Benefit-Cost Analysis: A Practical Guide for the Systematic Evaluation of Project and Policy Alternatives*, University of Toronto Press, 2010, pp.3-15. A standard text with details on principles and methods is: A. Boardman et. al., *Cost-Benefit Analysis: Concepts and Practice*, 3rd ed., 2006. For guidelines on the application of cost-benefit analysis in relation to regulatory proposals, see Treasury Board of Canada Secretariat, *Canadian Cost-Benefit Analysis Guide: Regulatory Proposals*, 2007.

[3] 'Standing' is defined by the jurisdiction or parties for which the analysis is being done. For an assessment of the public interest in Manitoba, all people within the province would be considered to have standing.

With its broad scope, cost-benefit analysis attempts to calculate an overall bottom line to determine which of the alternatives is socially preferred, based on the value that people place on what is produced (what people in principle would be willing to pay for all of the positive consequences) relative to the cost people assign, or compensation they in principle would require, to pay for the inputs and offset the negative consequences.

MA-BCA is a variation of traditional cost-benefit analysis. It adopts the same broad scope and the same basic valuation principles. However, MA-BCA recognizes that not all consequences can meaningfully or reliably be monetized in order to calculate an overall bottom line. Furthermore it recognizes that an overall bottom line can mask important distributional considerations. It is not just overall net benefits but also the nature and distribution of those benefits and costs that can govern what is "preferred" from a broad social or public interest perspective.[4]

Accordingly, the objective of MA-BCA, like traditional cost-benefit analysis, is to identify the full range of positive and negative consequences of the alternatives and to assess their significance. However, the assessment does not have to be entirely in dollar terms and the consequences all aggregated to a bottom line. The results are presented in a matrix form for a disaggregated set of evaluation criteria or accounts. The purpose is to identify the advantages or disadvantages of

[4] One of the first government agencies to adopt a multiple account approach to project assessments in North America was the U.S. Water Resources Council, *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, 1983. For a recent review and explanation of the multiple account approach see Marvin Shaffer, *Multiple Account Benefit-Cost Analysis* (2010).

the alternatives and the key trade-offs for the different parties and interests that are affected, information with which judgments about the preferred alternatives can be made.[5]

13.1.2 The Evaluation Accounts

A standard way to conduct cost-benefit analysis is to start with the valuation of the project's inputs and outputs based on market prices – the net revenues or return on investment from the perspective of the proponent. Then the analysis proceeds by identifying and assessing positive and negative consequences – social benefits and costs – that the market valuation does not reflect. The MA-BCA of Manitoba Hydro's preferred and alternative resource plans follows that basic approach.

Similar to the cost-benefit assessment of the Wuskwatim project[6], the MA-BCA of Manitoba Hydro's preferred and alternative resource development plans starts with the incremental revenues and expenditures for Manitoba Hydro and its project partners. Then the MA-BCA addresses consequences for Manitoba Hydro customers, Manitoba taxpayers, the economy, the environment and affected communities that this market valuation does not capture or adequately reflect.

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[5] MA-BCA is similar to multi-criteria or multi-attribute analyses that are commonly used in project and policy evaluations. In such analyses, a broad set of criteria and indicators of relative advantage or impact are established for the assessment of the alternatives. However, in multi-criteria analysis, criteria and indicators are established by the analyst or stakeholder group governing the evaluation process. In MA-BCA, the accounts and indicators are based on the principles of traditional cost-benefit analysis. They are designed to take into account impacts on everyone with standing that is affected, and to reflect the values of those affected. Unlike multi-criteria or multi-attribute analysis, MA-BCA is not an alternative to traditional cost-benefit analysis, but rather a variation of it. See Marvin Shaffer, *Multiple Account Benefit-Cost Analysis* (2010), pp 43-47.

[6] Marvin Shaffer & Associates Ltd., *Social Net Benefits of Advancing the Wuskwatim Project*, prepared for Manitoba Hydro, August, 2003, and *Social Net Benefits of Wuskwatim vs. Wind Development*, prepared for Manitoba Hydro, February 27, 2004.

Specifically, the MA-BCA assesses the preferred and alternative plans in terms of the following criteria or evaluation accounts:

Market Valuation

This account assesses the net benefit or cost of the preferred and alternative plans to Manitoba Hydro and its project partners. It analyzes the incremental revenues generated by the surplus electricity supply in the different plans, relative to the incremental capital and operating expenditures incurred. The present value difference between the incremental revenues and expenditures measures the net market value or cost of the investment in new electricity supply in each plan.

This market valuation account relies on the assessment of the economics of the different plans from a Manitoba Hydro perspective as presented in previous chapters. The same annual revenue and expenditure cash flows and residual asset values as estimated for the resource plan analysis are used here.

In this MA-BCA, however, the present values of the incremental revenues and expenditures are different. Present values are calculated here by applying a real discount rate that reflects the social opportunity cost of capital. A real rate of 6% is used, based on recent research on discounting in cost-benefit analysis.[7] In the previous resource planning economic analysis, a

[7] In their recent study, Burgess and Zerbe calculated a discount rate range of 6.6% to 7.3% real based on their estimates of the social opportunity cost of capital in the U.S. M. Moore *et. al.* argue that rate is too high, and estimate the social opportunity cost of capital to be 5% real. The 6% rate used in this study is roughly mid-point between these estimates. Also, the 6% rate is more consistent with a provincial Manitoba perspective than the somewhat higher rate that Burgess and Zerbe might suggest. The social opportunity cost of capital is calculated by weighting and then summing the cost of the different potential sources of capital: savings, borrowing from outside

somewhat lower discount rate was used to reflect the estimated weighted average cost of capital from a corporate perspective.[8]

Manitoba Hydro Customer

This account assesses the consequences of the different plans for Manitoba Hydro customers. It relies on the financial analysis in Chapter 11 that provides estimates of the rate increases in the short to medium and long term that would be required to recover net system costs and meet corporate financial targets. It also addresses the extent and significance of differences in the reliability of supply under abnormal weather, water condition and other contingencies because of the different mix of assets and interconnection capacity in the different plans.

To provide consistency in the assessment of rates in the preferred and alternative plans, revenue requirements were calculated to achieve common financial targets. The even annual rate increases required to achieve a 75:25 debt/equity ratio by the 20th year of the planning period were calculated for each plan. After year 20 the rates were adjusted each year to maintain an interest coverage ratio of 1.2.

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the jurisdiction, and displacement of other investment. The weights reflect the relative importance of each source. From a provincial perspective there will tend to be more outside borrowing than displacement of other investment within the provincial economy. The greater the weight of outside borrowing relative to displacement of other investment, the lower will be the discount rate. See D. Burgess and O. Zerbe, "Appropriate discounting for benefit-cost analysis", *Journal of Benefit-Cost Analysis*, 2(2), 2011 and M. Moore et al, "More appropriate discounting: the rate of social time preference and the value of the discount rate, *Journal of Benefit Cost Analysis*, 4(1), 2013.

[8] In Manitoba Hydro's financial analysis of rate impacts, a discount rate based on time preference is used. This time preference rate is lower than the social opportunity cost of capital used in this MA-BCA and Manitoba Hydro's weighted average cost of capital used for resource planning. The time preference rate is used in the rate analysis because the purpose of the discount rate in that analysis is simply to assign weights (discount factors) to present versus future rate impacts based on the trade-offs people would willingly make (e.g., as they do when they save, deferring present consumption for future consumption opportunities). It is important to note that in the financial analysis, the cost of capital is already reflected in the calculation of revenue requirements and rates; therefore it would in effect be double counting to apply a cost of capital-based discount rate.

While based on the same surplus sale revenues and capital and operating expenditures as in the market valuation account, this Manitoba Hydro customer account is different in that it indicates the impacts over time, not just an overall net present value; it takes into account the effect of partnership arrangements which affect the net revenues to Manitoba Hydro separate from its project partners; and it calculates rate impacts based on Manitoba Hydro's forecast actual cost of capital, as opposed to the discount rate used to calculate the present value net benefit or cost in the first account.

The rate impact assessment in this Manitoba Hydro customer account does not attempt to measure a social benefit or cost in addition to what is estimated by the market valuation. Rather, it serves to indicate a key distributional effect – how the net benefit or cost estimated in the market evaluation account is shared or borne by Manitoba Hydro's domestic customers through impacts on rates over time.

The assessment of system reliability, on the other hand, does address additional benefits or costs not captured in the market valuation. While all of the plans are designed to meet Manitoba Hydro and industry-standard reliability criteria, they differ in terms of their ability to meet load under all possible weather, water conditions, forced outage and other contingencies.

Differences in the estimated loss of load probability and consequently load carrying capability are used to indicate differences in the system reliability in the different plans. To illustrate the value of the different reliability in the different plans, estimates of the expected unserved energy are multiplied by an estimated cost of supply interruptions to calculate differences in the expected costs of the very infrequent, but nonetheless potentially very disruptive bulk system failures to meet demand.

Manitoba Government

This account assesses the net benefit or cost of the different plans to the Manitoba government and therefore Manitoba taxpayers. It analyzes the incremental net revenues accruing to the government. The present value of the incremental net revenues measures the net benefit from the point of view of taxpayers.

The construction and operation of the different projects in Manitoba Hydro's plans have a wide range of direct and indirect impacts on government tax revenues. There are the taxes and fees paid by Manitoba Hydro directly; there are income and sales taxes paid by those directly and indirectly employed by the projects, or by firms directly and indirectly supplying goods and services for the projects.

Many of these tax impacts, however, do not constitute incremental net revenues for government. The income and sales taxes paid by Manitobans who would otherwise be employed elsewhere would not be incremental to the extent those taxes would be paid in any event. The income and sales taxes paid by in-migrants (attracted to the province as a result of the increased economic activity due to the projects) may be incremental revenues but would not be incremental *net* revenues to the extent they are offset by the increased costs government must incur to supply the infrastructure and service they and their families need.

In order to ensure this account captures net benefits as opposed to gross impacts, and to avoid double counting benefits addressed in the Manitoba economy account,[9] only direct incremental taxes and fees paid by Manitoba Hydro net of incremental government costs or risks are included. In this analysis this is conservatively limited to the water rentals and capital taxes paid in each plan. They are clearly incremental revenues that government would not otherwise receive; and they are not offset by incremental expense. These incremental net governmental revenues are not captured as net benefits in the market valuation account. They simply appear as costs to Manitoba Hydro.

There are other taxes and fees that Manitoba Hydro pays to government. For example, there are debt guarantee fees. However, given that the provincial debt guarantee fee is provided in exchange for this guarantee, the multiple account analysis has excluded the debt guarantee fees from the analysis of net benefits to the Manitoba government. It is assumed that these fees serve to offset the risk of higher borrowing costs and consequently may not constitute net benefits for government. There are also sinking fund administration fees, but it is assumed they are intended to pay for incremental administration costs, again not constituting a net benefit for government.

Coal taxes and the carbon charges assumed to be paid by Manitoba Hydro are also reported, but not included as net benefits in the government account. First, the carbon charges may not be manifested in a tax; they could arise, for example, from the purchase of permits in a cap and trade system. Second, even if carbon tax payments were made (like the existing coal tax), these

[9] The Manitoba economy account assesses the incremental income due to the increased employment and economic activity generated by the different plans. The estimated benefits are measured pre-tax and therefore capture both the benefit to the affected individuals and government.

are clearly intended to reflect part of the cost to society of carbon emissions. They are not a net benefit per se.[10]

Manitoba Economy

This account assesses the consequences of the different plans for the Manitoba economy. It analyzes the amount of employment and wages generated by the projects in each plan and estimates the potential incremental income that employment offers for Manitobans. The present value of the incremental income is an indicator of the employment net benefit generated in the different plans.

It is important to note that this account is different from economic impact analyses that serve to estimate the direct, indirect and induced demand for labour generated by a project's expenditures. Economic impacts do not indicate incremental employment or wages – they indicate gross effects. They are useful for understanding how a project may affect total economic activity and employment in different industries and regions, but not what net benefits that entails. The purpose of this analysis is to assess net benefits in accordance with the principles of cost-benefit analysis.[11]

[10] In the environmental account discussed below, the social cost of GHGs is measured by the externality they entail – the estimated social cost of GHGs less the carbon charges assumed in the market valuation. If the carbon charges were included as a benefit to government, the GHG cost in the environmental account would have to be correspondingly larger to include the total social cost of the GHG emissions. The net overall effect would be the same.

[11] For a discussion of the limitations of economic impact analysis and its difference from cost-benefit analysis see, P. Grady and R. Muller, "On the Use and Misuse of Input-Output Based Impact Analysis in Evaluation", *Canadian Journal of Program Evaluation*, 3(2), 1988, pp.49-61.

This account focuses on employment as opposed to purchases of goods and services because of the assumption that it is in the labour market where there is greatest potential for net benefits or "economic rents" to be earned – i.e., where there may be a significant difference between what is paid and the minimum compensation required to offset the incremental or opportunity costs of what is provided.[12] As in the Manitoba government account, the intent here is to capture the net benefit, not the total impact.

Employment net benefits are measured by the wages that are paid less the minimum amount the workers would have to receive to take the jobs: what those workers would otherwise have earned or the value of the activity they otherwise would have engaged in. In well-functioning economies, the incremental income (or in economic terms, the "economic rent") will be relatively small. People are paid more or less what is required to attract them from what they would otherwise be doing.

However, there are circumstances and regions where the net benefits can be significant – in particular, in regions where there is involuntary unemployment, limited alternative opportunities and limited willingness or ability to move to regions with better employment prospects. Here the net benefits from new job opportunities can be significant and, like the net benefit to taxpayers, they are not reflected in the market valuation account. The wages paid to construction and operating workers are simply costs from Manitoba Hydro's perspective.

[12] In competitive markets, the incremental income (or in economic terms, the 'economic rent') from sales will generally be small. Offsetting the gross revenues firms receive are the costs they must incur to provide the goods and services they sell. There would be some net return, but over the long run and under normal market conditions, one could expect that the net return is what is needed to attract capital – in other words it would reflect the cost of capital in the affected industries.

The assessment of the employment net benefits in the different plans is based on the amount and regional location of the jobs, and the estimated origin of the persons filling the available positions. No Manitoba net benefit is assigned to the jobs estimated to be filled by in-migrants because of the provincial perspective taken in this MA-BCA.

Environment

This account addresses the consequences of the different plans for the environment. It considers impacts on GHG emissions in Manitoba and elsewhere, criteria air contaminant (CAC) emissions in Manitoba, and bio-physical effects associated with the construction and operation of the projects in the different plans. The focus of this account is not the impacts in themselves, but rather the externality they represent – the external net benefit or cost to Manitobans not reflected in the market valuation or other accounts.

With respect to GHG emissions, what is measured is the estimated social cost of emissions in excess of the carbon taxes or charges assumed to be paid by Manitoba Hydro and therefore already taken into account. The social cost of GHG emissions in theory should reflect the maximum amount Manitobans would be willing to pay to reduce carbon emissions as part of the global effort to avoid serious, potentially catastrophic effects of climate change. The precise value of that willingness to pay is difficult to determine. However, there is considerable evidence that it is much greater than the carbon taxes or charges assumed in the market valuation account.[13] Estimates of the social cost of GHG emissions based on Environment

[13] Rough calculations indicate that the cost of the measure to phase out coal-fired generation in Manitoba was well in excess of \$100/tonne of CO_{2e} when first introduced and remains well over \$50/tonne of CO_{2e} at current coal and natural gas prices.

Canada and U.S. government reports[14] are used in this analysis to indicate the potential external costs associated with GHG emissions in the different plans.

With respect to CAC emissions, estimates of damage costs associated with nitrogen oxide (NO_x) and particulate matter (PM) emissions that have been developed in other jurisdictions are used to illustrate the potential magnitude of the external cost they entail for Manitobans.

With respect to biophysical effects, the issue is whether there are residual impacts despite the mitigation and compensation built into the projects' plans and costs. Summaries of the major impacts identified in the Keeyask EIS and preliminary descriptions and assessments for other projects in the plans are presented and the nature and extent of any residual effects – i.e., remaining externality – are discussed.

Social

This account addresses consequences of the different plans for aboriginal and non-aboriginal communities as well as other social effects not addressed in the other accounts.

One of the social consequences analyzed in this account is the net return and other benefits for Manitoba Hydro's project partners. This is not an additional net benefit to what is already

[14] See Environment Canada, *Heavy Duty Vehicle and Engine Greenhouse Gas Emissions Regulation,* section 7.3.3, Feb.22, 2013 (http://gazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html#footnoteRef.82118), and U.S. Interagency Working Group on Social Cost of Carbon, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866*, May 13, 2013.

estimated in the market valuation, but rather an important distributional consequence. It indicates the share of the economic return that will accrue to the project partners.

This account also considers other impacts on communities affected by the projects in the different plans. As with the environmental account the focus here is not the impacts in themselves, but rather the externality they represent: the external net benefit or cost to affected communities as a result of impacts on services, infrastructure or well-being not avoided or offset by mitigation and compensation plans – i.e., not reflected in the market valuation.

Finally, this account addresses other consequences not considered elsewhere such as the long-term sustainability attributes of the different plans – in particular the heritage value of assets remaining at the end of the planning period. The issue analyzed here is whether the "bequest value" Manitobans place on the assets they leave for future generations is fully captured by the discounted present value of the residual asset values taken into account in the market valuation.[15]

[15] The economic concept of bequest value was first raised in a seminal article by John Krutilla ("Conservation Reconsidered", *American Economic Review*, Vol. 57, no. 4, September 1967) who argued that the main reason people are willing to allocate considerable resources (or forego immediate development benefits) for conservation is because of their desire to preserve important environmental attributes for the benefit of future generations. While developed with regard to the value of preserving natural resources, the concept of bequest value more generally recognizes a willingness to pay or allocate resources today for the benefit of future generations. It is a fundamental factor underlying the argument for greater investment in measures that will reduce the risk of climate change many years into the future.

Risk

The estimated consequences of the preferred and alternative plans depend on a number of factors including capital costs, energy prices and economic variables. The assessments under each account are done initially for a reference scenario set of assumptions in order to determine the advantages and disadvantages of the different plans under these mid-range assumptions. However, given the underlying uncertainties, the range of possible outcomes the different plans entail are important considerations in the overall assessment.

In this account, the probability of different net cost and rate implications are used to depict the extent of uncertainty in the relative advantages for the different plans. The potential effect of modifying the plans at key decision points is then considered to indicate how the different downside risks in the different plans can be mitigated.

Summary

Table 13.1 summarizes the multiple account framework. It shows the criteria, nature of analysis and indicators that are used to evaluate and compare the preferred versus alternative development plans.

Table 13.1 SUMMARY OF MULTIPLE ACCOUNT FRAMEWORK

Account	Purpose	Analysis	Indicators
Market Valuation	Net benefit to Manitoba Hydro and project partners.	Incremental revenues from surplus sales less incremental capital and O&M expenditures.	Present value of net revenues or cost (market valuation of investment).
Manitoba Hydro Customer	Consequences for customers in short to medium and long term.	Rate increases required to recover costs and meet MH financial targets. System reliability.	Average annual and cumulative rate increases over the planning period. Load carrying capability and cost of expected unserved load.
Manitoba Government	Net benefit to taxpayers.	Incremental government net revenues. Amount of additional Manitoba Hydro debt guarantee.	Present value of incremental revenues to government, net of incremental costs (including consideration of risk of debt guarantee).
Manitoba Economy	Consequences for the economy.	Employment generated and incremental income earned.	Present value of incremental income.
Environment	Consequences for emissions and natural and bio-physical effects.	Impact on GHGs in Manitoba and elsewhere. Manitoba CAC emissions Biophysical impacts.	Present value of social cost of Manitoba GHGs in excess of carbon charge. Present value of CAC damage costs. Nature and extent of residual biophysical impacts.
Social	Consequences for aboriginal and non-aboriginal communities. Other social impacts not addressed elsewhere.	Benefits to project partners. Impacts on affected communities. Value people place on assets remaining at end of planning period.	Nature and significance of partner benefits. Nature and extent of residual community impacts. Potential bequest value of remaining assets.
Risk	Nature and significance of key assumptions.	Range of possible consequences. Risk mitigation potential.	Probability distribution of system net revenues and rates.

13.2 The Resource Development Plans

The MA-BCA assesses the preferred and three alternative resource development plans. Two of the alternative plans assume no new U.S. interconnection or firm export sales: one based on the development of new gas-fired thermal generation as required to meet growing domestic loads; and one based on hydro – specifically the development of Keeyask G.S. The other alternative resource development plan assumes a new interconnection and firm export sales, but on a smaller scale than in the Development Plan with a 250 MW (230kV) as opposed to a 750MW (500kV) interconnection.

13.2.1 Manitoba Hydro's Preferred Development Plan

Manitoba Hydro's Preferred Development Plan combines the development of new hydro generation to meet growing domestic load with new access to the U.S. market and new firm export sales in order to enhance the value of the new hydro development and existing hydro system, and thereby reduce the long-term cost for customers. This plan would see the development of the Keeyask generating station (G.S.) and related transmission for 2019/20; Conawapa generating station (G.S.), related transmission, and north-south network upgrades for 2025/26; a new 750 MW interconnection with the U.S. for 2020/21; and new export sales with Minnesota Power (250 MW from 2020-2035) and Wisconsin Power Service (108 MW from 2014-2021, 100 MW from 2021 to 2027 and 300 MW from 2026-2036) as well as an expansion of the Northern States Power export sale (125 MW from 2021-2025). It is assumed that toward the end of the planning period (starting in 2041), Manitoba Hydro would add simple cycle gas thermal units as required to meet currently forecast domestic load growth.

In terms of the pathway[16] this plan represents, it is a commitment to the development of Keeyask G.S., the 750 MW interconnection and new export sales. While the pathway anticipates the development of Conawapa G.S. for 2025/26, the decision on that is not required

[16] The concept of pathways is developed in the next chapter where it is recognized that long term development plans may be modified in the future as new information becomes available. In this sense the pathway defines what is set and what adjustments to the plan may be considered after initial decisions and commitments are made following the NFAT process.

at this time, and the precise in-service date could be deferred if warranted by load growth, market or other conditions. What is done toward the end of the planning period will be determined in the future, depending on precise needs and opportunities available at that time. The assumption of gas plants starting in 2041 is simply a method used in all of the plans to ensure the forecast load can be met in a manner consistent with Manitoba Hydro's planning criteria through the end of the planning period.

13.2.2 The Smaller Interconnection Alternative (K19/Gas24/250MW)

Like the Preferred Development Plan, this smaller interconnection alternative combines the development of hydro generation to meet growing domestic requirements with new interconnection and export sales in the U.S. However, the interconnection in this case would only be 250 MW and the firm export sales commitments would be less. This plan also does not include the development of the Conawapa G.S. and related transmission and network upgrades. Gas-fired thermal generation is added as required to meet growing load after the development of Keeyask G.S.

The specific planning assumptions for this alternative are as follows:

- The construction of the Keeyask generating station and related transmission with an in-service date of 2019/20.
- The construction of a new 250 MW transmission interconnection with the U.S. with an in-service date of 2020/21.
- New export sale commitments of 250 MW with Minnesota Power from 2020-2035, 100 MW with Wisconsin Power Service from 2021-2027, and 125 MW with Northern States Power from 2021-2025.
- New SCGTs starting in 2024/25 and CCGTs starting in 2032/33.

This smaller interconnection alternative serves to indicate the advantages or disadvantages of following a similar strategy as in the preferred case, but with smaller capital cost and export commitments. It also represents a fallback option if the 750 MW (500 kV) line does not receive regulatory approval or the firm export sales are not all satisfactorily concluded.

In terms of the pathway this plan represents, it commits to the development of Keeyask G.S. and a small interconnection. What transpires after the development of Keeyask G.S., however, could change. One variant for example, would be to develop Conawapa G.S. instead of gas plants when required to meet domestic load.

13.2.3 Keeyask with No New Interconnection (K22/Gas)

This plan assumes that Manitoba Hydro would develop Keeyask G.S., without a new interconnection, solely as required to meet domestic load growth. The plan assumes that there would be a relatively small new firm export commitment to absorb some of the surplus that Keeyask G.S. would generate when first developed. It further assumes the development of gas-fired thermal generation after Keeyask G.S. as required to meet growing domestic demand.

The specific planning assumptions for this alternative are as follows:

- The construction of the Keeyask generating station and related transmission with an in-service date of 2022/23.
- New export sale commitments of 100 MW with Wisconsin Power Service from 2023-2027.
- New SCGTs starting in 2029/30 and CCGTs starting in 2034/35.

This plan serves to indicate the advantages or disadvantages of retaining a preference for hydro to meet growing load, but without the new interconnection and export sales opportunity currently available to Manitoba Hydro.

In terms of the pathway this plan represents, it commits to the development of Keeyask G.S. and abandons the opportunity for and benefits of the current new interconnection opportunity. As with the previous plan, what transpires after the development of Keeyask G.S. could change. Again one variant would be to develop Conawapa G.S. instead of gas plants when required to meet growing domestic load.

13.2.4 Gas Thermal with No New Interconnection (All Gas)

This plan assumes that Manitoba Hydro would not develop a new interconnection or any new firm export sales with the U.S. and would rely on gas-fired thermal generation to meet growing load. Based on the current load growth forecast, Manitoba Hydro would develop SCGTs starting in 2022/23 and CCGTs starting in 2031/32.

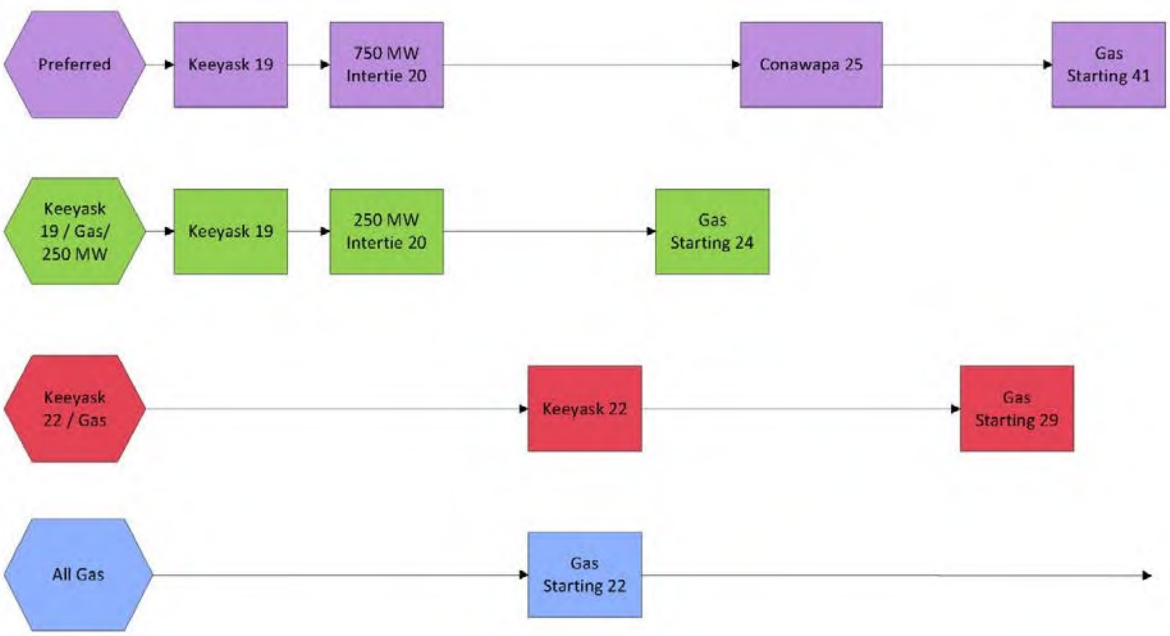
This plan serves to indicate the advantages or disadvantages of relying on gas thermal instead of hydro for the foreseeable future. It is the lowest capital cost alternative and the one with the least facility and export commitments.

In terms of the pathway this plan represents, it abandons the development of Keeyask G.S. for the foreseeable future, and the current opportunity for and benefits of a new interconnection. It could, however, see the development of new hydro in the future if warranted by unfolding conditions.

13.2.5 Summary

The specific components in the preferred and alternative plans assessed in this MA-BCA are shown in Figure 13.1 below.

Figure 13.1 PREFERRED AND ALTERNATIVE DEVELOPMENT PLANS



13.3 Evaluation by Account

13.3.1 Market Valuation Account

The total present value expenditures and revenues for the preferred and the alternative plans under the reference scenario set of assumptions are shown in Table 13.2. The present values are based on the estimated annual incremental capital and system operating expenditures and revenues over the 2014-2047 planning period presented in previous chapters. The residual asset values reflect the present value of the estimated net benefit that the assets remaining at the end of the planning period would provide in subsequent years relative to the costs Manitoba Hydro would be facing in the all gas development plan.[17] The present values are calculated at a 6% real discount rate, a rate intended to reflect the weighted average social opportunity cost of capital from a provincial perspective.

[17] The zero value shown for the all gas plan does not mean there would be no assets remaining at the end of the planning period. It is simply that the residual values were calculated relative to that case.

Table 13.2 MARKET VALUATION OF PREFERRED AND ALTERNATIVE PLANS

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Incremental capital exp.	7,373.9	3,812.1	3,338.0	1,158.9
Less: residual asset value (relative to all gas)	[1,933.3]	[804.6]	[849.6]	0.0
Fuel exp (excl tax)	307.7	856.3	767.6	1,151.2
Imports	971.0	893.0	847.7	1,030.9
O&M, other (excl tax)	2,220.5	2,227.6	2,170.3	2,171.2
Taxes and carbon charge	3,008.1	2,729.8	2,676.7	2,445.2
Total Expenditures	**11,947.9**	**9,714.1**	**8,950.7**	**7,957.4**
Firm export sales	4,513.6	2,685.1	1,606.0	1,331.7
Spot / opportunity sales	4,818.5	4,430.2	4,458.4	3,355.8
Total Revenues	**9,332.1**	**7,115.3**	**6,064.4**	**4,687.5**
Net Cost	**2,615.8**	**2,598.8**	**2,886.3**	**3,269.9**
Difference from Development Plan	**0**	**(17.0)**	**270.5**	**654.1**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

As shown in the table, the preferred and the smaller interconnection plans exhibit the lowest net costs, followed by the plan with Keeyask G.S. but no new interconnection. The all gas plan with no new interconnection exhibits the highest net costs.

The Preferred Development Plan entails much higher capital expenditures than the others, but these are offset by the much higher firm export sale revenues and a much higher residual value of the assets, with Conawapa G.S. as well as Keeyask G.S. remaining at the end of the planning period. The Preferred Development Plan also incurs much lower fuel costs, most notably as compared to the all gas plan.

13.3.2 Manitoba Hydro Customer Account

Rate Impact

The present value net costs of the different plans indicates their relative advantage to Manitoba Hydro and its customers over the long term, but the impacts on rates in the short to medium versus longer term depend as much on the mix of expenditures as their total amount.

Capital-intensive plans give rise to more marked rate impacts in the short to medium term, as revenue and cash flow requirements have to increase to achieve debt-equity and other financial targets. Fuel-intensive plans give rise to more marked rate impacts in the longer term with their relatively large ongoing and escalating annual costs.

Under the reference scenario assumptions the short to medium term rate increases required for the Preferred Development Plan would be greater than with the three alternative plans. With the Preferred Development Plan, a projected even annual rate increase of 3.95% would be required to achieve a target 75:25 debt/equity ratio by year 20 of the planning period.[18] The projected cumulative rate increase by 2031/32 would be 108%. For the three alternative plans projected even annual rate increases in the 3.4 to 3.5% range would be required to achieve the target 75:25 debt/equity ratio by year 20. The projected cumulative rate increase to year 2031/32 is estimated at 90% for the all gas and small interconnection plans and 92% for the plan with Keeyask G.S. but no interconnection – approximately 16 to 18 percentage points less than the Preferred Development Plan.

[18] This and all other rate increases discussed in this section are expressed in nominal dollars, that is, including the effect of the general rate of inflation. The real increases, after adjusting for inflation, would be approximately 1.9% per year less.

The higher rates with the Preferred Development Plan would be needed in the short to medium term to raise revenues and cash flow to achieve the target debt-equity ratio. However, the higher rates would be an investment for the long term. Upon completion of the intensive capital investment period and the achievement of the target debt/equity ratio in year 20, there would be reduced inflationary pressure on costs with the predominately hydro system in place. At that point the cumulative rate increases with the Preferred Development Plan would fall below those in the other plans within a relatively short time frame.

Under the NFAT reference scenario assumptions, the projected cumulative rate increase with the Preferred Development Plan would be 106% by year 50 (2061/62) virtually the same as the cumulative increase to year 20 (2031/32). The projected cumulative long term rate increase for the two plans with Keeyask G.S. would be between 140% (Keeyask G.S. with no interconnection) and 143% (Keeyask G.S. with the small interconnection), approximately 34 to 37 percentage points more than with the Preferred Development Plan. The projected cumulative long term rate increase for the all gas plan would be 176%, approximately 70 percentage points more than the Preferred Development Plan.

Reliability

The different development plans are all designed to ensure Manitoba Hydro has sufficient resources to be able to meet its peak and annual load, even under a wide range of forced outage, extreme weather and other circumstances. Manitoba Hydro's planning criteria provide for a very high degree of system reliability – there is a very high probability of being able to meet system requirements under all contingencies. Nevertheless, system reliability is never 100%. There generally will be some combinations of adverse circumstances under which

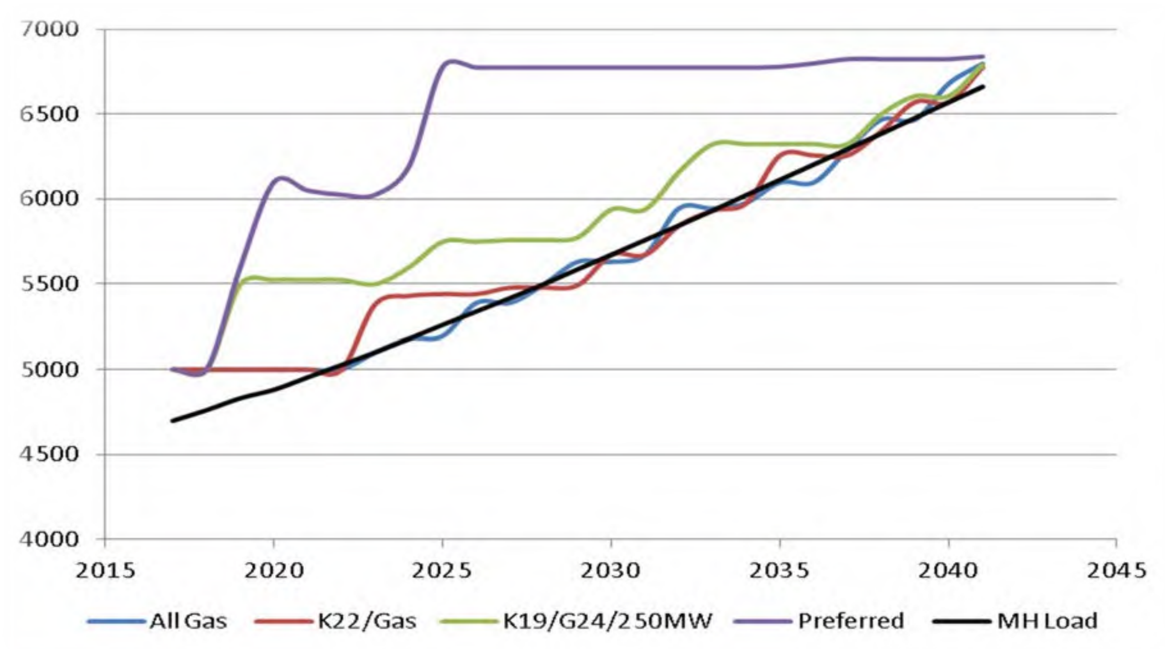
Manitoba Hydro's generating and bulk transmission capacity would not be sufficient to meet the system load.

The degree of system reliability can be measured by what planners call the "loss of load expectation" – the average number of days per year that the load could not be fully met. A common industry standard is .1 days per year, or an inability to meet system load one day every 10 years. The lower the loss of load expectation, the greater is the system reliability. This can equivalently be expressed in terms of the system's load-carrying capability. With greater reliability the system can reliably carry or meet a greater amount of peak load.

Figure 13.2 shows the estimated load-carrying capability of the Manitoba Hydro system (at the industry standard loss of load expectation of .1 day per year) with the preferred and alternative plans.[19] As shown in the figure, the load-carrying capability of the Preferred Development Plan is significantly greater than the others. The interconnection combined with the additional hydro resources contributes to much higher reliability. For the same reason, though to a lesser extent, the alternative with the smaller interconnection and Keeyask G.S. has a greater load-carrying capability than the two alternatives without a new interconnection.

[19] See Appendix 13.1, Reliability Evaluation, August 1, 2013.

Figure 13.2 **PEAK LOAD CARRYING CAPABILITY (MW)**



With greater reliability, customers could expect less failure of bulk supply and consequently less unserved load. While failures in bulk supply would be very infrequent, they can have major consequences. To indicate the potential significance of the differences in unserved load, the expected unserved energy costs were estimated based on an outage value of $10,000/MWh. The expected unserved energy cost for the all gas and Keeyask/gas alternatives would be greater than for the Preferred Development Plan by $101 million and $105 million in present value, respectively, over the planning period. The expected unserved energy cost for the small interconnection alternative would be less, but still some $56 million greater than with the Preferred Development Plan.

While the precise outage value is uncertain and would depend on the timing and nature of the outages, the estimates serve to indicate the relative advantage of the large interconnection over the smaller one and the advantage of both of those compared to the two alternatives without a new interconnection.

In addition to this reliability benefit, the Preferred Development Plan offers customers more security against the risks of extreme drought. The import capability with the large new interconnection plus the advancement of hydro generating capacity for export would provide Manitoba Hydro greater access to back-up supply and flexibility to manage extreme droughts than with the other alternatives, particularly those without any new interconnection.

Summary of Customer Account

In sum, the Preferred Development Plan would result in greater rate increases than the other plans in the short to medium term, with the projected cumulative rate increase approximately 16 to 18 percentage points more than the alternatives by 2031/32. However, the Preferred Development Plan would result in the lowest rates over the longer term. By 2061/62 the projected cumulative rate change in the Preferred Development Plan would be approximately 34 to 70 percentage points less than the other plans.

The Preferred Development Plan would benefit customers with its greater system reliability and significantly lower expected cost of unserved load, as well as its greater ability to manage extreme drought.

13.3.3 Manitoba Government Account

Included in the annual expenditures and financing costs that Manitoba Hydro incurs, and that are reflected in its rates, are taxes and other fees and charges paid to the provincial government. These include the capital taxes and water rental fees that constitute a significant component of the annual expenditures captured in the market valuation account; the debt guarantee and sinking fund administration fees that add roughly 1% to Manitoba Hydro's cost of capital, and thereby directly affect rates; and the coal taxes and assumed carbon charges[20] that add to the cost of thermal power operations.

In Table 13.3 below the amount of these payments that would be made in the preferred and alternative development plans are shown. As shown in the table, the total payments are substantial, ranging from $4.3 to $5.6 billion in present value over the planning period. The largest amount of payments arises with the Preferred Development Plan – some $660 to $770 million greater than the two plans with Keeyask G.S., and $1.27 billion greater than the all gas plan.

Table 13.3 DIRECT MH PAYMENTS TO MANITOBA GOVERNMENT

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Capital Tax	1,457.1	1,202.7	1,188.0	991.9
Water Rentals	1,512.4	1,413.3	1,385.6	1,303.4
Debt Guarantee Fee	2,597.5	2,218.3	2,162.1	1,894.9
Sinking Fund Admin Fee	7.1	6.3	5.9	4.4
Coal Tax	10.3	10.3	10.3	10.3
Potential Carbon Charges	28.3	103.4	92.8	139.6
Total Payments	**5,612.7**	**4,954.3**	**4,844.7**	**4,344.5**
Difference from Preferred Development Plan	**0**	**[658.4]**	**[768.0]**	**[1,268.2]**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

[20] The carbon charges are included to indicate their potential contribution to the total payments to government, but they may or may not be manifested as a tax, depending on the policy government were to adopt to implement such charges.

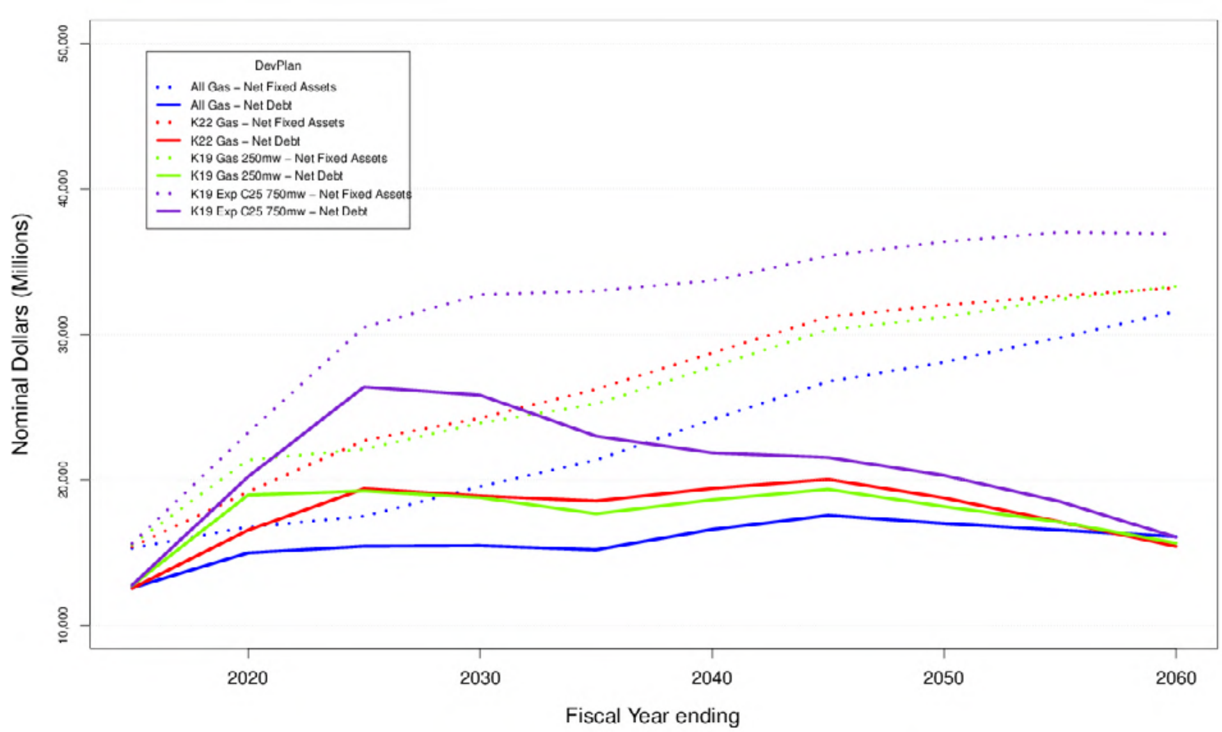
In terms of the economic significance of these payments to government, and therefore Manitoba taxpayers, the question is what net benefit do they provide. To what extent do they constitute incremental revenues for government not offset by incremental costs or risks?

The coal taxes and carbon charges do not offer net benefits. As explained in section 2, the carbon charges may not result in direct payments to government, for example in a cap and trade system, and in any event would be intended to internalize at least part of the social cost of GHG emissions. The sinking fund administration fee also would not constitute a significant net benefit for government, on the assumption that the fee serves to compensate government for the administration costs it incurs.

The debt guarantee fees are substantial, but so too is the amount of debt that government would be guaranteeing. Figure 13.3 shows the projected balances of net fixed assets and net debt with the preferred and the alternative plans. As shown in the figure, there would be an increase in the total amount of Manitoba Hydro's debt with all of the plans, but particularly in the Preferred Development Plan with its development of both Keeyask G.S. and Conawapa G.S.

Figure 13.3 MANITOBA HYDRO'S PROJECTED BALANCES OF NET DEBT AND NET FIXED ASSETS – NFAT REFERENCE SCENARIO ASSUMPTIONS

(MILLIONS OF NOMINAL$)



The level of net debt must be considered in the context of the entire balance sheet, including the associated net assets that are under construction or in service. In the medium term, while net debt levels are the highest with the Preferred Development Plan, that plan also has the overall highest capital investment, fixed assets and retained earnings.

The Province of Manitoba provides a flow through credit to Manitoba Hydro and guarantees the vast majority of its debt. Given that the provincial debt guarantee fee is provided in exchange for this guarantee, the multiple account analysis has not included the debt guarantee fees as part of the net benefits to the Manitoba government. It is assumed that the fee does not provide a net benefit. Under this assumption, the net benefits for government (and taxpayers) would arise only from the capital taxes and water rentals that Manitoba Hydro pays.

Accordingly, the estimated net benefit to government is shown in Table 13.4 for the preferred and alternative plans.[21]

Table 13.4 NET BENEFITS TO MANITOBA GOVERNMENT

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Capital tax	1,457.1	1,202.7	1,188.0	991.9
Water rentals	1,512.4	1,413.3	1,385.6	1,303.4
Total net benefit	**2,969.5**	**2,616.0**	**2,573.6**	**2,295.3**
Difference from Preferred Development Plan	**0**	**[353.5]**	**[395.9]**	**[674.2]**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table, while smaller than the total payments Manitoba Hydro would make to government, the total net benefit from capital taxes and water rentals is substantial, ranging from $2.3 to almost $3.0 billion in present value over the planning period. The net benefits are greatest for Manitoba Hydro's Preferred Development Plan – some $350 to $400 million

[21] No expenditures are shown in the calculation of net benefits as there are no significant incremental expenditures that government would incur as a result of the different plans. The provincial government has contributed to training programs for Keeyask and as well road improvements in the area. However, these expenditures have already been incurred and no significant further expenditures are expected.

greater than the two alternative plans with Keeyask G.S., and $670 million greater than the all gas plan.

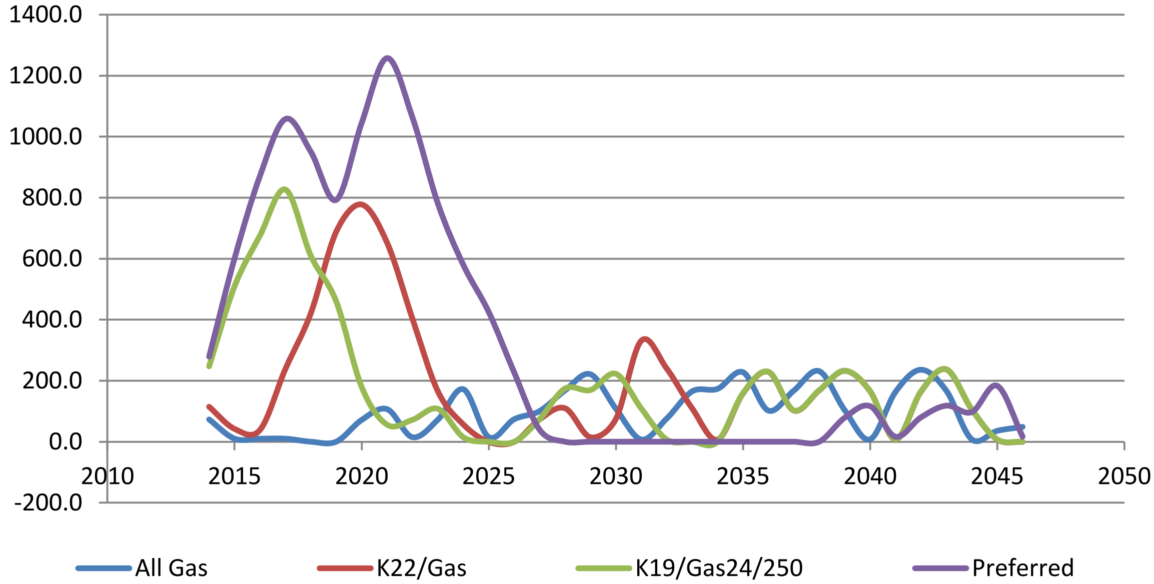
13.3.4 Manitoba Economy Account

Manitoba Hydro's Preferred Development Plan will significantly affect the Manitoba economy as a result of the demand for goods, services and labour generated by the construction and operation of the different projects in the different plans. As explained in section 2, of particular interest in this MA-BCA are the impacts on the demand for labour. That is where there is greatest potential for "economic rents" or net benefits to be generated.

As shown in Figure 13.4, there is a marked difference in the level and pattern of capital investment in the preferred and the alternative plans. The difference is most pronounced in the first part of the planning period, through to the completion of Conawapa G.S. in the Preferred Development Plan. During that initial period the Preferred Development Plan exhibits the greatest level of spending, followed by the two alternatives that include the development of Keeyask G.S. (which differ in the timing but not significantly in the amount of capital spending). The all gas alternative has the least amount of capital spending in the first part of the planning period, with only small amounts invested for thermal power plants starting in the 2020s. Later in the planning period, capital spending is relatively low in all of the plans, but least with Manitoba Hydro's Preferred Development Plan because of the limited need for additional generating capacity once Conawapa G.S. is built.

Figure 13.4 ANNUAL CAPITAL EXPENDITURES - NFAT REFERENCE SCENARIO ASSUMPTIONS

(MILLIONS OF 2014$)

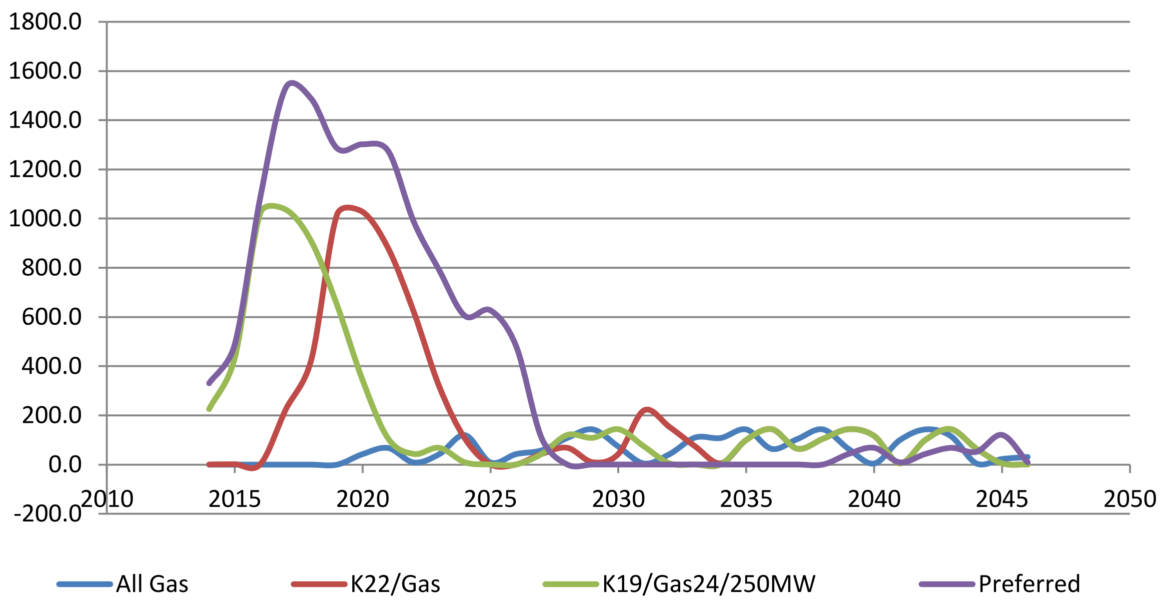


These differences in capital spending carry over into the demand for labour. Figure 13.5 shows the total annual employment directly required for the construction of the generating and transmission projects in the different plans.[22] The largest amount of construction employment is generated by the Preferred Development Plan, again followed by the two plans that include Keeyask G.S. The all gas alternative generates the least amount of construction employment, far less than the other plans.

[22] Employment and wage estimates in this section are based on project data in Manitoba Hydro, Range of Resource Options, Appendix 7.2.

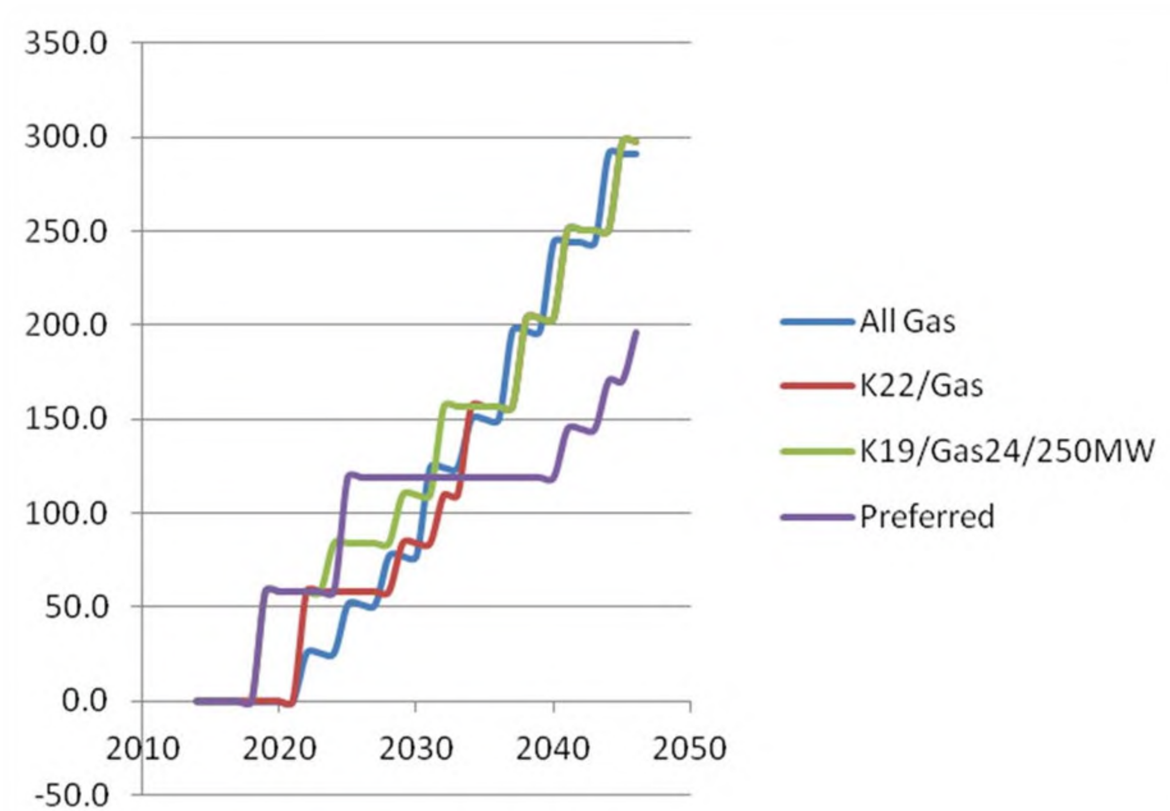
Figure 13.5 ANNUAL EMPLOYMENT FOR PROJECT CONSTRUCTION

(PERSON YEARS)



The demand for labour in operations and maintenance (O&M) is different. Figure 13.6 shows the total annual O&M employment directly required for the projects developed in the preferred and the alternative plans. All of the plans generate an increasing amount of annual O&M employment. Toward the end of the planning period, however, the three alternatives without Conawapa G.S. generate more annual employment than the Preferred Development Plan because of the need to add more thermal plants to meet growing load.

Figure 13.6 ANNUAL EMPLOYMENT FOR PROJECT OPERATIONS AND MAINTENANCE



(PERSON YEARS)

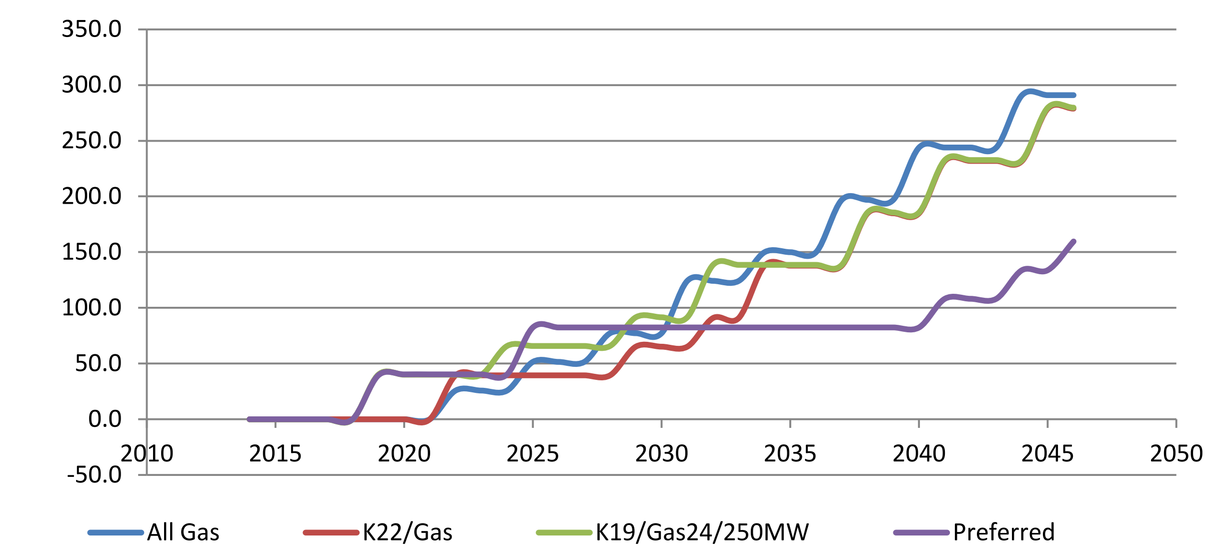


Table 13.5 shows the present value of the gross wages generated by the direct employment in project construction and O&M in the preferred and alternative plans. The wages are shown separately for the employment that takes place in northern versus southern Manitoba.

Table 13.5 GROSS WAGES FOR CONSTRUCTION AND O&M

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Construction – N. Man.	1,~~224.9~~317.4	~~591.3~~599.9	~~497.2~~503.9	--
Construction – S. Man.	~~40.6~~142.0	~~84.5~~95.0	~~70.4~~72.0	~~59.9~~62.6
Total Construction	1,~~265.5~~459.4	~~675.8~~694.9	~~567.6~~575.9	~~59.9~~62.6
O&M – N. Man.	~~127.4~~85.0	~~76.7~~49.6	~~61.4~~40.5	--
O&M – S. Man.	~~3.3~~4.2	47.~~1~~4	37.~~4~~3	~~72.4~~71.5
Total O&M	~~130.7~~89.2	~~123.8~~97.0	~~98~~77.8	~~72.4~~71.5
Total Gross Wages	1,~~396.2~~548.6	~~799.6~~791.9	~~666.4~~653.7	~~132.3~~134.1
Difference from Preferred Development Plan	0.0	~~[596.6]~~(756.7)	~~[729.8]~~(894.9)	~~[~~(1,~~263.9]~~414.5)

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table the total gross wages directly generated by the Preferred Development Plan would be much greater than with the other plans and more heavily concentrated in northern Manitoba.

The net benefits derived from the employment on Manitoba Hydro's projects, however, are measured not by the gross wage impact, but rather by the incremental income or other benefits Manitobans would realize. That would depend on the *increase* in income or other benefit that Manitobans would earn in relation to what they would otherwise be doing. And that in turn would depend on where the workers originate from and what alternative opportunities they would have.

Significant net benefits would only be realized to the extent that the jobs provide opportunities for Manitobans which are better than what would otherwise be available. That is most likely in regions where there are high levels of unemployment, or when there are complementary programs and other measures enabling workers to upgrade their skills and earning potential, or where the jobs simply offer better wages or benefits than available elsewhere.

There will not likely be widespread unemployment over the long term in Manitoba as a whole without these projects. Labour force data indicate that the unemployment rate in Manitoba is relatively low and growing demand for labour combined with the impact of "baby boomer" retirements are expected to maintain low rates of unemployment, with shortages in some occupations.[23] The net benefit from new jobs will generally be limited to the advantage they offer relative to alternative sources of employment – the amount required to attract the workers away from what they would otherwise do.

At the same time, however, it is important to recognize that there has been chronic unemployment in northern Manitoba, particularly in Aboriginal communities, with limited alternative prospects and with social and cultural barriers to migration to areas where employment prospects are better.[24] Jobs opportunities created in northern Manitoba,

[23] See Manitoba Government, *Manitoba Government Labour Force Trends* and Manitoba Construction Sector Council, *Construction Looking Forward 2012-2020 Key Highlights*.

[24] Statistics Canada data indicated that the 2001 unemployment rate for Keeyask Cree Nations was 40% and for the northern Manitoba Aboriginal population [Census divisions 19,21,22 and 23] it was 28% compared to 6.1% for Manitoba as a whole. While the rates have no doubt changed since 2001 (in part because of the Wuskwatim project), the relative pattern and vulnerability to unemployment is likely the same. See Keeyask Hydropower Limited Partnership, *Environmental Impact Statement-Response to EIS Guidelines*, Chapter 6, Environmental Effects Assessment, June 2012, p.6-143.

combined with training and other measures to enable northern Manitobans to fill those positions, can provide significant net benefit.

For this assessment it is assumed that the net benefits of the jobs filled by Manitobans would generally be in the order of 15% of the gross wages. That is consistent with a study of the relationship between wages and the social opportunity cost of labour (what the workers would otherwise have earned) for a major project developed when labour markets were generally tight, as one could expect in this case.[25] However, the net benefit for northern Aboriginal employment, supported by training, recruitment and retention policies and programs, is assumed to be in the order of 50% of the gross wages paid. Again this is consistent with estimates of the relationship between wages and the social opportunity cost of labour where alternative opportunities are more limited.[26] With respect to in-migrants it is assumed the net benefits would be zero from a Manitoba perspective. The in-migrants would pay income and other taxes, but it is conservatively assumed these would be offset by the cost of services that government would have to provide for them.

With respect to the origin of the workers filling the jobs generated in the different plans, it is assumed that for the northern projects ~~70~~40 to 45% of the construction positions would be filled by Manitobans, and of the Manitobans, ~~47~~50% would be northern Aboriginal.~~ This is~~ The Manitoba share of the construction employment is less than what has been observed for the Wuskwatim Project and ~~is generally consistent with the employment impact estimates~~may be conservative, but reflects the larger size of the projects. The northern aboriginal share (50% of

[25] See Chun-Yan Kuo, "Evaluating the Social Cost of Job Creation", *Canadian Journal of Program Evaluation"*, Special Issue, 1997, pp. 67-82.

[26] Ibid.

the Manitoba workers or 20 to 22.5% of the total number of jobs) is within the range for northern aboriginal construction employment estimated in the Keeyask EIS.[27]

~~It is assumed Manitobans would fill all of the southern Manitoba construction jobs. This is based on the relatively small number of jobs the southern projects would need to fill. However, it should be noted that some of the thermal power plant construction work is highly specialized which could require out-of-province or out-of country workers. Consequently the net benefits generated by those projects (which are relatively small in any event) could be overstated with the all Manitoba sourcing assumption.~~

With respect to the southern construction jobs, it is assumed that Manitobans would fill just over 50% of the gas plant related employment and almost all of the tie-line and head office related employment. The share of gas plant jobs going to Manitobans is based on consulting reports indicating that they require a large amount of specialized work combined with the fact that Manitoba has not undertaken such projects in recent years.

With respect to the O&M jobs in the north and the south, it is assumed all would be filled by Manitobans. For the northern O&M jobs it is assumed that at least 45% would be filled by northern Aboriginal people based on current shares of northern operations employment and targeted measures expected with Keeyask G.S.[28]

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[27] For a breakdown of the person-years of employment on the Wuskwatim project through to November 2012 see Manitoba Hydro, *Wuskwatim GS Employment, November 2012 Monthly Report*, p.11. In the Keeyask EIS it was estimated that northern aboriginal would fill between 13 and 40% of the direct construction employment for Keeyask. See Keeyask Hydropower Limited Partnership, *Environmental Impact Statement,* Chapter 6 p.6-434.

[28] Northern Aboriginal people currently account for 42% of northern operations employment. The Joint Keeyask Development Agreement calls for the placement of 182 Keeyask Cree Nation members in operating jobs

Based on these employment assumptions—plus an estimate that the average wages for the mix of construction jobs filled by northern Aboriginal people would be approximately 75% of the total project average wages—the net benefits of construction employment in the north would equal ~~19.14~~12.2 to 12.4% of the total gross wages paid; for construction employment in the south net benefits ~~would equal 15%~~per dollar of ~~the total~~ gross wages paid~~.~~ would range from 7.8% (for the all gas case where a large number of the workers would be from out-of province) to 14.6% (for the preferred case for which most of the southern employment would be filled by Manitobans). The net benefits of O&M employment in the north would be 30.~~75~~8% of the total gross wages paid; for O&M employment in the south net benefits would be 15% of the total gross wages paid. In Table 13.6 the resulting employment net benefits generated by the preferred and alternative plans are shown.

Table 13.6 EMPLOYMENT NET BENEFITS FOR PROJECT CONSTRUCTION AND O&M

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Construction – N. Man.	~~234.4~~160.7	~~113.2~~74.4	~~95.1~~62.5	~~0.0~~--
Construction – S. Man.	~~6.1~~20.7	~~12.7~~10.8	~~10~~7.6	4.9~~.0~~
Total Construction	**~~240~~181.5**	**~~125.8~~85.2**	**~~105.7~~70.1**	**4.9~~.0~~**
O&M – N. Man.	~~39~~26.2	~~23.6~~15.3	~~18.9~~12.5	~~0.0~~--
O&M – S. Man.	~~.5~~0.6	7.1	5.6	10.~~9~~7
Total O&M	**~~39.7~~26.8**	**~~30.7~~22.4**	**~~24.5~~18.1**	**10.~~9~~7**

throughout the hydro system. That would be equivalent to more than 100% of the O&M jobs that would be created by Keeyask and Conawapa combined. The 45% assumption is conservative, recognizing it may take some time until the target can be reached.

Total Net Benefits	~~280.2~~208.3	~~156.5~~107.6	~~130~~88.2	~~19.8~~15.6
Difference from Preferred Development Plan	0.0	~~[123~~(100.7~~]~~)	(~~150.0]~~120.1)	~~[260.3]~~(192.7)

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table, the employment net benefits, though much smaller than gross wages, would still be significant in the plans that include northern hydro development. Those plans generate a significant number of jobs, a large proportion of which would be in a region where they would be particularly beneficial. The employment net benefits would be greatest with the Preferred Development Plan - $~~123~~100 to $~~150~~120 million greater than the two plans with Keeyask G.S. and ~~$260~~over $190 million greater than the all gas plan.

Clearly the assumptions used to develop these estimates are rough, and arguably conservative for purposes of estimating the net benefits from the employment and other economic activity generated by the projects in the different plans. Nevertheless, they do serve to indicate the relative magnitude of the employment net benefits and the ~~significant~~ advantage of the Preferred Development Plan.

13.3.5 Environment Account

The preferred and alternative development plans differ in terms of the impacts they would have on GHG emissions; NO_x and other local CAC emissions; and terrestrial and aquatic habitat and natural resource impacts.

GHG Emissions

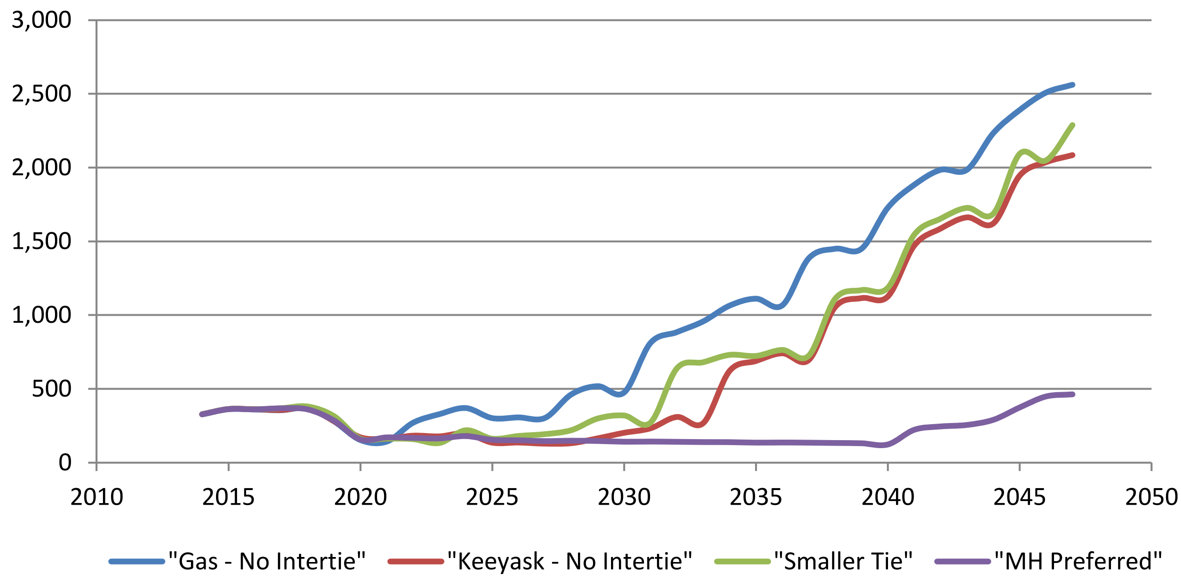
The development plan that Manitoba Hydro undertakes will affect GHG emissions both within and outside Manitoba. Within Manitoba, the plan will determine the amount of thermal generation that would be used to meet growing load and backup low-water conditions, and consequently affect thermal power-related GHG emissions. It will also govern the development of new hydro reservoirs, generating stations and transmission lines, and therefore the production of associated lifecycle GHG emissions. With respect to GHG impacts outside Manitoba, the plan will determine Manitoba Hydro's exports and imports of power, and consequently affect the amount of thermal power generation and related GHG emissions in the interconnected jurisdictions. There are also lifecycle GHG impacts outside Manitoba associated with the project development plans.

Figure 13.7 shows the estimated amount of Manitoba Hydro thermal generation-related GHG emissions associated with the preferred and alternative plans. As shown in the table, emissions are lowest with the Preferred Development Plan.[29] Unlike the alternatives, the Preferred Development Plan incorporates the development of both Keeyask G.S. and Conawapa G.S., and consequently entails far less thermal generation than the others. The highest level of emissions is with the all gas plan. By the end of the planning period the annual emissions in that plan would be some 2 million tonnes (CO_{2e}) per year greater than with the Preferred Development Plan.

[29] The Preferred Plan is the only plan which emissions are lower than Manitoba Hydro's annual greenhouse gas emissions target of 520 kilotonnes of CO_2e throughout the planning horizon.

Figure 13.7 **MANITOBA HYDRO THERMAL GENERATION-RELATED GHG EMISSIONS**

('000 TONNES CO_{2E})



In the market valuation of the different plans, it was assumed that Manitoba Hydro would pay a charge for its carbon emissions from natural gas-fired thermal generation as well as a tax on the coal used in the single remaining coal-fired unit. The timing and level of charges depend on future policies in Manitoba and Canada with respect to new emission taxes or membership in a cap and trade system. In the absence of defined policies at this time, the carbon pricing from other regions was considered and judgment applied to create a plausible range of future GHG-emission charges. For the reference scenario analysis, the GHG emissions charge for natural gas-fired thermal generation was assumed to be approximately \$5/tonne CO_2 in 2015 rising to approximately \$25/tonne CO_2 by 2048 (in constant 2012\$).

These assumed charges, however, do not reflect the full social cost of GHG emissions – i.e., the maximum amount people would be willing to pay to reduce emissions in order to reduce the expected costs and risks of global warming and climate change.

Recent estimates of the social cost of GHG emissions are much higher than the assumed carbon charge. Environment Canada has estimated that the social cost of GHG emissions, based on the present value of expected climate change costs is currently over $28/tonne CO_2, rising to almost $60/tonne CO_2 by 2050 (in constant 2011$).[30] Including consideration of the willingness to pay to avoid uncertain, but potentially catastrophic, climate change impacts raises the estimated cost to over $112/tonne CO_2. Similarly, a U.S. government inter-agency team recently estimated the social cost of GHG emissions at $38/tonne CO_2 in 2015 rising to $71/tonne CO_2 in 2050 (in constant 2007$ US),[31] and recognized that the cost would be much greater the more that people are willing to pay to avoid damages in the future (the lower the discount rate), and the more that people are willing to pay to avoid uncertain, catastrophic risks.[32]

For purposes of estimating the external cost of the Manitoba GHG emissions in the different plans – the difference between the estimated social cost of GHG emissions and the carbon charges plus coal taxes included in Manitoba Hydro's estimated expenditures – it is assumed that the social cost of GHG emissions would be $40/tonne CO_2 in 2014, rising to $80/tonne CO_2 by 2048 (in constant 2012$). This is somewhat higher than Environment Canada's estimate of GHG damage costs, but less than its estimate of the willingness to pay to avoid the risks of uncertain but catastrophic effects. It is broadly consistent with the most recent U.S. estimates, again without any provision for the willingness to pay to avoid uncertain, catastrophic risks.

[30] In constant 2012$ that would be over $28.50 rising to almost $61/tonne.

[31] In constant 2012$ Cdn that would be $42 rising to $78/tonne.

[32] See Environment Canada, *Heavy Duty Vehicle and Engine Greenhouse Gas Emissions Regulation,* section 7.3.3, Feb.22, 2013 (http://gazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html#footnoteRef.82118), and U.S. Interagency Working Group on Social Cost of Carbon, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866*, May 13, 2013.

Table 13.7 shows the estimated present value of the external GHG costs from the Manitoba thermal generation in the different plans based on these assumptions.

Table 13.7 EXTERNAL COST OF MANITOBA THERMAL GENERATION-RELATED GHG EMISSIONS

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Estimated social cost of GHG emissions	188.8	472.6	427.6	620.4
Estimated coal tax and carbon charge payments	38.6	113.8	103.1	149.9
External Cost of GHG Emissions	**150.2**	**358.8**	**324.5**	**470.5**
Difference from Preferred Development Plan	-------	**208.6**	**174.3**	**320.3**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table, the estimated external costs of the Manitoba thermal generation-related GHG emissions in the Preferred Development Plan are significantly less than the alternatives. As compared to the all gas case, the present value external cost in the Preferred Development Plan is an estimated $320 million less.

In addition to thermal generation-related GHG emissions there would be the emissions associated with the development of reservoirs, generating stations and transmission lines. Estimates are not available for all of the project development impacts in all of the plans. However, the largest GHG emission impacts within Manitoba would likely result from the Keeyask and Conawapa Projects, with the clearing, flooding and construction-related impacts they would have.

A lifecycle GHG assessment for the Keeyask Project[33] indicates that land-use changes including reservoir clearing and flooding would result in an estimated 496,000 tonnes CO_{2e} of emissions. Construction activities, including building materials and manufacture, transportation and on-site construction activities, would result in approximately 454,000 tonnes CO_{2e} (an estimated 40% of which would occur within Manitoba). In total the lifecycle development impacts for Keeyask G.S., including provision for future maintenance and refurbishment activities and decommissioning, would amount to some 979,000 tonnes CO_{2e} of emissions. Approximately 700,000 tonnes CO_{2e} would occur within Manitoba. The development of the Conawapa Project would also generate some GHG emissions, though less than Keeyask Project because of the much more limited flooding it entails.

Taking into account the social cost of the emissions resulting from the development of Keeyask G.S. would reduce the GHG advantage of the plans with Keeyask G.S. relative to the all gas plan. However, the impact would be relatively small. The Keeyask G.S. emissions would be some two orders of magnitude less than the emissions from the thermal operations they displace. Similarly, taking into account the emissions from the development of Conawapa G.S. would reduce the GHG advantage of the Preferred Development Plan relative to the others. But the impact here would also be relatively small, especially with Conawapa G.S. emissions even less than Keeyask G.S.

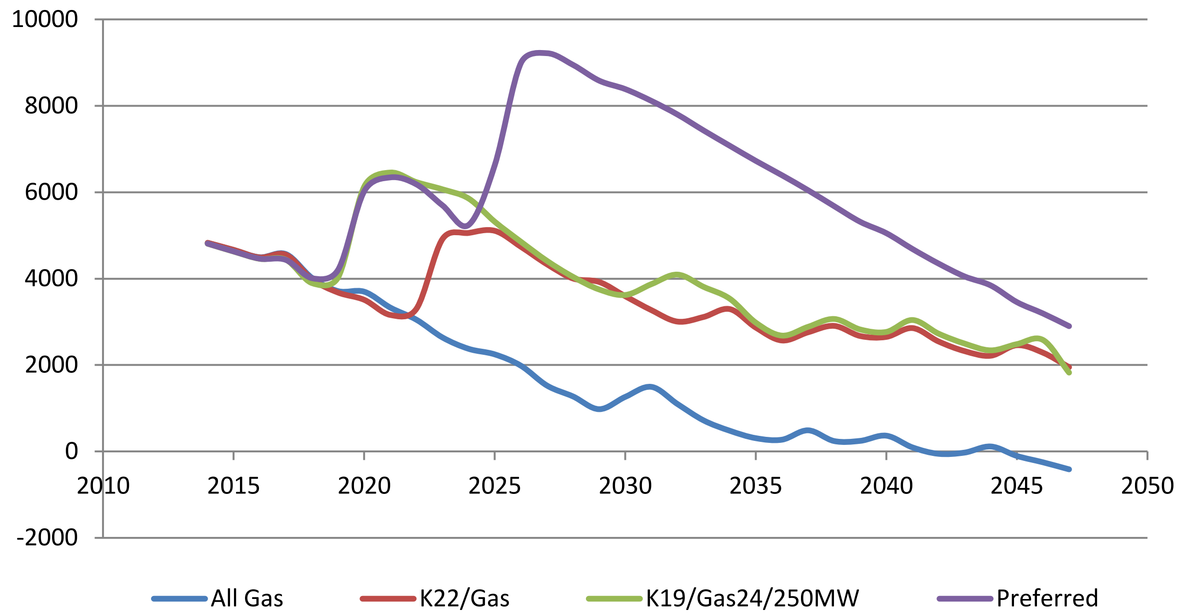
Moreover, whatever GHG emissions impacts would result from the development of Keeyask G.S. and Conawapa G.S., they would be more than offset by the very significant positive impact those projects have on global displacement of GHG emissions. Figure 13.8 shows the estimated

[33] Appendix 7.3: Life Cycle Greenhouse Gas Assessment Overview.

impact of the different development plans on GHG emissions outside Manitoba due to Manitoba Hydro's exports and imports, and consequently on thermal power generation outside the province.

Figure 13.8 REDUCTION OF THERMAL GENERATION-RELATED GHG EMISSIONS OUTSIDE MANITOBA

('000 TONNES OF CO_{2E})



As shown in the figure, the plans with Keeyask G.S. would all significantly reduce GHG emissions in the U.S. The Preferred Development Plan with Keeyask G.S. and Conawapa G.S. would have an even greater impact. In some years the annual displacement of GHG emissions outside Manitoba with the Preferred Development Plan would exceed 8 million tonnes. This single-year impact is many times larger than the total 100-year lifecycle GHG impacts of these projects. Overall, the Preferred Development Plan, and to a lesser extent the Keeyask-gas and smaller interconnection alternatives, would make very significant contributions to the reduction of global GHG emissions.

Local CAC Emissions

In addition to GHG emissions, thermal generation in Manitoba produces emissions of nitrogen oxide (NO_x), fine particulates (PM_{10}) and other criteria air contaminants (CACs). Figures 13.9 and 13.10 show the estimated tonnes of NO_x and PM_{10} emissions in Manitoba in the different plans. As shown in the figures, the all gas alternative has the greatest amount of emissions, followed by the two alternatives that include the development of Keeyask G.S. The Preferred Development Plan, with the development of both Keeyask G.S. and Conawapa G.S. has significantly less CAC emissions than the others.

Figure 13.9 NO_X EMISSIONS IN MANITOBA IN PREFERRED AND ALTERNATIVE PLANS

(TONNES)

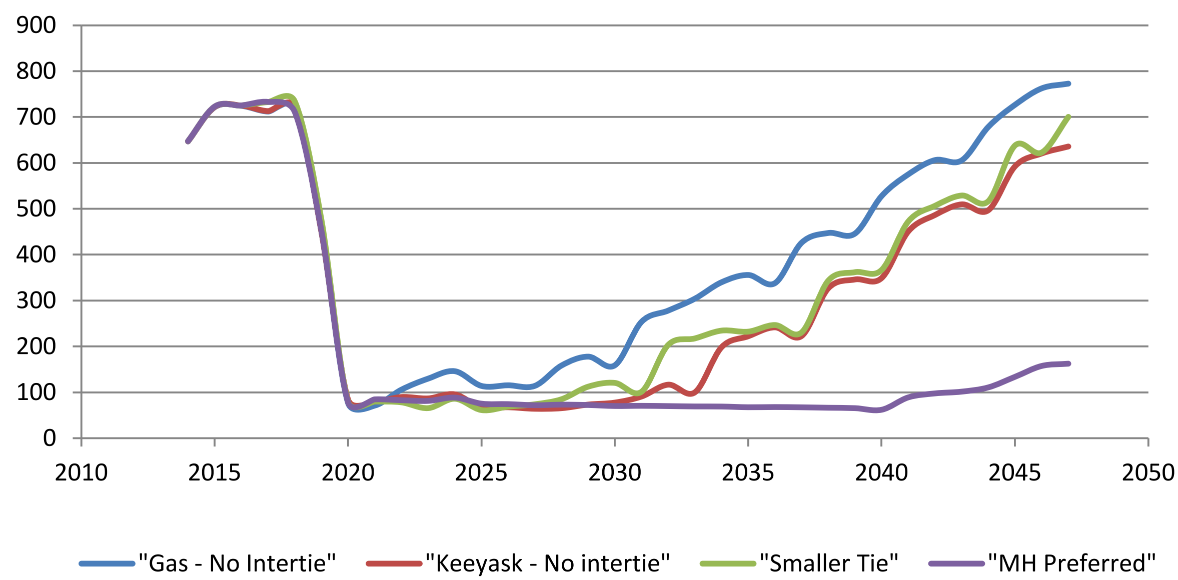
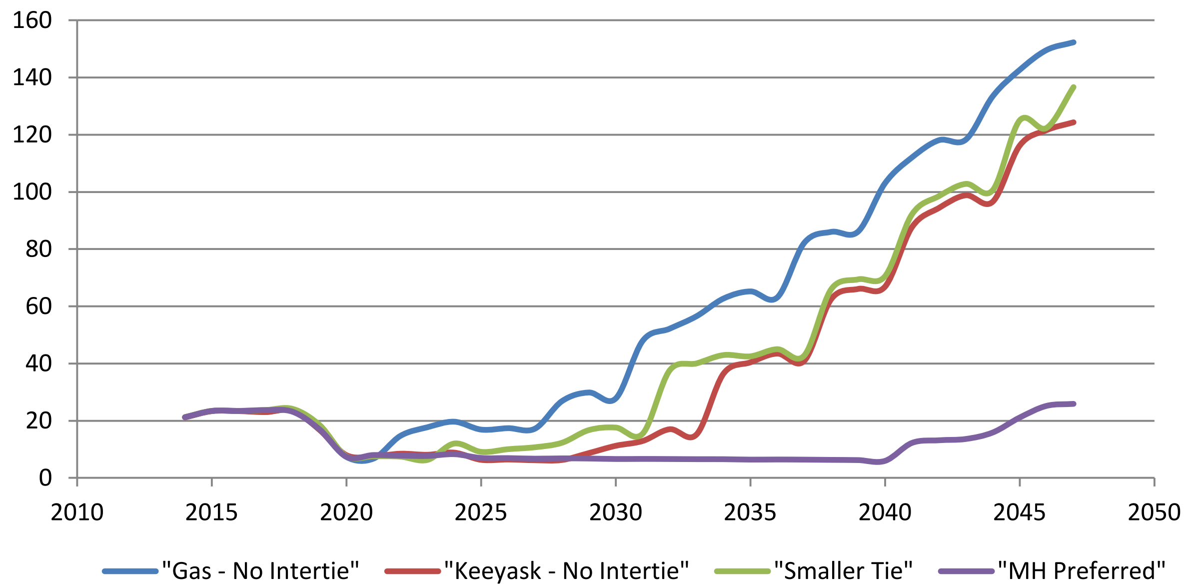


Figure 13.10 PM_{10} EMISSIONS IN MANITOBA IN PREFERRED AND ALTERNATIVE PLANS

(TONNES)



These emissions are of concern because of the health and other adverse impacts they can have. A measure of the cost they entail is their total damage costs – the estimated costs of the illness and premature death, as well as any agricultural or other adverse resource impacts they may have.

The exact damage costs associated with these emissions depend on many factors, including meteorological conditions, topography, and the size, proximity and demographics of exposed populations. External cost studies undertaken for the European Commission (2005) show estimates of the damage costs of NO_x emissions ranging from 1,000 euros/tonne to over 9,000 euros, and damage costs of PM ranging from just over 4,000 euros/tonne to over 60,000 euros per tonne.[34] Higher ranges are reported with higher assumed values for the willingness to pay to reduce the risk of loss of life years. A key factor governing the costs is nearby population, as human exposure to the pollutants is critical in determining the incidence of illness and death due to the emissions.

For purposes of illustrating the potential damage costs of the CAC emissions in the preferred and alternative plans, damage cost values of $3,000/tonne for NO_x and $20,000/tonne for PM_{10} are assumed (2012$ Cdn). These are in the lower end of the range of the EU study, which is appropriate for relatively small southern population centres like Brandon and Selkirk where much of the thermal generation would likely take place.

Table 13.8 shows the total present value costs of the CAC emissions in each plan based on these damage cost estimates. As shown in the table, the total costs and differences from the referred plan are relatively small. While arguably the costs estimates are conservative[35], the fact remains that with appropriate siting and modern pollution control technology, the pollution-related external costs of thermal generation can be minimized. There are advantages in avoiding CAC emissions, but they are relatively small compared to GHG impacts and other consequences of the different plans.

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[34] See European Commission publication, *Damages per tonne of emissions of $PM_{2.5}$, NH_3, NO_x and VOCs from each EU25 Member State (excluding Cyprus) and Surrounding Seas*, March 2005.

(http://ec.europa.eu/environment/archives/cafe/activities/pdf/cafe_cba_externalities.pdf)

[35] The European PM damage cost estimates are for $PM_{2.5}$. One could expect higher costs for finer particulates (PM_{10}) because of the greater health hazard they present. Also the damage cost estimates could increase over time. See U.K. Department of the Environment, Air Quality: economic analysis, May 10, 2013 (www.gov.uk/air-quality-economic-analysis) where it is recommended to assume an increase in the real value of damage costs over time due to an expected increased willingness to pay to reduce the risk of loss of life as incomes rise. It is also recommended to use a lower discount rate (3.5% real) as compared to the 6% real rate used to calculate present values in this study.

Table 13.8 CAC DAMAGE COSTS FROM MANITOBA THERMAL GENERATION IN PREFERRED AND ALTERNATIVE PLANS

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Estimated damage cost of NO_x emissions	13.4	16.9	16.3	18.9
Estimated damage cost of PM emissions	4.1	9.2	8.3	11.9
Total CAC Damage Costs	**17.5**	**26.1**	**24.6**	**30.8**
Difference from Preferred Development Plan	-------	**8.6**	**7.1**	**13.3**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

Bio-physical Impacts

The development of new generation and transmission facilities in the different plans would have a wide range of physical, aquatic and terrestrial environmental impacts.

In the Preferred Development Plan, there would be the impacts associated with the development of the Keeyask and Conawapa hydro stations, related transmission and network upgrades; a new 750 MW interconnection with the U.S.; and some 600 MW of simple cycle gas turbine capacity should that capacity be needed toward the end of the planning period (2041-46) to meet requirements.

In the smaller-interconnection alternative there would be the impacts of the development of Keeyask G.S. and related transmission; a 250 MW interconnection to the U.S.; and over 1,600 MW of simple and combined cycle gas turbine capacity. The Keeyask-gas alternative would give rise to the same development impacts, except for the interconnection to the U.S. which would not be built in that case. With the all gas alternative there would be the impacts associated with the development of gas turbine capacity – some 900 MW of simple cycle capacity and 1,540 MW of combined cycle capacity.

As discussed in ***Chapter 2 – Manitoba Hydro's Preferred Development Plan Facilities,*** Manitoba Hydro and its Cree Nation partners have undertaken a detailed environmental assessment of the Keeyask generation project. The assessment sets out the scope of the project, its potential effects, plans to avoid and mitigate adverse effects and an evaluation of residual effects (i.e. those that remain after mitigation).[36]

The project would entail the flooding of 45 km^2 of land initially, increasing another 7 or 8 km^2 over time. There would be increases in water levels upstream and flow impacts up to 3 km downstream. There would as well be clearing of land for construction, access and transmission line right of ways.

Among the aquatic impacts, there would be some loss of spawning and foraging habitat as well as some blockage of fish passage. Extensive mitigation measures have been planned to minimize and offset these effects. These include plans in construction and for turbine design to minimize impacts; development of new habitat and fish passage; and implementation of a fish stocking program. While some short term declines in fish populations are expected, no declines are expected over the long term, and lake sturgeon populations in the region are expected to

[36] Keeyask Hydropower Limited Partnership, *Environmental Impact Statement-Response to EIS Guidelines*, Chapter 6, Environmental Effects Assessment, June 2012.

increase with the stocking and stewardship programs despite the loss of habitat due to the project.[37]

The federal government is considering whether to list lake sturgeon in the Nelson River as endangered under the *Species at Risk Act (SARA)*. Manitoba Hydro's planning is based on the assumption that this will not occur, particularly given the stocking and stewardship programs that are being developed and implemented. Were listing under *SARA* to occur the Keeyask and Conawapa Projects could be delayed or cancelled. If Manitoba Hydro (and in the case of Keeyask the partnership) decided to proceed with the projects, federal permits would be required.

The development of Keeyask G.S. would result in an increase in methylmercury concentrations in fish peaking 3 to 7 years after impoundment. It is expected the methylmercury concentrations would revert back to original levels after 30 years. Monitoring and communication programs, as well as funding of offsetting programs to support harvesting in alternative locations are planned to mitigate these effects.

Among the terrestrial impacts is the loss of habitat, including wetland areas, affecting mammals, birds and waterfowl. There would also be impacts due to sensory disturbance, increased traffic and human presence, and greater access to and pressure from hunting. For birds there could as well be impacts from wire strikes. Mitigation measures include careful

[37] Manitoba Hydro has been working on stewardship activities with provincial and federal regulators, academic institutions, First Nations and stakeholder organizations such as the Nelson River Sturgeon Board and the Saskatchewan River Sturgeon Management Board. The objective is to develop a comprehensive set of programs designed to protect and enhance lake sturgeon populations. See NFAT, Appendix 2.1 for details.

siting of infrastructure facilities away from sensitive sites, such as caribou calving habitat and regionally rare habitat types. New wetland habitat and nesting areas would be developed. Cumulative effects for all priority habitat types would be maintained below 10%, a key indicator of ecosystem sustainability. An access management and hunting control plan would also be implemented.

Manitoba Hydro is of the view that these mitigation measures combined with offsetting programs and the compensation provided for in the adverse effects agreements, plus the fact that from the very outset a low-level development option was selected to minimize flooding and the increase in water levels upstream, would serve to ensure that the residual impacts would be relatively small.

The economic measure of the cost of any residual impact on environmental resources and attributes is the compensation required by those people who would be adversely affected to willingly accept the impacts and risks. The acceptance and participation of the KCNs in the Joint Keeyask Development Agreement suggests that the cost (for social as well as natural resource and environmental effects as they affect local residents) would be largely internalized in the design, plans and agreements governing the project development. There would be no major *external* cost to take into account.

Detailed environmental assessments have not been undertaken for the other projects in the preferred and alternative plans. Preliminary assessments indicate, however, that the impacts of the Conawapa Project would be similar in nature to the Keeyask Project, except the flooding and related aquatic impacts would be much less. It would entail only 5 km^2 of flooding as compared to 45 km^2 for Keeyask G.S. There would be less linear development to connect

Conawapa generation to the system than for Keeyask G.S. – five 7-km lines would be required to connect the generating station to the converter station. However, the combined development of Keeyask G.S. and Conawapa G.S. would require upgrades to the HVDC collector system as well as upgrades to some 470 km of the north-south 230 kV AC transmission system.

At this point, and subject to the findings in project-specific environmental assessment reviews, Manitoba Hydro is of the view that preliminary project designs and cost estimates for Conawapa G.S. and the related upgrades provide for sufficient mitigation to minimize residual adverse effects to acceptable levels. It is also expected that some form of local agreements would be entered into to ensure whatever residual biophysical impacts or risks remain, they would be addressed. Thus, as with the Keeyask Project, it is not anticipated there would be significant external environmental costs from the projects' impacts on aquatic or terrestrial habitat and resources as they affect local residents.

The same general conclusion applies to other projects in the different plans. Careful siting, construction methods, and right-of-way maintenance provisions would be used to minimize the environmental impacts of the U.S. interconnection. With respect to gas thermal plants, the land requirements are small (some 2.8 hectares for a 320 MW CCGT plant and 1.7 hectares for a 216 MW SCGT, and linear development of 2 to 55 km depending on the exact site). New terrestrial impacts could be minimized further with brownfield development at existing power station sites. There would be some steam and cooling water requirements, but these would be minimized with efficient water recycling design.

Some residual impacts could occur with these projects, but they would be the subject of detailed environmental reviews and arrangements with directly affected individuals or communities. It is anticipated that most, if not all of the costs, would be internalized in the measures that would be undertaken in securing easements and land, and in the project construction and operations.

In summary, while the bio-physical impacts would differ across the different plans, there would not appear to be a major difference in the external costs they give rise to. For the most part the impact-related costs have been internalized with the project designs and plans, and consequently are already reflected in the revenues and expenditures in the market valuation account.

13.3.6 Social Account

The project developments in the preferred and alternative plans would have a wide range of social and economic effects for project partners, local and regional communities, and Manitobans as a whole.

For partners there would be the expected returns and other benefits from their investment and participation in the projects. For affected communities there would be employment and business impacts, as well as potential impacts on traditional and commercial resource activity. There would also be potential impacts on population, housing, infrastructure and services; transportation; family and community well-being; health and safety; and culture and heritage resources. For Manitobans generally, there would be potential impacts on widely held values, including the long-term sustainability or bequest value people in principle may be willing to pay for.

Project Partners

In the preferred and alternative plans that include the development of the Keeyask Project, the investment, employment, direct contract award and other provisions of the JKDA would take effect. These would generate significant benefits for the four Cree Nations (KCNs) that would partner with Manitoba Hydro in the development of the project.

In the Keeyask Environment Impact Statement (EIS) it was estimated that the project would generate between 235 and 600 person-years of construction employment for the KCN partners. There would as well be direct negotiated contracts generating employment and profits from the provisions of camp services, clearing and site preparation, road construction, and other work. For the longer term, there would be a target placement of 182 KCN members in operating positions in Manitoba Hydro.[38]

The investment provisions would enable KCN to acquire an equity interest up to 25% in the project, with the potential of generating significant net returns from their investment. Agreements have not yet been reached for Conawapa, but it is expected for that project, too, there would be benefit-sharing arrangements with local First Nations in the vicinity of the project, as well as a range of local and regional employment, training and business opportunities.

As for the other projects in the preferred and alternative plans, in particular the thermal projects that would be developed, there are no plans to enhance local employment

[38] Keeyask Hydropower Limited Partnership, *Environmental Impact Statement* Chapter 6, pp. 6-434 to 6-439.

opportunities as in the JKDA and no investment participation or direct income benefit arrangements are envisaged at this time.

The net returns to Manitoba Hydro project partners and other direct income beneficiaries would be significant in all of the plans with Keeyask G.S., but particularly if it is built in conjunction with new sales and a new interconnection. That enhances the average export price and participant returns. The largest benefits would be realized with the Preferred Development Plan because of the larger interconnection and sales it includes and because of the benefit-sharing agreement that Conawapa G.S. is assumed to entail.

Local and Regional Community Impacts

A detailed socio-economic impact assessment has been undertaken for the Keeyask Project, but not for the other projects in the preferred and alternative plans.

The Keeyask G.S. assessment has indicated that there would be significant employment benefits throughout the region, and spin-off business benefits in Gillam and Thompson. Gillam would realize longer-term benefits because of the permanent jobs that would be located there to support Keeyask operations. While there are concerns about wage pressure and cost-of-living impacts that could result, these are not expected to be significant because of an anticipated business closure and consequent weakness elsewhere in the regional economy.

There are expected to be some adverse impacts on domestic resource use and commercial trapping due to disturbance to fish and wildlife resources and habitat. However, they would be limited and offset by the provision of alternative harvesting opportunities and compensation arrangements. Licensed trapline holders would be eligible for compensation.

There could be some in-migration to local and regional communities during construction, with consequent pressures on housing, recreational and other facilities, and community services. The impacts are expected to be limited, in part because the existing housing shortage in nearby local communities would discourage project workers from returning to those communities. However, the impacts would be monitored and mitigation measures taken as required. Additionally, plans are being developed to address infrastructure and service requirements in Gillam, with an expected increase in its permanent population.

Concerns about transportation have been expressed, including impacts due to increased traffic on provincial roads. Impacts on provincial roads would be mitigated by improvements to PR 280, and impacts on winter road access and ferry landings would be monitored.

As with other major projects in remote areas, there would be both positive and negative potential impacts on families and community well-being. The increased income and employment opportunities can significantly benefit families, but at the same time they can give rise to undesirable activities such as drug and alcohol abuse. Undesirable interaction between construction workers and local residents would be expected to be much reduced compared to previous experiences, but this issue would remain a priority of Manitoba Hydro, the communities, RCMP and other local service providers to monitor and address. Similarly, monitoring and mitigation measures would be implemented to address other community and health concerns, in particular with regard to increased methylmercury levels in fish after impoundment.

Overall, while there would be some adverse effects, for the most part they would be mitigated and limited in duration. Some concerns would no doubt remain, but again, the KCNs support and participation in the project suggest that local adverse effects would be offset by the positive impacts and expected benefits.

Detailed assessments for the other projects in the preferred and alternative plans have not been undertaken. The impacts and mitigation plans for Conawapa G.S. would be similar to Keeyask G.S., with similar net effects. The impacts for thermal power plant developments would be different, but again it could be expected that siting and mitigation plans would minimize residual adverse effects. Transmission line development through private lands raise different social issues, including disputes about the compensation paid for easements. For the transmission lines associated with generation-related, network upgrade and interconnection projects, siting would be carefully done to minimize impacts, and fair market value paid for access to or purchase of private land. In most instances the number of parties and amount of money involved would be relatively small. Nevertheless, while not necessarily significant from a broad provincial perspective, any residual impacts could be quite important from the perspective of those directly affected.

In sum, there would be the full range of positive and negative impacts major projects can have on nearby communities and affected property owners. For the most part, adverse impacts would be minimized or offset with careful project planning, siting, monitoring, mitigation and compensation arrangements. However, some negative residual effects could still occur for some individuals and families.

Manitobans as a Whole

For Manitoba as a whole, the cost-benefit question is whether there are social benefits or costs – consequences that people in principle value positively or negatively – not reflected in the other accounts. There could be some broad community support for the engagement with Aboriginal Communities in the plans with northern hydro development. There could as well be strong preference for development plans that rely on renewable as opposed to non-renewable fossil-fuel resources. For some Manitobans there may be a willingness to pay for such consequences or attributes that go beyond what is already reflected in Manitoba Hydro's aboriginal partnership agreements and in the costing of GHG emissions already taken into account, though it is not clear how significant that would be from a broad provincial perspective.

One aspect of the plans, however, that may be more broadly significant and that may not have been fully recognized in the other accounts, is what one could describe as a bequest value – the value of the assets that will benefit future generations of Manitobans over the very long term.

The residual value of the assets at the end of Manitoba Hydro's planning period was included in the present value calculations in the market valuation account. This was done by projecting and comparing for the different plans the capital and O&M costs net of export revenues required to maintain the system from 2047 through to 2090. The residual value of the hydro generating and related assets in the preferred and two alternative plans with Keeyask G.S. was then calculated by calculating the long-term net cost saving relative to the all gas plan, with its greater need for replacement investment, greater O&M and lower export revenues.

The calculated residual values for the hydro assets remaining at the end of the planning period were significant, as one would expect given their long life and minimal operating cost. However, their 2047 residual value was calculated at a real discount rate of 5.05% reflecting Manitoba Hydro's weighted average cost of capital; and its 2014 present value in this MA-BCA was calculated with a 6% real discount rate reflecting the weighted average social opportunity cost. The question is whether those discount rates give adequate weight to the future benefits – whether they truly reflect what people would be willing to pay today for benefits passed onto future generations.

Discount rates of 5.05% and 6% (real) are lower than the rates that private industry would use to calculate the present value significance of residual assets remaining at the end of the planning period. However, that is because private industry typically assigns much greater weight to the more immediate consequences of its decisions. It is precisely because of that, it has been Crown Corporations that have undertaken the major hydro developments in Canada in the past. As a matter of public policy and with government support Crown Corporations were able to give much greater weight to the long-term value of their investments. In effect, they applied much lower discount rates in the assessment of their investment decisions; and as can be seen with the very low electricity prices in Manitoba, Quebec and British Columbia as compared to other jurisdictions, that has served this present generation very well.

In recent years, a number of economists specializing in cost-benefit or related analyses argue that traditional cost of capital-based discount rates do not give adequate weight to the intergenerational consequences of investment and policy decisions. Some economists advocate and some government cost-benefit guidelines have in fact adopted declining real discount rates over time to give greater weight to intergenerational impacts in the distant future.[39] This has been particularly important in the assessment of climate change concerns; it is also relevant to any long-lived assets providing benefits into the very distant future.

The application of lower, intergenerationally sensitive discount rates would increase the weight or present value significance of the assets remaining at the end of the planning period and increase the advantage of the plans with Keeyask G.S. and especially the Preferred Development Plan with Keeyask G.S. and Conawapa G.S. as compared to the all gas plan. In economic terms it would add an important bequest value to these plans, over and above what has already been taken into account. No attempt is made in this assessment to quantify the magnitude of that potential value; it is simply recognized as a potentially important qualitative consideration to take into account in the overall assessment of the relative merits of the different plans.

13.3.7 Summary of Reference Scenario Assessment

In Table 13.9, the assessment of the preferred and alternative development plans under the market valuation, customer, Manitoba government, Manitoba economy, environment and social accounts are summarized. The dollar values show the estimated present value difference from the Preferred Development Plan under Manitoba Hydro's NFAT reference scenario set of assumptions, with positive values indicating a net advantage (higher net revenue/benefit or lower net cost) relative to the Preferred Development Plan; negative values indicate a net disadvantage (higher net cost).

[39] See e.g. M. Weitzman, "Why the Far-Distant Future Should be Discounted at Its Lowest Possible Rate", *Journal of Environmental Economics and Management*, Vol.36, 1998, pp.201-8; P. Portnoy and J. Weyeant, *Discounting and Intergenerational Equity*, Resources for the Future, 1999; and U.K. HM Treasury, *The Green Book: Appraisal and Evaluation in Central Government*, p.26.

As shown in the table, the market valuation – the incremental revenues and expenditures for Manitoba Hydro and its project partners – shows that the plan with Keeyask G.S. and no new interconnection is preferable to the all gas plan and that the plans with a new interconnection (large or small) are preferable to the two alternatives without one. As between the Preferred Development Plan and the one with the smaller interconnection, there is little difference. The smaller interconnection is slightly better with its estimated present value net revenues (at a 6% real discount rate) $17 million greater than with the Preferred Development Plan.

In summary, from a long-term Manitoba Hydro perspective it is advantageous to develop Keeyask G.S. (as opposed to gas thermal) and even more advantageous when developed in conjunction with a new interconnection and firm export sales to the U.S.

As one moves from a strictly Manitoba Hydro to broader social or public interest perspective, the long-term advantage of the plan with Keeyask G.S. and particularly Keeyask G.S. with a new interconnection relative to all gas, become even more pronounced. There are significant advantages for customer reliability, government, the economy, and in relation to GHG emissions for the plans with Keeyask G.S. as compared to all gas. And with these broader net benefits taken into account there is a significant advantage of the Preferred Development Plan relative to the plan with the smaller interconnection. The estimated present value of the monetized net benefits of the Preferred Development Plan is $~~680~~654 million greater than the plan with the smaller interconnection; $~~1 billion~~967 million greater than the plan with Keeyask G.S. and no interconnection; and $1.~~9~~855 billion greater than the all gas plan.

Table 13.9 SUMMARY OF REFERENCE SCENARIO ASSESSMENT

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Market Valuation Net revenues (cost) to MH and partners	--	17.0	(270.5)	(654.1)
Customer Account Cumulative rate increase	Preferred Development Plan has highest rate increases in first 20 years (cumulatively 16 to 18 percentage points more than the alternative plans) but has lowest rate increases over long term (cumulatively by year 50 approximately 34 to 37 percentage points less than the two alternatives with Keeyask G.S. and 70 percentage points less than the all gas plan).			
Reliability	Preferred Development Plan and to lesser extent the alternative with the smaller interconnection provides greater load carrying capability, lower expected loss of unserved energy and greater ability to manage extreme drought			
Government Incremental revenues net of costs/risk	--	(353.5)	(395.9)	(674.2)
Manitoba Economy Employment net benefits	--	(~~123~~100.7)	(~~150.0~~120.1)	(~~260.3~~192.7)
Environment Manitoba GHG external cost	--	(208.6)	(174.3)	(320.3)
Global GHG impact	Preferred Development Plan and to lesser extent the two plans with Keeyask G.S. would contribute to a reduction in global emissions by displacing thermal generation in US.			
Manitoba CAC damage cost	--	(8.6)	(7.1)	(13.3)
Residual biophysical	Aquatic and terrestrial impacts with hydro projects in Preferred Development Plan and plans with Keeyask G.S.; subject to detailed environmental hearings, residual effects and local external cost expected to be relatively small with initial design, extensive mitigation, monitoring, compensation and benefit-sharing arrangements.			
Social Partner net return	Significant net returns from up to 25% interest in Keeyask G.S. and income benefits from Conawapa G.S. in Preferred Development Plan; significant benefits from up to 25% interest in two alternatives with Keeyask G.S., greater with new sales and interconnection.			
Community impacts	Wide range of potential impacts on local employment and business; population, infrastructure and service; social and community well-being; owners of land needed for rights of way and easements; major commitments and plans to minimize adverse residual effects with extensive mitigation, monitoring, compensation and partnership arrangements.			
Other Manitoba	Potentially significant bequest value from the hydro assets remaining at end of planning period; greatest with Preferred Development Plan and to a lesser extent in the alternatives with Keeyask G.S.			
Overall Monetized Net Benefit (Cost)	**--**	**(~~677~~654.4)**	**(~~997.4~~967.5)**	**(1,~~922.2~~854.6)**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

There are important distributional and non-monetized impacts that the monetized net benefit numbers do not show. A key distributional issue is the pattern of rate impacts over time. The Preferred Development Plan exhibits the lowest rate increases over the long run, but the largest increases in the short to medium term. On the other hand the Preferred Development Plan offers the greatest bequest value for future generations – a value that may not be fully captured by the residual value in Manitoba Hydro's assessment of net system costs.

This distributional trade-off calls for careful consideration of short to medium versus long-term interests. A long-term perspective strongly supports the Preferred Development Plan with its development of Conawapa G.S. as well as Keeyask G.S. A shorter-term perspective will favour less capital expenditure, though the results would still indicate an advantage for the plans with Keeyask G.S., and especially Keeyask G.S. and a new interconnection over the all gas plan. There is not the same short to medium versus long term trade-off when comparing the Keeyask/gas or Keeyask/small tie alternatives versus the all gas plan as there is with the Preferred Development Plan.

The main non-monetized issues concern the environmental and social impacts of the projects in the different plans. The assessment does not indicate that there would be major residual effects or trade-offs to consider given the extensive monitoring, mitigation and other measures that are planned, but this will be addressed in detail in the environmental hearings the projects require.

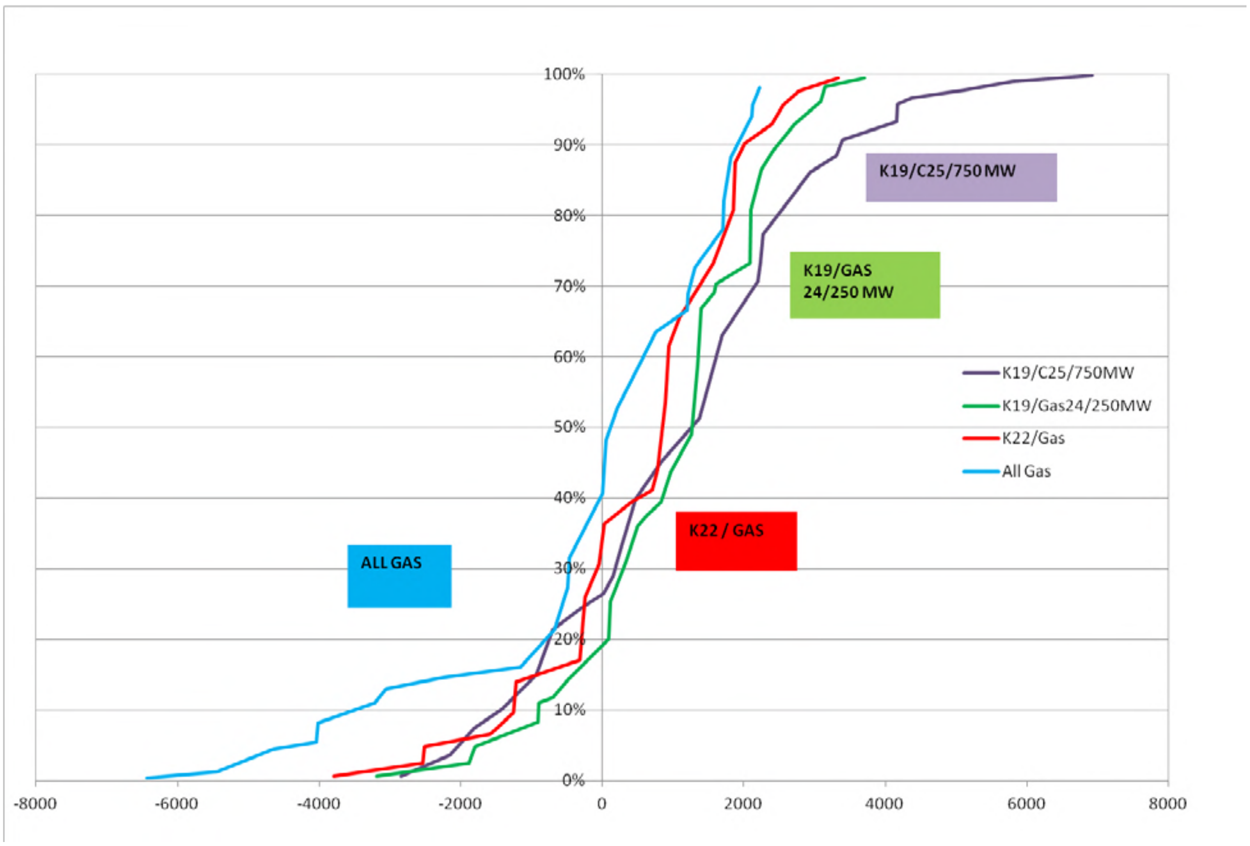
13.3.8 Uncertainty and Risk

The benefits and costs estimated with Manitoba Hydro's reference scenario set of assumptions indicate that the development of Keeyask G.S. offers significant advantages over gas; that the development of Keeyask G.S. is more advantageous with a new interconnection and firm sales than without; and that the Preferred Development Plan, which includes the development of Conawapa G.S. and a large new interconnection, is the best overall from a broad provincial perspective over the long term.

However, there is uncertainty in the reference scenario assumptions and therefore in the consequences of the different plans for Manitoba Hydro revenues and expenditures and customer rates. It is not just the consequences of the Preferred Development Plan, but rather of all the plans that are subject to considerable uncertainty. The question thus arises, does the uncertainty favour some plans over others – is there a risk trade-off that could change the relative advantage of the different plans based on the reference scenario analysis.

To address this question, the revenue and expenditure and consequent rate implications of the different plans were analyzed under a wide range of assumptions. With probabilities attached to the different underlying assumptions, probability distributions of the range of outcomes were calculated. In Figure 13.11 the probability distribution of the net present values of the preferred and alternative plans are shown. They are presented as "S-curves" which show the cumulative probability values. A given point on the curve indicates there is a percentage value (from the y-axis) chance that the net present value (calculated relative to the all gas reference scenario result) will be less than or equal to the corresponding amount of the x-axis.

Figure 13.11 MANITOBA HYDRO NET REVENUE S-CURVES



2014 PRESENT VALUE IN MILLIONS OF 2014$

The curves show that there is a wide range of outcomes for all of the plans. However there are differences. Manitoba Hydro's Preferred Development Plan would appear to offer the greatest upside potential. The all gas plan, on the other hand, exhibits the greatest downside risk. With respect to the Preferred Development Plan versus the alternative with the smaller interconnection there is a trade-off. There is a 50% chance the small-interconnection alternative would be better than the Preferred Development Plan and it generally has less downside risk. The Preferred Development Plan however has an equal chance of being better with greater upside potential.

The S-curves shown in Figure 13.11 are based on set development plans. In the all gas case, for example, the plan assumes a continuation of gas plant development even in scenarios where gas and energy prices rise above what is currently expected. In the Preferred Development Plan Conawapa G.S. is developed for 2025 even if low market prices or high interest rates would favour delaying the in-service date. As discussed in the next chapter, each development plan represents a pathway which preserves some flexibility to make changes depending on unfolding events. And that flexibility can serve to mitigate certain downside risks.

For example, some of the downside risk of the all gas plan can be mitigated by shifting back to hydro or other sources if fuel and carbon prices rise to the point where gas-fired thermal is clearly uneconomic. Similarly, up until the commitment date for Conawapa G.S., some of the downside risk of the Preferred Development Plan can be mitigated by deferring development expenditures should it become apparent that project development would not be economic with the currently planned early in-service date.

With these mitigation opportunities, the differences in the extent of the downside risk greatly diminish. The all gas plan could become gas followed by Keeyask G.S. or Conawapa G.S. as opposed to Keeyask G.S. followed by gas. The Preferred Development Plan could be Keeyask G.S. without Conawapa G.S. or Keeyask G.S. with Conawapa G.S. at a later date.

What differentiates the plans is not so much the extent of the downside risk due to unfolding future events, but what is retained or foregone by the initial decisions. The all gas alternative retains the opportunity to have a no hydro future, but it foregoes the benefit and upside potential with the early development of Keeyask G.S., and in particular the development of Keeyask G.S. with the current export and interconnection opportunity. As for Keeyask G.S.

without a new interconnection, it foregoes the expected benefit and potential upside from the current export and interconnection opportunity. And as for the Keeyask G.S. with a small tie, it foregoes the benefit and potential upside of the larger sales and early development of Conawapa G.S.

Overall, there is little reason to reconsider the broad conclusions concerning the relative long term (net present value) advantage of the different plans suggested by the reference scenario analysis. The plan with Keeyask G.S. is better from an expected and risk point of view to the all gas plan, and the plans with a new interconnection are better than the ones without.

As with the reference scenario findings, the rate implications in the short to medium term versus long term are a different matter. Figure 13.12 shows the probable range of the projected cumulative rate impacts of the different plans after 20 years; Figure 13.13 the probable range of the projected cumulative rate increases over 50 years.

The rate impact ranges in these figures reinforce the short to medium term rate versus long term trade-off identified in the reference scenario analysis. Over the long term (by year 50) the rate impact with the Preferred Development Plan is lower with a narrower band of uncertainty than the others, but the opposite is true in the short to medium term. The rate impact with the Preferred Development Plan is cumulatively greater and more uncertain than the others.

These projected rate impact figures are based on the set development plans as opposed to the pathways they represent. Cumulative rates with the pathways would show narrower ranges for all of the plans. However, the general pattern and short to medium term versus long-term trade-off would remain much the same.

Figure 13.12 **PROJECTED MANITOBA HYDRO CUMULATIVE NOMINAL RATE INCREASES TO 2031/32**

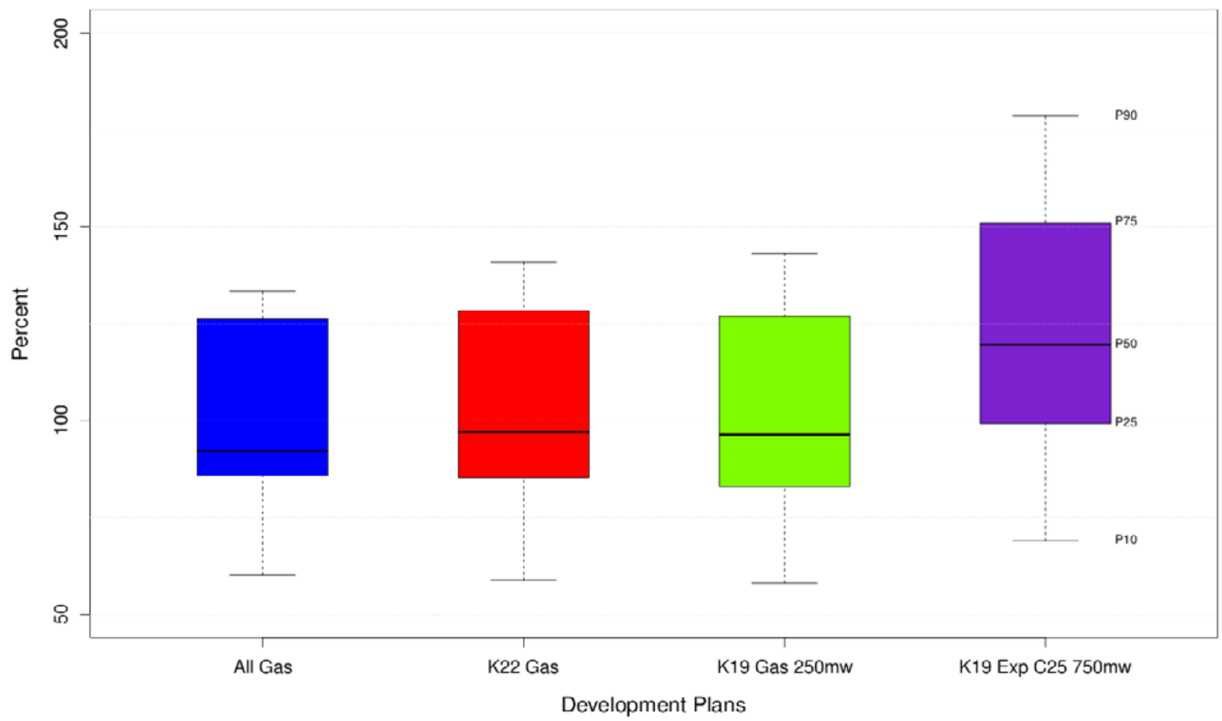
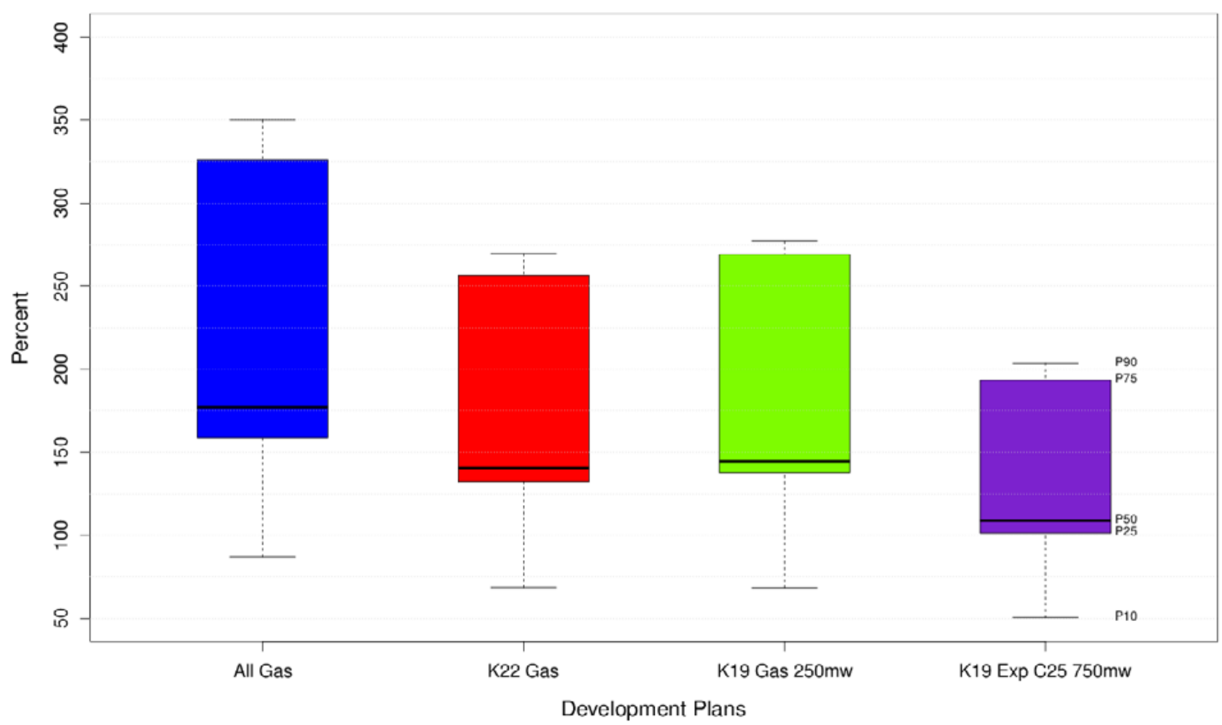


Figure 13.13 PROJECTED MANITOBA CONSUMERS CUMULATIVE NOMINAL RATE INCREASES TO 2061/62



13.4 Conclusions

The purpose of a multiple account benefit-cost assessment is not so much to determine which of a set of alternatives is best, but rather to identify their advantages or disadvantages and the key trade-offs from a broad social or public interest perspective.

This multiple account benefit-cost assessment of Manitoba Hydro's Preferred Development Plan and alternative plans with and without Keeyask G.S. and with and without a new interconnection and firm sales with the U.S. indicate that there are key trade-offs that require careful consideration, most notably between a strictly Manitoba Hydro and broader social perspective and between customers in the short to medium versus long term.

The main findings are as follows:

- Developing Keeyask G.S. to meet domestic load offers significant net benefits relative to the all gas plan not only for Manitoba Hydro but also more broadly to society as a whole; developing Keeyask G.S. offers significant tax, employment, GHG and social benefits that go beyond the benefits to Manitoba Hydro and its partners.
- Plans that include a new interconnection offer significant net benefits compared to those that do not include a new interconnection. These plans significantly enhance the net benefits for Manitoba Hydro and its partners.
- The alternative with the 250 MW interconnection and the development of Keeyask G.S. but not Conawapa G.S. offers similar expected net benefit to Manitoba Hydro and its partners as the Preferred Development Plan, without the short to medium term rate trade-off that the Preferred Development Plan gives rise to. At the same time this alternative with a smaller interconnection and Keeyask G.S. only does not offer the same long-term legacy value or upside potential as the Preferred Development Plan. Nor does it offer the same long term rate, customer reliability, tax, employment, GHG and social benefits as the Preferred Development Plan.
- The Preferred Development Plan offers the lowest projected rate impacts for the long term and significantly greater benefits to society as a whole than the smaller interconnection alternative. It does, however, require higher projected rate increases in the short to medium term than the other plans. The more weight one places on the broader public interest consequences and the longer-term effects, the more one would favour this plan.

TAB 10

REFERENCE: Chapter 13: Integrated Comparisons of Development Plans - Multiple Account Analysis; Page No.: 53-54

PREAMBLE: One significant environmental concern of the proposed Keeyask and Conawapa hydro dams relates to the effects of these proposed dam projects on lake sturgeon. As noted by Manitoba Hydro in the NFAT (Manitoba Hydro 2013, Ch.13 p.54):

"The federal government is considering whether to list lake sturgeon in the Nelson River as endangered under the Species at Risk Act (SARA). Manitoba Hydro's planning is based on the assumption that this will not occur, particularly given the stocking and stewardship programs that are being developed and implemented. Were listing under SARA to occur the Keeyask and Conawapa Projects could be delayed or cancelled. If Manitoba Hydro (and in the case of Keeyask the partnership) decided to proceed with the projects, federal permits would be required."

In response to concerns about lake sturgeon, Manitoba Hydro notes in the NFAT filing that (Manitoba Hydro 2013, Ch.13 p.53-54):

"Among the aquatic impacts, there would be some loss of spawning and foraging habitat as well as some blockage of fish passage. Extensive mitigation measures have been planned to minimize and offset these effects. These include plans in construction and for turbine design to minimize impacts; development of new habitat and fish passage; and implementation of a fish stocking program. While some short term declines in fish populations are expected, no declines are expected over the long term, and lake sturgeon populations in the region are expected to increase with the stocking and stewardship programs despite the loss of habitat due to the project."

While the mitigation measures are notable, there are several concerns being raised about the desirability and effectiveness of Manitoba Hydro's approach. While recognizing that the purpose of the NFAT review is not to delve into the EIS, we feel it is necessary to share some concerns raised in the EIS review given that they relate directly to statements made in the NFAT submission. For example, some concerns noted in the information requests for the EIS review process include:

• CAC 0042 remarks on the massive and inexplicable die-offs that occur without warning at Grand Rapids hatchery

• CEC 0031 notes that fish stocking "should be the last mitigation option and not the first"

• MB Wildlands 0052B expresses concern about genetic diversity of Sturgeon in the fish stocking programs

• CEC 0029 expresses concern that stocking without a suitable habitat will not create viable and self-sustaining populations, and the EIS does not suitably describe the habitat

• PFN 0025 notes, among other things, that the stocking program as described in the EIS is overly general, does not actually propose an actual program, and does not provide results of the 2012 trial.

There are several other concerns raised in the IRs, but it should be clear that that the fish stocking program is not a guaranteed success, may not even be a desirable approach, and is insufficiently described to make an accurate assessment of at this point. For these reasons, it is uncertain whether Manitoba Hydro is justified in its claims regarding lake sturgeon in the NFAT submission.

QUESTION:

Please provide a more complete description of the possible effects of, and range of possible consequences for lake sturgeon, recognizing and addressing the concerns raised by interveners in the EIS process.

RESPONSE:

Background

On September 30, 2013 Manitoba Hydro undertook to provide matrices of macro environmental and socio-economic issues comparing Keeyask, Conawapa, gas turbines and wind generation. PUB Order 119/13 added demand side management (DSM) to the resource options to be considered in the matrices, and Manitoba Hydro has chosen to also include transmission projects.

These matrices, which summarize the various components of the PUB's definitions of macro environmental and socio-economic as defined in PUB Order 92/13, are provided in this response to CAC/MH-231a.

The matrices and supporting text draw information from a variety of sources: Manitoba Hydro information, including chapters 2 and 13 and appendices E, 7.2 and 7.3 of the NFAT submission; Round 1 IRs submitted as part of the NFAT review; the Keeyask environmental impact statement and related IRs; the Clean Environment Commission's Bipole III Transmission Project report (as a general proxy for potential effects of the Manitoba-Minnesota Transmission Project and North-South Transmission Upgrade Project); environmental impact statements and monitoring reports for Manitoba wind farms; and information from Health Canada, Environment Canada and the United Stated Environmental Protection Agency. When information from the latter three is used, appropriate citations are provided.

For the NFAT review, it is necessary to identify those critical environmental characteristics that at a macro level may differentiate the environmental and socio-economic effects of hydroelectric, gas turbines, wind generation and DSM, as well as transmission projects. PUB Order 92/13, with five macro environmental and five socio-economic categories, provides the framework for this analysis. For each of those categories, the following are the environmental components or topics considered in the matrix:

- Land: the primary features used for the matrix are the project footprints and the type of area affected.
- Air: the primary feature is greenhouse gas production.
- Water: the primary features considered are water quality and consumption.
- Flora: the primary feature considered is wetlands.
- Fauna: the primary features considered are lake sturgeon, which is receiving additional attention because it has been assessed as "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is being considered for listing under the federal Species at Risk Act (SARA); caribou, which includes boreal woodland caribou, has been listed under SARA and The Endangered Species Act (Manitoba); and birds, which may be affected by hydroelectric and wind generation projects as well as transmission lines.

- Employment and Training: In addition to total employment opportunities, this category includes consideration of effects on northern and Aboriginal communities.
- Business Opportunities: Again, this category also considers potential impacts on northern and Aboriginal communities.
- Personal, Family and Community Life: Two issues are considered in this category: i.) impacts from interaction between construction workers and local residents and ii.) impacts on human health from increased mercury levels in fish. Human-health concerns were also identified from sound associated with wind turbines.
- Infrastructure and Services: Proponents and/or contractors generally assume some responsibility for housing construction workers on major projects and may become involved in housing for operational staff.
- Resource Use: Hunting, fishing and gathering are primary resource uses potentially affected by projects in remote wilderness areas, while impacts on agricultural practices are a primary concern in southern Manitoba.

In their focus on critical topics, the matrices do not cover many topics considered in the environmental assessments. Thirty-eight valued environmental component (VECs) and dozens more supporting topics were studied as part of the Keeyask environmental impact assessment, and the Bipole III environmental assessment had even more VECs – 67. The Consumers Association of Canada and Manitoba Hydro agreed to focus the NFAT review to a much smaller number of critical topics, and while there was agreement on several of these, the final list was determined by Manitoba Hydro. In selecting the most critical topics for the NFAT review, the environmental matrix focuses on sturgeon but not other fish species such as walleye or whitefish (whose long-term populations, according to the Partnership's environmental assessment, are expected to increase in the reservoir and remain stable in Stephens Lake) or northern pike (whose populations are expected to remain similar to pre-project conditions). Similarly, the matrix focuses on greenhouses gases but not other air emissions, such as NO_x, SO_x and PM_{10}, which are emitted by gas turbines but are controlled by existing technology within regulatory limits. Water quality is cited as an issue associated with hydroelectric projects, although the effects, for the most part, can be well managed, and with hydraulic fracturing ('fracking') used in natural gas exploration and production; but the matrices make no mention of water quality associated with transmission, gas turbine and wind projects because the potential effects are much more limited and managed with existing construction practices. The matrices also make no mention of recent public concerns about earthquakes related to fracking. Under infrastructure and services, the socio-economic matrix focuses on housing, for which proponents of large projects accept some measure of responsibility. However, the matrix does not include other services such as transportation, health care and policing for which other agencies take a leading responsibility. By screening out topics such as these, the resulting analysis is intended to assist the PUB discern the major differences in macro environmental and socio-economic effects resulting from the different technologies.

Macro-environmental Comparison of Resource Options

Keeyask 695 MW	**Conawapa** 1485 MW	**Transmission**	**Gas** SCGT:216 MW	**Wind** 100 MW	**DSM**
Air					
Greenhouse gases (2.5 tonnes / GW.h)	Greenhouse gases 1.4 tonnes / GW.h	Greenhouse gases (Not calculated; minor or negligible)	Greenhouse gases (SCGT: 764 tonnes / GW.h) (CCGT: 509 tonnes / MW.h)	Greenhouse gases (13 tonnes / MW.h)	Greenhouse gases (Reduction of 1 million tonnes by 2027/28)
Land					
125 km^2 / 695 M (0.2.75 km^2 / MW) 225 m^2 / GW.h	10 - 20 km^2 / 1485 MW (0.005 - 0.01 km^2 / MW) 16 - 32 m^2 / GW.h	M-M Project: - In Manitoba: Early estimate of 12 - 15 km^2 - In Minnesota: Early estimate of 24 km^2 N-S Upgrade Project: Under study	For generating station: 0.03 km^2 / 320 MW (negligible on a per MW basis) Including upstream gas production: 650 – 1070 m^2 / GW.h	Footprint: 0.15 – 0.30 km^2 Total area: 15 – 46 km^2 Footprint: 21 m^2 / GW.h Total area: 6,600 m^2 / GW.h	
Water					
Water quality	Water quality		Water quality and Consumption (Related to exploration and production of natural gas)		Consumption (Consumer savings of 10 billion litres by 2027/28)

Keeyask 695 MW	**Conawapa** 1485 MW	**Transmission**	**Gas** SCGT:216 MW	**Wind** 100 MW	**DSM**
Flora					
Wetlands	Wetlands				
Fauna					
Lake Sturgeon (Long-term benefit)	Lake Sturgeon (Under study)				
Birds	Birds	Birds		Birds and Bats	
Caribou	Caribou	Caribou (North-South Upgrade Project)	Caribou (Effects related to exploration and production of natural gas in Alberta)		

Macro Environmental Effects

Land

- **Keeyask**: The Keeyask Project will require about 125 km^2 of land in the boreal forest. Of that, approximately 50 km^2 is land that will be flooded for the reservoir and converted into aquatic habitat. The remainder is required for the generating station, dams, dykes, transmission lines and related infrastructure such as roads and borrow areas. This area is equivalent to about 290 m^2/GWh.
- **Conawapa**: The Conawapa Project will require over 20 km^2 of land in the boreal forest during construction and slightly less than 10 km^2 during operations. Of that, 5 km^2 is land that will be flooded for the reservoir and converted into aquatic habitat. This operational area is equivalent to about 16 m^2/GWh.
- **Manitoba-Minnesota and Northern Upgrade Transmission Projects**: The route for the Manitoba-Minnesota Transmission Project is not yet confirmed. However, at a preliminary high level, it is estimated it may require approximately 12 to 15 km^2 of land in Manitoba, some of which may be forest and other natural areas and some of which may be agriculture, and 24 km^2 in Minnesota, where this project is referred to as the Great Northern Transmission Line. The North-South Upgrade Project is also in its early stages with the routes and length dependent upon a facility study that is not yet complete. It would occur on lands in the boreal forest, as well as on agricultural land.
- **Gas**: A gas turbine generating station would require approximately 2 to 3 hectares (i.e., 0.02 - 0.03 km^2). This does not include land required for the exploration and production of natural gas in locations such as Alberta, the source of Manitoba Hydro's natural gas. Including land use associated with the upstream extraction and production of natural gas would increase the land use intensity to approximately 650 – 1,070 m^2/GWh, depending upon the efficiency of the station.
- **Wind**: The towers required for a 100 MW wind farm would have a 15 to 30 ha footprint but would be spread over a much larger area to maintain turbine performance (e.g. to manage 'downstream' effects from one tower to the next) and allow for setbacks from residences and other buildings – in the neighbourhood of 15 to 45 km^2 or more for a

100 MW wind farm. Calculations for land use intensity reflect this same broad range, from 21 m^2/GWh for a small footprint to 6,600 m^2/GWh for the broadly affected area.

Air

The Intergovernmental Panel on Climate Change has determined climate warming is unequivocal, human influence on the climate system is clear, and continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. It further states that limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.[1] Greenhouse emissions are measured in carbon dioxide equivalents (CO_{2e}). The following is based on data from the Pembina Institute's life-cycle greenhouse assessment (Appendix 7.3 of the NFAT submission).

- **Keeyask**: 2.5 tonnes of CO_{2e} per GWh
- **Conawapa**: 1.4 tonnes of CO_{2e} per GWh
- **Manitoba-Minnesota and Northern Upgrade Transmission Projects**: Minor based on preliminary order of magnitude estimate
- **Gas**: 509 tonnes of CO_{2e} per GWh for CCGT; 764 tonnes of CO_{2e} per GWh for SCGT
- **Wind**: 13 tonnes of CO_{2e} per GWh

As well, Manitoba Hydro has estimated its electric Power Smart programs will reduce greenhouse gas emissions by over 1 million tonnes between 2013/14 and 2027/28.

Water

Water quality is fundamental to the health of aquatic life. Federal and provincial guidelines and objectives and guidelines assist in defining water quality conditions. Water consumption can also be a concern, especially when natural gas is produced using a technique known as hydraulic fracturing ('fracking').

[1] IPCC WGI AR5 (2013). Summary for Policymakers: Twelfth Session of Working Group 1.

- **Keeyask**: The main effect to water quality during construction will be increases in sediment, i.e. total suspended solids (TSS). With the implementation of protocols to manage sediment during in-stream construction, increases in TSS will generally be measurable near the project. For a few months during two years of construction, small increases in TSS will extend past the Kettle Generating Station. Increases in TSS are not expected to be large enough to harm plants or animals living in the water. Other potential effects to water quality caused by construction activities such as runoff and accidental spills are managed with standard construction practices, and effluents from wastewater will be treated according to a provincial licence.

  Water quality in newly flooded areas will be affected during the initial years of operation, and then are expected to diminish over the next 10 to 15 years. Overall water quality will be suitable for aquatic life in the main part of the reservoir and downstream of Keeyask, and will be suitable at most locations during most times of the years in the flooded area.

  The effectiveness of the environmental protection plan will be monitored, and additional measures (i.e. adaptive management) can be implemented if necessary. Participants in the environmental and NFAT reviews have expressed concern about potential changes to water quality that could affect aquatic life, such as changes in nutrients and particularly the introduction of sediment.

  The Partnership’s analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding water quality are the subject of review in the environmental review processes.
- **Conawapa**: Although the environmental assessment is still not complete, Conawapa is expected to have minimal effects on water quality, most of which would occur during construction.

- **Manitoba-Minnesota and Northern Upgrade Transmission Projects**: With established construction methods, most notably at water crossings, water quality is not expected to be a concern with transmission projects. In its report on the Bipole III Project, the Clean Environment Commission concluded water quality should be protected if protection and mitigation measures are stringently followed.
- **Gas Turbines**: Potential effects to water quality caused by construction activities such as runoff and accidental spills are managed with standard construction practices. However, "upstream" of the gas turbines, concerns about water quality and consumption are associated with the extraction of natural gas, which is used to produce electricity from natural gas turbines. Hydraulic fracturing (i.e. "fracking") is a technique used to produce natural gas from unconventional reservoirs, such as shale, tight sands and coalbeds. It involves the injection of fluids, including large quantities of water, under pressures great enough to fracture the gas-producing formation. The resulting fractures are held open using "proppants," such as fine grains of sand or ceramic beads. While Natural Resources Canada reports that provincial officials in British Columbia, Alberta and Saskatchewan have never had a confirmed case of groundwater contamination caused by fracking, the United States House of Representatives has asked its Environmental Protection Agency2 to undertake a Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources. Its Progress Report (2012) notes concerns regarding potential effects on the quality of potable water and the large volumes of water required for the fracking process. This study is on-going.

  Gas turbines also consume water, which is covered by provincial licensing requirements.
- **Wind**: Relatively small potential effects to water quality caused by construction activities such as runoff and accidental spills are managed with standard construction practices.

[2] United States Environmental Protection Agency (2012). *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report.*

- **DSM**: Three residential and commercial programs included in the 2013 – 2016 Power Smart Plan are expected to capture additional water saving benefits for consumers. The Water and Energy Saver Program, Lower Income Energy Efficiency Program and Commercial Kitchen Appliance Program are expected to save consumers 10 billion litres of water between 2013/14 and 2027/08.

Flora

Wetlands convert sunlight into vegetation, create soil, protect shorelines and contribute to biodiversity, and some wetlands provide high quality habitat not otherwise available for some plant and animal species. Some wetland types or specific wetlands are particularly important at the regional, provincial or global scale. Ramsar, the North American Waterfowl Management Plan, Ducks Unlimited and the Manitoba Heritage Marsh Program have identified wetland sites that are globally, nationally or provincially significant.

- **Keeyask**: Approximately 90% of the Keeyask regional study area is wetland. The Keeyask Project is expected to affect slightly over to 80 km^2 of wetland, which is less than 1% of the total wetland area in the regional study area. The Keeyask region contains no sites identified as globally, nationally or provincially significant by Ramsar, the North American Waterfowl Management Plan, Ducks Unlimited and/or the Manitoba Heritage Marsh Program. The Partnership will replace 12 ha of off-system marsh habitat that will be flooded by the project.

  Participants in the environmental and NFAT reviews have expressed concern about the characterization of cumulative effects on Nelson River wetlands and the time required to re-establish wetland habitats. The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding wetlands are the subject of review in the environmental review process.

- **Conawapa**: While the environmental assessment is currently on-going and no conclusions have been reached, at this time Conawapa's effect on wetlands is expected to be minimal because of its limited footprint.
- **Manitoba-Minnesota and North-South Upgrade Transmission Projects**: With the application of standard construction practices, including the establishment of buffers and the ability to route away from sensitive sites, transmission projects' effects on wetlands would be expected to be minor for the Manitoba-Minnesota Project. The North-South Upgrade Project passes through areas of northern Manitoba which are largely wetlands. Manitoba Hydro will apply standard construction practices, including winter construction and routes that avoid sensitive wetland types to the extent practicable, to manage effects on wetlands.
- **Gas Turbines**: Gas turbines have limited footprints and can be located away from wetlands. Wetlands would not be expected to be a concern. The exploration and production of natural gas would affect wetlands.
- **Wind Generators**: Wind turbines would not be expected to be placed on wetlands.
- **DSM**: Not applicable.

Lake Sturgeon

Lake sturgeon are culturally and spiritually important to the Cree, are a Manitoba heritage species, have been designed as endangered by COSEWIC, and are being considered for listing under the *Species at Risk Act (SARA)*.

- **Keeyask**: Keeyask will affect sturgeon spawning and young-of-year habitat and will block sturgeon movements from Stephens and Gull Lakes, although studies have shown upstream movements from Stephens Lake do not appear to be a life-cycle requirement. To mitigate these effects, the Partnership will develop new sturgeon habitat; undertake an experimental, up-stream fish passage study; install turbines that enable a large percentage of fish to successfully pass downstream; and implement a regional sturgeon stocking program. The effectiveness of the mitigation program will be monitored, and additional measures (i.e. adaptive management) will be implemented if necessary.

Among concerns raised during the review processes, participants have expressed concern that stocking programs, while successful in some areas, have not been proven at hydroelectric projects; all habitat required for sturgeon to fulfill their life cycles may not be available once the project is developed; and the ability of large sturgeon to move past the generating station.

The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding sturgeon are the subject of review in the environmental review processes.

- **Conawapa**: Sturgeon-related concerns associated with Conawapa include effects to habitat and blockage of movements. Mitigation will include the creation of new habitat, consideration of fish passage, and a regional stocking program. The Conawapa assessment is also giving special attention to two migrating species, brook trout and cisco. The environmental assessment is on-going at this time.
- **Manitoba-Minnesota and Northern Upgrade Transmission Projects**: Not applicable
- **Gas**: Not applicable
- **Wind**: Not applicable
- **DSM**: Not applicable

Caribou

Caribou are important to the northern ecology and to northern Aboriginal people. Boreal woodland caribou are protected under the federal *Species at Risk Act (SARA)* and *The Endangered Species Act* (Manitoba). Some local Cree identify woodland caribou in the Keeyask region, but federal and provincial regulators have not determined that the caribou resident in the Keeyask area are protected boreal woodland caribou. Manitoba is in the process of updating its caribou range boundaries. Boreal woodland caribou have a low natural population growth rate and are sensitive to habitat and human disturbance. Environment Canada[3] has

[3] Environment Canada, 2012. *Recovery Strategy for Woodland Caribou* (Rangifer tarandus caribou)*, Boreal population, in Canada.*

identified forestry, oil and gas exploration and production, mining and mineral exploration and development, hydroelectric development and tourism as having a negative effect on boreal woodland caribou.

- **Keeyask**: Habitat losses, habitat fragmentation, increased predator access and sensory disturbances from heavy machinery and construction activities such as blasting will affect caribou. Among strategies to mitigate these potential effects, the Partnership has adjusted roads, borrow areas and excavated placement areas to avoid sensitive caribou habitat; will limit some construction activities such as blasting to the extent practicable during the calving season; and will block access trails once they are no longer required (i.e., post-construction). New calving habitat is also expected to be created on new islands in the new reservoir. The effectiveness of the mitigation program will be monitored, and additional measures (i.e., adaptive management) can be implemented if necessary. The Partnership expects the overall effects to caribou to be adverse but regionally acceptable because habitat loss is small compared to its widespread regional availability, predation is not expected to change, and changes to intactness are expected to be small over the caribou's range. The Keeyask Partnership recognizes broader issues related to caribou management go beyond those of individual projects, and is working to develop a process that allows for coordination of its activities with those of others involved in long-term caribou monitoring and management in the region. Participants in the review processes have expressed a number of concerns, including: the accuracy of the Partnership's predictions regarding habitat suitability and loss; the herd affiliation of caribou resident in summer; and cumulative effects. They have also questioned whether the caribou identified by Aboriginal traditional knowledge as woodland caribou would be considered by Environment Canada to be a self-sustaining population. The local Cree are concerned caribou will disappear from the area and not return for a long time. The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding caribou are the subject of review in the environmental review process.

- **Conawapa**: As with Keeyask, Manitoba Hydro recognizes broader issues related to caribou management go beyond those of individual projects, and is working as a member of the Keeyask Partnership to develop a process that allows for coordination of its activities with those of others involved in long-term caribou monitoring and management in the region.
- **Manitoba-Minnesota and North-South Upgrade Transmission Projects**: There are no caribou in the area when the Manitoba-Minnesota Project would be located. However, boreal woodland caribou exist in areas where the North-South Transmission Upgrade Project may be located. The potential effects on caribou would be included in the environmental assessment, along with methods to manage and mitigate those effects. In its Bipole III report, the Clean Environment Commission expressed concern about the marginal status of many caribou herds and was encouraged by a list of Manitoba Hydro mitigation measures. The commission added that additional mitigation measures may be required if monitoring indicated a continued adverse effect of the project on caribou. In supporting Manitoba Hydro's application for the Bipole III Environment Act licence, the commission set out several recommendations related to on-going caribou monitoring and management. These resulted in licence conditions to which Manitoba Hydro will adhere.
- **Gas Turbines**: A gas-turbine generating station located near a load centre in southern Manitoba would not affect caribou. However, the COSEWIC Assessment and Update Status Report on Woodland Caribou[4] (2002) noted much of the species' range includes areas where natural gas is also extracted. COSEWIC further noted the government of Alberta (the source of Manitoba Hydro's natural gas) has guidelines regarding development activities on caribou ranges.
- **Wind Generation**: Not applicable.
- **DSM**: Not applicable.

[4] Committee on the Status of Endangered Wildlife in Canada. 2002. *COSEWIC Assessment and Update Status Report on the Woodland Caribou – Rangifer tarandus caribou.* Environment Canada, Ottawa.

Birds and Bats

Some species of birds are an important source of game for Aboriginal people, both as a food source and cultural activity. Migratory species are protected under the federal *Migratory Bird Convention Act* and some species are protected under the federal *Species at Risk Act* and/or *The Endangered Species at Risk Act* (Manitoba).

- **Keeyask**: Approximately 185 bird species potentially breed within or migrate through the Keeyask regional study area. Of these, 150 migrate to southern areas for winter. Eight at-risk species were observed in the regional study area, including three listed under SARA. A single bat was observed early in the period of studies. No nationally, regionally, or locally important migratory bird habitat, as designated by the Canadian Wildlife Service and/or Bird Studies Canada, occurs within the regional study area. Construction activities will disturb birds close to the project site, habitats will be lost and changed, and increased access could result in larger harvests. Among measures to mitigate these effects, clearing and blasting will be restricted to the extent practicable during the bird-breeding season, buffers will be established, and some new habitat, including nesting islands and platforms, will be created. The effectiveness of the mitigation program will be monitored, and additional measures (i.e. adaptive management) can be implemented if necessary. Participants in the review processes have raised a number of concerns, including the need for more details about the reduction of construction activities during the breeding season, declines in the availability of waterfowl for hunting, and the need for more details about the monitoring program.

  The Partnership expects effects on birds will be adverse but regionally acceptable because of the mitigation programs and the widespread availability of the type of habitats affected by the project. The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding birds are the subject of review in the environmental review process.

- **Conawapa**: While some specific species may differ between Conawapa and Keeyask, Manitoba Hydro expects to take a similar approach to mitigating effects on birds, with a similarly positive result.
- **Transmission Projects**: The Clean Environment Commission's findings about birds in its Bipole III report may be informative regarding the Manitoba-Minnesota and the North-South Upgrade projects. Of 400 bird species identified in Manitoba, 371 have ranges within the Bipole III study area, and 218 of those are seasonal breeders. With Manitoba Hydro's mitigation and monitoring measures, the Commission concluded Bipole III poses little risk to bird populations beyond a relatively small amount of habitat loss and bird-wire collisions.
- **Wind Generation**: Effects on birds and bats were identified as concerns in the EISs of wind farms licenses in Manitoba. The licences for both projects required monitoring of these effects. According to data submitted to Manitoba Conservation and Water, a 2006 study at the St. Leon Project identified an annual bird mortality of four birds per turbine and no evidence of bat mortality. However, outside the study 13 bats died over a short duration. A 2011 – 2012 study at the St. Joseph Project identified bird mortality of two birds per turbine and bat mortality of 22.5 per turbine. The studies concluded these rates are low to moderate.
- **DSM**: Not applicable.

1 **Socio-economic Comparison of Resource Options**

Keeyask 695 MW	**Conawapa** 1485 MW	**Transmission**	**Gas** SCGT:216 MW CCGT: 320 MW	**Wind** 100 MW	**DSM**
Employment (construction) (Estimates are in person years)					
Northern / Aboriginal: 500 – 1700 person Manitoba (includes Northern / Aboriginal): 4300 direct; 3400 indirect Canada: 15,500 Total: 23,300	Aboriginal / Northern: more than Keeyask but not yet estimated Manitoba: 5000 direct; 4100 indirect Canada: 21,000 Total: 30,100	Total: not yet estimated Northern Aboriginal: not yet estimated	SSGT total in Manitoba: 116 CCGT total in Manitoba: 320	Total in Manitoba: 50 - 120	
Employment (operations) (Estimates are in full-time equivalent positions)					
Total: 50 Northern Aboriginal: Not estimated, but expected to be among the 50 (45% of Manitoba Hydro's existing northern workforce is Aboriginal) Note: Minimum of 182 jobs in existing operations targeted for KCN Members	Total: 60 Northern Aboriginal: Not estimated, but expected to be among the 60 (45% of Manitoba Hydro's existing northern workforce is Aboriginal)	Total: not yet estimated Northern / Aboriginal: not estimated	SSGT total: 52 CCGT total: 94 Northern / Aboriginal: nil	Total: 6 - 12 Northern / Aboriginal: nil	Total: not estimated Northern / Aboriginal: not estimated

Keeyask 695 MW	Conawapa 1485 MW	Transmission	Gas SCGT:216 MW CCGT: 320 MW	Wind 100 MW	DSM
Local Business Opportunities					
Northern Aboriginal: $200,000,000 Other suppliers and subcontractors	Northern Aboriginal: Not yet determined Other suppliers and subcontractors	Northern Aboriginal: Clearing contract Other suppliers and subcontractors	Northern Aboriginal: nil Other suppliers and subcontractors	Northern Aboriginal: nil Other suppliers and subcontractors, including contracts with landowners	2,300 registered contractors
Infrastructure and Services					
Housing:	Housing:				Housing: Improvements to existing housing stock, including northern and First Nations
Personal, Family and Community Life					
Worker interaction with local residents Mercury	Worker interaction with local residents		See “Water Quality” in the macro environmental matrix	Noise	
Resource Use					
Domestic hunting, fishing and gathering	Domestic hunting, fishing and gathering	Domestic hunting, fishing and gathering Agricultural equipment / practices	Domestic hunting, fishing and gathering (Effect related to exploration and production of natural gas)		

Socio-economic Effects

Training and Employment

The matrix provides data regarding direct jobs that will be created by the projects, along with available data on indirect jobs from the Keeyask and Conawapa projects. For an analysis of the net benefits of employment between the preferred and alternative development plans, please see section 13.3.4 of the NFAT submission (Integrated Comparisons of Development Plans – Multiple Accounts Analysis).

- **Keeyask**: The Keeyask Project would provide extensive employment opportunities in northern Manitoba and throughout Manitoba and Canad. To enhance employment opportunities, 2670 northern Aboriginals received training in a variety of trades and service occupations through the Hydro Northern Training and Employment Initiative. Under the collective bargaining agreement for construction of the project, northern Aboriginal and other northern Manitobans will be given hiring preferences. An Advisory Group on Employment will monitor employment issues during the construction phase. Among concerns raised by participants in the review processes, the Manitoba Metis Federation5 is concerned about the lack of Metis-specific data and programs. Other participants expressed concerns related to 'boom-and-bust dynamics' associated with employment on major construction projects, the potential for employment incomes to lead to 'destructive ends', and inequity of anticipated incomes among members of First Nation communities. The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding employment and training are the subject of review in the environmental review process.
- **Conawapa**: Aboriginal and other northern residents will benefit from past experience with the Hydro Northern Training and Employment Initiative and preferences under the collective bargaining agreement. If construction of Conawapa follows within a few years

[5] The MMF and Manitoba Hydro, acting on behalf of the Keeyask Partnership, have reached an agreement for an MMF-led Traditional Land Use and Knowledge Study, Socio-economic Impact Assessment and historical narrative for the Keeyask region. Please see MMF-MH I-0001(b) and MMF-MH I-0002 for more information regarding Metis-related information.

of Keeyask, many should be able to benefit from their Keeyask experience to gain employment at Conawapa.

- **Manitoba-Minnesota and North-South Upgrade Transmission Projects**: Employment opportunities have not yet been calculated. Short-term opportunities will exist for northern and Aboriginal workers.
- **Gas**: Since gas turbines would be developed on private land in southern Manitoba, northern and Aboriginal people would not be expected to receive training and employment preferences on a gas turbine project. The exploration and production of natural gas employs many people elsewhere in Canada.
- **Wind**: Since wind farms would likely be developed on private land in southern Manitoba, northern and Aboriginal people would not be expected to receive training and employment preferences. Preferences for southern Aboriginal people may be more likely if towers were placed on reserve or Crown lands. As well, the environmental impact statements for wind projects developed in Manitoba did not indicate any preference for southern Aboriginal people.
- **DSM**: With 2300 Power Smart registered contractors, many people are employed in the private sector to deliver Power Smart-related programs, but the total number is not tracked. The following are a few examples:
    - A contractor associated with Refrigerator Retirement Program established a warehouse and de-manufacturing plant with 17 employees. Its call centre services were contracted to another local firm.
    - A contractor with the Water and Energy Saver Program employs 23 people.
    - Northern and Aboriginal people are among those gaining employment and training opportunities through the First Nations Power Smart Program, in which work is performed by local community members.
    - Twenty-eight members of two First Nations completed training in 2013 to install geothermal heat pump systems and nine have gone on to become certified installers. These people may be employed by First Nations installing the systems through a partnership between Aki Energy, a non-profit social enterprise group,

and the Power Smart Community Geothermal Program. The installations are financed through Manitoba Hydro's PAYS program.

Business Opportunities

While general civil contracts would be expected to be awarded to companies with the resources and expertise required for large energy projects, local businesses may be able to provide services and materials to the projects.

- **Keeyask**: The local Keeyask Cree Nations (which are receiving opportunities to invest in the project with favourable financing terms) have negotiated a number of business contracts for the construction of the Keeyask Infrastructure Project, and several more will be negotiated for the generation project. Total value of the contracts for the four Cree Nations will total over $200 million, which is substantial for these communities with limited previous experience. These contracts should also assist these communities in developing capacity for future business opportunities. Among concerns raised by participants in the review processes, the Manitoba Metis Federation6 is concerned that Metis have not been offered the same opportunities as KCN businesses. The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding business opportunities are the subject of review in the environmental review process.
- **Conawapa**: Although the Conawapa ownership structure is not yet finalized, Manitoba Hydro is committed to achieving long-term, sustainable benefits for First Nations in the vicinity of the project with a focus on income, training, employment and business opportunities. The broader regional communities will have access to project benefits, which may include some form of income sharing; these plans are still being developed.
- **Manitoba-Minnesota and North-South Transmission Projects**: Construction of transmission lines is normally conducted over two years: in the first winter, rights-of-way are cleared; during the second winter, towers are erected and lines strung. Clearing

[6] Ibid.

contracts may be awarded to local Aboriginal businesses employing local people, and limited local employment is available with the general contractor during the second phase. In its Bipole III report, the Clean Environment Commission termed the local business opportunities as "modest".

- **Gas**: Since new gas turbines would be developed on privately-owned land in southern Manitoba, northern and Aboriginal businesses would not be expected to receive business preferences. However, southern businesses could benefit from modest opportunities.
- **Wind**: Since new wind farms would be developed on privately-owned land in southern Manitoba, northern and Aboriginal businesses would not be expected to receive business preferences. Southern Aboriginal business may negotiate preferences, particularly if wind farms are located on reserve or Crown lands in southern Manitoba. No preferences were identified in the EISs of the two existing wind farms in Manitoba.
- **DSM**: Power Smart Programs are supported by an extensive network of contractors, with over 2,300 Power Smart registered contractors. One service sector that has realized substantial growth is related to home insulation. Since the introduction of the Home Insulation Program, the number of businesses providing insulation services has increased four-fold, with a similar increase in the capacity of existing contractors active prior to the launch of the program.

Infrastructure and Services

Proponents and/or contractors accept responsibility for providing accommodations for larger construction forces, while employers and/or employees attend to housing infrastructure during the operational phase. First Nation members living on reserve may live in housing supplied by the First Nation. Housing will be the focus of the socio-economic analysis.

- **Keeyask**: Construction workers on the generation project will be housed in a well-equipped camp with on-site recreational facilities, as well as health care and counseling services. The camp will be 140 kilometers via the north access road to Gillam. (The site for a camp for about 50 - 100 workers on the south access road has not been determined.) Infrastructure and services will be expanded under the Gillam Redevelopment and Expansion Program to meet the growing workforce of Gillam. Few off-reserve First Nation workers are expected to return to live in their home communities, which currently have severe housing shortages and are located some distance from the project site. Among concerns raised by participants in the review processes, the Manitoba Metis Federation[7] is concerned that effects on Metis as a distinct group have not been studied. Another participant questioned whether Manitoba Hydro should intervene regarding the lack of housing on First Nation reserves. The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding housing are the subject of review in the environmental review process.

- **Conawapa**: See Keeyask. The Conawapa main camp with accommodation for 2,500 people will be located approximately 2 km west of the generating station site.
- **Manitoba-Minnesota and North-South Transmission Projects**: Construction crews are housed in temporary remote camps or, if facilities are available, in local communities.
- **Gas turbines**: Requirements for housing for crews working on gas turbines would be expected to be met through existing service providers.
- **Wind**: Requirements for housing for crews working on wind turbines would be expected to be met through existing service providers.
- **DSM**: Power Smart programs improve the energy efficiency of existing housing stock, including in First Nation and other northern communities.

Personal, Family and Community Life

Different human health concerns are associated with the different resource options. Each is discussed as follows:

- **Keeyask**: Concern has been expressed about past experience with hydroelectric developments regarding negative interactions between non-local construction workers

[7] Ibid.

and local residents. Strategically addressing public safety and associated concerns is of great importance for new projects, which include Conawapa and Bipole III in addition to Keeyask. Several measures will be implemented to limit the potential for adverse worker interaction. Among these measures, almost all workers constructing the generating station will be housed at a fully serviced camp with recreational facilities, lounge, and on-site health care and counseling services. The camp will be on the north side of the river 140 kilometers by road from Gillam. A small camp for 50 – 100 workers will be located on the south side of the river. A Worker Interaction Sub-committee will provide a coordinate approach to monitoring and addressing worker interaction issues across all Manitoba Hydro projects. This committee includes representatives from Manitoba Hydro, Town of Gillam, Fox Lake Cree Nation, RCMP and other stakeholders. Nevertheless, some adverse effects are expected. Among concerns raised by participants in the reviews, the Manitoba Metis Federation8 is concerned about the absence of programs developed specifically for Metis residents.
A second important health-related concern is increasing mercury levels in fish. Flooding of the Keeyask reservoir will result in an increase in mercury levels in fish, which could affect health if people eat too much of this fish. Mercury levels are expected to peak within 3 to 7 years of reservoir impoundment and then gradually diminish over the next three decades to current background levels. To address these concerns, the KCNs' adverse effects agreements provide access to fish from off-system lakes; and a risk communication plan is being developed with the local communities and health officials to promote a healthy fish diet with safe consumption guidelines. Among concerns from participants, the Manitoba Metis Federation is concerned that Metis-specific programs are not available9. Another process participant expressed concern about standards for consumption of fish with mercury.

The Partnership's analysis of the existing environment; the appropriateness of its

[8] Ibid.
[9] Ibid.

mitigation, monitoring and adaptive management plans; and conclusions regarding worker interaction and mercury are the subject of review in the environmental review process.

- **Conawapa**: Please see the previous paragraph under "Keeyask" regarding negative interaction between construction works and local residents.

  Since there is virtually no flooding associated with Conawapa, mercury levels in fish are not expected to rise.
- **Gas**: Please see the information about concerns related to potable water under "Water".
- **Wind**: According to Health Canada, as the number of wind turbines has increased in Canada, public concerns have been expressed about the health effects of wind turbine sound. As a result, Health Canada is collaborating with Statistics Canada on an epidemiological study to evaluate "measureable health endpoints" in people in 8-12 communities at distances up to 10 km from wind turbines. Blood pressure, heart rates, hair cortisol concentrations and sleep actimetry are being measured. The study will also include face-to-face interviews about noise annoyance, health effects, quality of life, sleep quality, perceived stress, lifestyle behaviours (e.g. cigarette smoking and alcohol consumption), prevalent chronic disease and property value impacts. Subjects will also be invited to participate in a physical health measures collection study10. Study results are expected in late 2014.
- **DSM**: Not applicable.

Resource Use

Resource use includes domestic hunting, fishing and gathering, which are protected by treaty and Aboriginal rights. They also provide healthy foods and are important to many people's cultural identity. In southern Manitoba, agriculture is the primary resource use.

[10] Health Canada: Environmental and Workplace Health. 2013. *Health Impacts and Exposure to Sound from Wind Turbines: Updated Research Design and Sound Exposure Assessment.* Ottawa.

- **Keeyask**: Through the construction of the generating station, dykes and roads and the creation of the reservoir, the Keeyask Project will affect hunting, fishing and gathering resources. In addition to mitigation to reduce these effects, each Keeyask Cree Nation has an adverse effects agreement with programs to provide the community members with alternative harvesting opportunities. In voting to support the adverse effects agreements, each community acknowledged that impacts on their Treaty and Aboriginal rights have been addressed. Among concerns raised by participants in the environmental reviews, the Manitoba Metis Federation is concerned programs and agreements have not been developed specifically for the Metis11. The Partnership's analysis of the existing environment; the appropriateness of its mitigation, monitoring and adaptive management plans; and conclusions regarding resource use are the subject of review in the environmental review process.
- **Conawapa**: While the environmental assessment is still underway and adverse effects agreements have not been negotiated, Manitoba Hydro expects to achieve results similar to those of Keeyask.
- **Manitoba-Minnesota and North-South Transmission Projects**: Transmission projects have the potential to affect domestic resource users by removing traditional plants and by improving access for other resource users to hunt moose and other game. Predators such as wolves can also use rights-of-way to prey on moose and other game. To mitigate these effects, lines may be routed away from sensitive sites and steps can be taken to lessen access to new rights-of-way. Along with issues related to the loss of harvesting opportunities, participants in the Bipole III review process also expressed concern about the use of herbicides. In response, the Clean Environment Commission recommended measures to limit herbicide use and post areas that have been treated with herbicides. The commission also heard concerns of how the transmission line would interfere with agricultural practices by obstructing farm equipment, irrigation equipment and aerial spraying. The commission recommended Manitoba Hydro consult with local landowners

[11] Please see MMF-MH I-000(b).

to route the line where it will have the least possible impacts on agricultural operations, unless there are clear and compelling reasons to route the line elsewhere.

- **Gas**: Not applicable to gas turbines in Manitoba. However, the exploration and production of natural gas would affect resource harvesting in other jurisdictions.
- **Wind**: Wind development in Manitoba to date has not affected Treaty and Aboriginal rights. If wind farms were developed on reserve or Crown land, appropriate measures could be required. Since wind farms are more likely to occur on private agricultural land, traditional resource use is not expected to be affected. With the exception of limits to aerial spraying, the EISs of the two existing wind farms in Manitoba did not identify concerns related to agricultural practices.
- **DSM**: Not applicable.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 6

PREAMBLE: MNP breaks down its analysis into three Valuable Environmental Components (VECs), namely Lake Sturgeon, Caribou, and Other At-Risk Fauna.

QUESTION:

Please reconcile your selection of VECs to the VECs identified in the Environmental Impact Statement (EIS) for Keeyask.

RESPONSE:

MNP has selected a subset of VECs to evaluate in an effort to bound our analysis and report to a manageable level for the NFAT Panel and to provide the Panel with a summary of the most significant impacts that should be considered based on expansive studies undertaken as part of the CEC process and others. Given that water regime was a discrete area of focus and some aspects of habitat change are also considered, we selected Sturgeon, Caribou and Other At-Risk Fauna as representative and highly valued elements of the local ecosystem.

The EIS for Keeyask defines VECs as "fundamental elements of the physical, biological or socio-economic environment, including the air, water, soil, terrain, vegetation, wildlife, fish, birds and land use that may be affected by a proposed project". Overall value and importance to people and importance to regulatory agencies and regulatory requirements are high on the list of evaluation criteria for broad components such as the terrestrial and aquatic environment.

The selection process is largely qualitative in nature and VECs can be broad (wetland function) or discrete (Caribou). The Keeyask EIS studied a full range of possible categories and 18 biophysical VECs were selected:

Ecosystem diversity, intactness, wetland function, priority plant, Canada goose, Mallard, Bald eagle, Olive-sided flycatcher, Common nighthawk, Rusty blackbird, Caribou, Moose, Beaver, Water quality, Lake sturgeon, Walleye, Northern Pike, Whitefish.

TAB 11

6. MACRO ENVIRONMENTAL: LAKE STURGEON

The EIS for the Keeyask generation project outlines the anticipated impacts to lake sturgeon populations in the study area, which includes the Nelson River, Stephens Lake, Gull Lake, Split Lake and Clark Lake. The aquatic studies focused on the expected changes in water levels, impacts to habitat and associated effects on fish behaviour. MH conducted these studies in partnership with the Cree Nations as a part of the Keeyask EIS.

Lake sturgeon are of particular concern in relation to the preferred plan because their populations were nearly completely depleted by commercial fishing in the late 19th and 20th centuries. The lake sturgeon's historic spawning sites, which are typically large rapids, have also been heavily impacted by hydroelectric development. Lake sturgeon are culturally and spiritually important to the Cree Nations and they hold special status as a heritage species in Manitoba.

In addition, lake sturgeon are particularly vulnerable due to a number of unique characteristics:

- They have a late sexual maturity (spawn after age of 25).
- Infrequent spawning patterns (every 3 to 7 years).
- Slow growth rate to maturity.
- Large body size.
- Longevity (greater than 60 years).

As a result, lake sturgeon are highly susceptible to overfishing and are slow to recover from events impacting temporal populations. For the purposes of this project, lake sturgeon are categorized as a VEC. In order to address the special concern surrounding lake sturgeon, MH has also developed a Lake Sturgeon Mitigation and Enhancement Strategy to reduce some of the impacts that this project (and others) will have on this species of fish.

The Conawapa generation project EIS is not yet completed. We have made assumptions regarding impacts using the information available in the NFAT filing. It is believed that impacts to lake sturgeon due to development of Conawapa will be similar in nature. Although, we caution that the specific degree, scale and location of impacts will differ.

6.1 IMPACTS

At the proposed Keeyask Generating Station site, there will be an alteration of habitat in the river channels between Gull Rapids and Stephens Lake due to creation of the reservoir. Aquatic habitat shifts are likely to result in habitat more suitable for species that favour lake-like conditions. Adult sturgeon, who favour riparian conditions, are likely to emigrate in response to the water regime change. MH has noted that stocking programs will increase the total number of sturgeon in the area, but that population structure will certainly change[62]. The largest concerns are the permanent loss of lake sturgeon spawning habitat at Gull Rapids and changes in water levels and flow of Birthday Rapids upstream of the proposed site. This disruption and loss of habitat is expected to impact spawning activities and result in a reduction in the number of new lake sturgeon in the region.

Moreover, the presence of a generating station will block connectivity between downstream and upstream populations. Despite uncertainty, it has been reported that there are already a low number of lake sturgeon in Stephens, Gull and Clark Lakes[63]. Gull Rapids is reported to be one of the last spawning

[62] Response to Information Request MNP-005, NFAT 2013.
[63] Keeyask Environmental Impact Statement, Chapter 6, Section 6.2.3.3.5: Environmental Impacts Assessment.

areas on the lower Nelson River[64] by First Nations inhabitants. The First Nations' knowledge of the fish and its behaviour and their observations should be considered strongly, given the unique relationship and intergenerational knowledge the northern communities can share. Turbine design is a mitigation feature expected to prevent undue mortality to fish passing through the generating station. 90% of small fish (up to 500 mm) passing through are expected to survive. It is identified that larger fish may experience injury or mortality if they come into contact with the turbines. There is a clear risk that the large size of sturgeon makes them vulnerable in this context. Studies conducted relative to the turbine design were largely based on different species under much different environmental characteristics. For example, results from studies conducted on operating turbines and fish mortality showed survival rates mostly 90% and above, but the proxy conditions were for many different species including walleye, pike and salmon. Results from Kelsey station were used to proxy the Keeyask conditions as well, but were for walleye and pike species[65] and found the lowest survival rates and highest injury rates. We believe there could be greater risk than that identified in the NFAT submission with respect to fish mortality and injury.

The table below summarizes the expected impacts of note:

Impact	Project Phase(s)	Description	Consequence	Significance
Disturbance of fish	Construction	Inputs of total suspended solids, blasting, dewatering.	Potential impact to spawning activities resulting in reduction of sturgeon being born in a specific age cohort and reaching adulthood. Movement of adults from the reservoir resulting in a shift in age structure of the population.	**High**
Loss and disruption of habitat	Construction, Operation (initial years only)	Sturgeon require a large turbid rapids habitat. Permanent loss of Gull Rapids (Stephen's Lake) as a spawning habitat. Rising water in Gull Lake and construction of the reservoir. Water level increases at Birthday Rapids making it a less suitable habitat for spawning.	Reduction in new sturgeon being produced due to spawning habitat alteration and loss. Movement of sturgeon likely upstream or downstream due to higher water levels in Gull Lake. Loss of young-of-the-year habitat due to reservoir construction. Long-term effects on occurrence and distribution of habitat for other life stages.	**High**
Impediments to fish movement	Construction, Operation	Fish movement altered due to presence of generating station and changes in water regime.	Downstream movement of fish will be altered and upstream movement will be blocked by the presence of the dam. Due to the size of lake sturgeon, injury and mortality (especially for fish near or over 500 millimetres in length) are expected when they encounter turbines downstream. When the lake water freezes, fish could become trapped or stranded in off-current bay and downstream of the spillway when it is not in operation.	**High**

[64] Ibid.
[65] Keeyask Environmental Impact Statement, Aquatic Environment Supporting Volume Appendix 1A. 2012

Impact	Project Phase(s)	Description	Consequence	Significance
Increased risk of over-harvesting	Construction, Operation	Domestic harvesters users.	Increased access for domestic harvesters resulting in overharvest.	**High**

6.2 Policy Risks

6.2.1 Lake Sturgeon Management Strategy

In 2012, Manitoba Conservation and Water Stewardship released the Lake Sturgeon Management Strategy for the recovery and protection of populations in the province. The objectives of the strategy are to ensure that existing populations are protected from depletion and in those areas with suitable habitat, lake sturgeon populations are restored to levels where they can be considered stable and self-sustaining. Although MH has committed to limit the number of lake sturgeon lost directly as a result of the construction and operation of Keeyask and increase the population long term, the project will have short term ramifications for the local lake sturgeon population and is therefore in direct conflict with this strategy.

1. MH plans to use stocking as a mitigation strategy to maintain the existing population. It has been suggested by MH that their conservation stocking program would include either developing another hatchery on the lower Nelson River or using the facilities at the Grand Rapids hatchery. The strategy calls for the genetic integrity and diversity of existing stocks to be preserved. If the option to use the Grand Rapids hatchery is employed, they must ensure local fish are used to supply the brood stock in order to maintain separate genetic stocks.
2. MH plans to create a temporary fish passage to allow connectivity while conducting further studies to validate the need for and cost of a lake sturgeon fishway. The provincial strategy states that the desirability of providing passage must be considered on a site by site basis. However, it does note that in some cases, upstream access to habitats that have been altered does *not* help to address all life stages needs and *may result in increased* downstream movement through generating stations[66]. In this case, there is a known lake sturgeon spawning habitat at Birthday Rapids upstream of Keeyask. It is unknown if lake sturgeon will journey to this location. In addition, more studies will need to be conducted on spawning patterns to ensure fish passage upstream will be beneficial to the affected populations. Given that the majority of the existing sturgeon population are adults, there will be a risk for injury or mortality when moving downstream since they will have to pass through the turbines or spillway with the addition of Keeyask.
3. The strategy supports the development of artificial spawning habitat and enhancement of habitat where they are limited and sites successes in other jurisdictions. Lake sturgeon populations currently suffer from limited suitable spawning areas and this issue is compounded by the permanent loss of Gull Rapids as a result of Keeyask. Lake sturgeon will be forced to find new spawning habitat and MH's plan to construct an artificial spawning habitat alongside the creation of upstream fish passage will support the provincial strategic objective of having a stable and self-sustaining population in the long run.
4. The strategy promotes the role of Sturgeon Management Boards, which arose out of concerns about the condition of lake sturgeon stocks and the desire of First Nations communities to ensure

[66] Government of Manitoba. *Manitoba Lake Sturgeon Management Strategy 2012.* 11 April 2012. Accessed in 2013. (http://www.gov.mb.ca/waterstewardship/fish/pdf/mb_sturgeon_mgmt_2012.pdf)

that there would continue to be lake sturgeon available to harvest[67]. The Saskatchewan River and Nelson River Sturgeon Management boards are largely made up of representatives from the provincial government and First Nations groups. The boards are responsible for conducting population studies and educational initiatives to support the recovery and stabilization of lake sturgeon populations. According to the strategy, it is felt that both boards have proven to be highly effective mechanisms for coordinating lake sturgeon studies involving local fishers, communities and First Nations in ongoing discussions on lake sturgeon management, and have the potential to expand their scope to encompass their respective river systems[68]. Additionally, the strategy calls for the Split Lake Resource Management Board to develop a lake sturgeon management plan with ongoing monitoring of stocks and harvests to ensure harvests are sustainable. The Nelson River Sturgeon Board has been stocking fingerlings in this reach since 1994, as well as stocking yearlings in 2008, 2009, 2011 and 2012. It is unclear what percentage of these stocks has survived.

Despite the risk of negative impacts to lake sturgeon in the short term post-construction, MH's proposed mitigation strategies and ongoing monitoring plans align with the overall strategy and provide a conduit for the investment required to meet the objectives of the provincial strategy. In addition, the studies funded by MH as part of the planning for the proposed Keeyask Generating Station have benefited the province by adding to the collective knowledge of lake sturgeon populations and their habitat.

6.2.2 Species at Risk Act (SARA)

SARA aims to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery and sustainment of viable populations. Due to the historic near depletion and the resulting vulnerability of the lake sturgeon species, they have been listed as 'endangered' by the Committee on Status of Endangered Wildlife in Canada and are currently being considered for protection under the Species at Risk Act (SARA).

If the project proceeds without lake sturgeon being listed as 'protected' under SARA, there is a risk that populations will not adequately recover after construction, making extinction more likely. If protected under SARA, Keeyask and Conawapa could be significantly delayed or cancelled if issues cannot be addressed appropriately, depending on the requirements of the SARA listing on development projects. If the projects proceed, federal permits for the allowance of certain impacts would be required. The impact to timelines and cost of the project should be considered in the economic analysis. It is unclear whether it has already been included by MH.

6.2.3 Manitoba Fisheries Branch – Fisheries Management Objectives

At the request of MH, Fisheries Management Objectives were created for the area between Birthday Rapids and the outflow of Stephens Lake. These objectives assume the project has been approved and are based on the optimal accepted outcomes. With respect to lake sturgeon, the objectives call for *"a viable population of lake sturgeon above the proposed Keeyask Generating Station site"*; *"conditions that support self-sustaining populations"* and an evidence-based *"determination of the needs for fish passage developed in consultation with provincial fisheries managers"*[69].

In order to create a sustainable population above the generating station, MH must consider the construction of a fish passage to remedy habitat fragmentation caused. The approach MH has committed to take is to conduct, at a minimum, a three-year study working together with key stakeholders, such as

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[67] Ibid.
[68] Ibid.
[69] Fisheries and Oceans Canada. *Re: Fish Passage, Keeyask Generating Station Project*. 12 July 2013. Accessed in 2013. (http://keeyask.com/wp/wp-content/uploads/2013/08/Fish-Passage-Letter-from-DFO-to-KHLP.pdf)

the province, to observe the impact of the constructed environment on fish behaviour to better understand their movement patterns and needs.

6.3 Physical/Macro Environmental Risks

6.3.1 Habitat Fragmentation and Loss

There are a number of impacts to the physical habitat of the lake sturgeon as a result of the preferred plan:

- Loss of Birthday Rapids as spawning habitat due to increased water levels, submerging the rapids following impoundment. It is unknown if lake sturgeon will continue to use this location.
- Changes in water regime and flow due to creation of the reservoir will make the young-of-the-year habitat north of Caribou Island in Gull Lake unavailable after impoundment. Lake sturgeon are *not* expected to continue to use this habitat.
- Fish access to Stephens Lake will be reduced due to presence of the generating station.
- A portion of Gull Rapids will be dewatered for installation of the principle structures (dams, powerhouse and spillway) eliminating the use of this area for spawning.
- Fish access from Stephens Lake, upstream of Gull Rapids will be lost.
- Fish have the potential to become stranded in isolated pools of water when the spillway ceases, and when water levels change in Stephens Lake and may be susceptible to winterkill if they remain in Little Gull Lake.

6.3.2 Increased Threat to Existing Lake Sturgeon Population

The Keeyask project is being developed in an area where lake sturgeon have already been impacted negatively by hydroelectric development and remaining populations estimated to be low in numbers. Lake sturgeon were once a key source of traditional food for First Nations communities in the area, but this is no longer the case due to drastic declines in the population of this fish since hydroelectric development began in the 1950's. The Fox Lake Cree Nation have argued that construction of the Keeyask Generating Station will lead to further declines in population levels due to impacts on water quality, spawning habitat loss and introduction of the dam[70].

Fish moving downstream of the generating station will be subject to a higher rate of turbine mortality if they are larger than 500 millimetres in length (the survival rate for those under 500 millimetres is 90%). Given that most of the lake sturgeon in the study area are larger than 500 millimetres, the survival rate is lower for downstream passage. However, based on available research to date, there is a small percentage of fish moving downstream and with a generating station in place they are less likely to do so. It has also been reported by the Cree Nations that post-impoundment lake sturgeon populations have decreased downstream of previous hydroelectric generating stations[71], which is an important consideration for MH and the province.

Adult lake sturgeon migrate upstream to spawn in specific locations (clean, coarse cobble, rubble), which are typically below impassable barriers, such as a waterfall or dam. Studies at this time have not revealed whether lake sturgeon will spawn near the dam. With the disappearance of spawning grounds and fragmentation of their habitat, material barriers exist to lake sturgeon productivity if Keeyask is developed.

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[70] Fox Lake Cree Nation. *Environmental Evaluation Report*. September 2012. Accessed in 2013. (http://keeyask.com/wp/wp-content/uploads/2012/07/FLCN-Environment-Evaluation-Report_Sept_2012.pdf)
[71] Keeyask Environmental Impact Statement, Chapter 6, Section 6.4.2: Environmental Impacts Assessment.

Once the young-of-the-year sturgeon hatch, the velocity of the water helps them to drift down stream to shallow parts of the river where there is sand or detritus substrates. This is the least understood life stage of lake sturgeon and more study on the Nelson River in particular is required in order to understand the impact the project will have, as lake sturgeon are more vulnerable to mortality at this life cycle stage.

6.4 Mitigation Strategies

Key mitigation strategies summarized in the Keeyask EIS include those demonstrated in the table below. The mitigation measures described in the EIS partially align with the most material risks.

Impact	Project Phase(s)	Mitigation	Considerations
Disturbance of fish	Construction	Avoiding spawning periods and implementation of in-stream construction timing windows, blasting guidelines, screening water intakes and salvaging fish prior to dewatering.	Sufficient.
Disturbance of fish and loss of habitat	Operation	Replacement of spawning habitat provided at several locations including the tailrace of the generating station and in Stephens Lake. Stocking fry, fingerlings and yearlings in areas directly impacted by the project and broader regions to compensate for lost production of lake sturgeon. Monitor to determine if the fast-water habitat of the reservoir is suitable habitat to attract spawning fish and modify if unsuitable.	Concerns raised by First Nations on the effectiveness of constructed spawning area below Keeyask powerhouse. Lack of immediate mitigation measures may not reduce effects in a timely manner. MH has never constructed young-of-year habitat and cannot guarantee it will be successful.
Increased risk of overharvesting	Construction, Operation	Long term conservation-stocking program is expected to increase sturgeon numbers in the region in the long term. Lake sturgeon awareness initiative will be created to inform domestic harvesters about the vulnerability of the lake sturgeon populations in Keeyask reservoir and Stephens Lake. First Nations Partnership has developed an access management plan that will strictly monitors site visitors on site and provide transportation and access to Thompson off duty. Fishing licences will also potentially be limited during construction as a measure to prevent overharvest by migrant workers.	Stocking will not produce results in the short term. Measures are already in place to prevent domestic overharvest, thereby reducing the impact of MH mitigation strategies in this area.
Impediments to fish movement	Construction, Operation	Upstream and downstream fish passage will be provided to maintain existing connections. Fish passage downstream will be facilitated via turbines and spillway (designed to reduce risk of injury and mortality). Barriers will be erected to prevent larger fish from passing through the powerhouse. Fish passage upstream will be facilitated by a trap and catch transport system, but avoiding depleting the Stephen's Lake remnant population. Channels will be constructed to connect large off-current bay in the reservoir with deeper sections of the reservoir and to	Fish moving downstream of the generating station will be subject to turbine mortality (~10%) if they are larger than 500 millimetres in length. Sturgeon mortality due to turbine, spillway or trash rack contact is not

Impact	Project Phase(s)	Mitigation	Considerations
		connect spillway pools with Stephen's Lake to prevent fish from becoming stranded.	well studied. Trap and catch is experimental until MH has collected more data on need and requirements for upstream fish passage.

6.4.1 Lake Sturgeon Stewardship Enhancement Program

MH has also implemented the Lake Sturgeon Stewardship Enhancement Program with the vision "*to maintain and enhance lake sturgeon populations in areas affected by MH's operations, now and in the future*".

The stated long term objectives are to:

- Ensure that the net effect of MH's current activities does not contribute to a decrease in existing lake sturgeon abundance in Manitoba.
- Operate and develop MH's facilities in a manner that will not jeopardize the sustainability of lake sturgeon populations in Manitoba.
- Promote recovery of lake sturgeon populations in Manitoba.

MH plans to stock fish to maintain and enhance the current population. However, it will take in excess of 20-25 years (a generation) in order to assess the effectiveness of the stocking strategy. There are also genetic risks inherent in stocking including outbreeding depression, domestication and inadequate representation of genetic diversity in the cultured population (Welsh et al 2007)[72]. Young sturgeon have a higher mortality rate. Consequently, even with stocking efforts, there is no guarantee the fish will survive to maturity and support a self sustaining population. In addition, plans to use the Grand Rapids hatchery as a source is not ideal since the species in Gull Rapids are of different variety than the species in that location.

Part of population recovery is also providing various types of habitat for lake sturgeon at different life stages. There is limited research to support the success of stocking and of artificial spawning habitat for lake sturgeon. Therefore, at this time it is unclear whether the mitigation measures that will be employed by MH will support conditions for a self-sustaining population in the Keeyask reservoir and Stephens Lake. MH plans to undertake comprehensive monitoring and to modify mitigation measures or supplement them, as required.

6.4.2 Lake Sturgeon Stewardship Agreement for the Lower Nelson River

The Cree Nations and MH are in the process of developing this agreement, which aims to recover the lake sturgeon population through partnership with First Nations in the area and Fisheries Branch of Manitoba Conservation and Water Stewardship. This agreement established the Lower Nelson River Sturgeon Stewardship Committee in spring 2013, which is mandated to protect and enhance sturgeon populations in the lower Nelson River from Kelsey to Hudson Bay.

Core activities include:

[72] Smith, A.L. Fisheries Section Fish and Wildlife Branch, Ontario Ministry of Natural Resources. *Lake Sturgeon (Acipenser fulvescens) Stocking in North America*. 2009. Accessed in 2013. (http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@letsfish/documents/document/stdprod_070696.pdf)

- Development of a stewardship plan complete with detailed measures, objectives and strategies.
- Establishing research and monitoring priorities.
- Undertaking research and monitoring activities based on both Western science and Aboriginal Traditional Knowledge to gain a better understanding of sturgeon populations in the Lower Nelson River.
- Undertaking protection and enhancement projects in the Lower Nelson River area.
- Creating a forum for the sharing of expertise, resources and capacity, including consultation and/or coordination, with relevant Resource Management Boards and the Nelson River Sturgeon Board (which operates on the Upper Nelson River between Lake Winnipeg and the Kelsey G.S.).
- Working to create a comprehensive repository of available information on Lake Sturgeon.
- Carrying out public education activities.
- Undertaking consultations regarding decisions about voluntary sturgeon harvest levels for member communities.

This agreement is in effect for 20 years and if the objectives are not met, the agreement would be renewed.

6.5 Fishway Needs and Costs

As part of our scope of work, we reviewed MH's NFAT filing with respect to the need and cost for a sturgeon fishway at either Keeyask Generating Station or Conawapa Generating Station. MH has determined that while a fishway for upstream passage *may* need to be constructed, the current designs incorporate sufficient features to support downstream passage only.

Lake sturgeon require habitat for spawning, foraging and overwintering. Adult lake sturgeon in Stephens Lake, which is downstream of the proposed generating station, typically swim upstream to spawn at Gull Rapids. With the construction of Keeyask, these sturgeon will end up in either Gull Lake or Stephens Lake, will require assistance moving upstream and will have to pass through turbines or spillway to move downstream. Though Gull Rapids will no longer exist, Birthday Rapids and other known lake sturgeon spawning habitat are upstream of the proposed generating station. Manitoba plans to construct habitat to fulfill all life stages upstream and downstream of Keeyask. However, it is not known how sturgeon will respond to the constructed habitat, passage is necessary to ensure they are able to fulfill all of their life stage requirements for population sustainability. There are also challenges for upstream fish passage due to the large size of sturgeon relative to the turbines.

Correspondence from the federal Department of Fisheries and Oceans Canada (DFO) to the Keeyask Hydropower Limited Partnership regarding fish passage noted that there is *"insufficient data at this time to conclude that there is or is not significant upstream movement of fish past the site of the proposed Keeyask Generating Station*[73]." DFO has concluded that is *"premature to warrant installation of a long term upstream fish passage facility"* but recommends that MH include elements necessary to allow for economically and technically feasible retrofit of fish passage facilities, should they be required. Also, requirements for fish passage facilities will be determined at a future date based on monitoring of fish movement, ability of the habitat to support all life history requirements, fisheries management objectives and support for ongoing fisheries productivity.

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[73] Fisheries and Oceans Canada. *Re: Fish Passage, Keeyask Generating Station Project*. 12 July 2013. Accessed in 2013. (http://keeyask.com/wp/wp-content/uploads/2013/08/Fish-Passage-Letter-from-DFO-to-KHLP.pdf)

MH plans to install a temporary, experimental catch and transport system and conduct studies of fish habitat and behaviour for a minimum period of 3 years to determine the requirements for a more permanent fish passage system. We believe this is a sensible approach since fish passage systems must be site specific and can be expensive to construct. Due to the lack of research on successful fish passage systems in the study area for lake sturgeon and in the absence of sufficient data on lake sturgeon behaviour, studies are necessary to ensure the appropriate facility is constructed from a cost-benefit perspective. In addition, MH needs to understand how lake sturgeon populations respond to the altered and constructed habitat.

While MH's approach is prudent, there are a number of concerns with the catch and transport system including:

- Interrupted and unnatural migration.
- Greater potential for injury and post-handling losses (mortality and drop out system).
- Response to catch and release tends to be species-specific.
- Relies heavily on human interactions.
- Typically requires a fish collection mechanism or trap to collect fish.
- May return fish to river it did not originate from, causing them to become disoriented.[74]
- Other fish may also get trapped and injured as a result.

Measures must be taken to ensure any negative effects of this method of fish passage are mitigated as much as possible.

6.5.1 Costs of Fishways

Costs for fishways are known to vary based on site characteristics, method of capture and amount of fish to be transported. There was no cost estimate provided by MH in the NFAT filing for fish passage facilities for the Keeyask or Conawapa Generating Stations. We have performed research to estimate a range of potential costs. In developing the expected cost of a sturgeon fishway, the purchase, installation, operational and ongoing improvement costs must be considered.

6.5.2 Purchase and Installation Costs

In a report by Katopodis Ecohydraulics Ltd. entitled "*Fish passage considerations for developing small hydroelectric sites and improving existing water control structures in Ontario* (May 2013)", the total costs and unit costs for fish passage systems are provided and summarized below:

[74] US National Oceanic and Atmospheric Administration. *Diadromous Fish Passage: A Primer on Technology, Planning and Design for the Atlantic and Gulf Coasts.* Accessed in 2013. (http://www.nero.noaa.gov/hcd/docs/FishPassagePrimer.pdf)

Fishway Cost as a Percentage of Total Project Cost for Various Fish Passage Systems[75]

Province	Location / Passage System	Passage System Construction Information	Key Species	Total Rise	Total Fishway Cost	Total Project Cost	Fishway Cost as % of Total Cost	MW
Quebec	Rupert River, weir at KP290; part of Eastmain-1-A Project (Pierre Vaillancourt)	2010 –nature-like rock ramp fishway; cost includes weir, access road (14 km) & bridge	Sturgeon	2 m	$9,700,000	$5,000,000,000	**0.2%**	918
Quebec	Lac Portneuf - remote area	1997 - vertical slot (4 m wide; 0.2 m drops; attraction flow chamber)	Brook trout	1.4 m	$1,000,000	Not available	**Not available**	25.9
Quebec	Rivière-des-Prairies (Richard	1985 - vertical slot (3 m wide; 45MW power dam)	Multispecies	8 m	$1,500,000	$14,000,000	**10.7%**	45
Manitoba	Churchill River Weir Fishway cost assumed as 1/3	1998 –nature-like rock ramp fishway; cost for entire rockfill Weir & fishway $7 million;	Lake cisco	2 m	$2,300,000	$220,500,000	**1.0%**	n/a
Alberta	Dunvegan Hydroelectric Project*	Ramp fishway, riffle/pool sequences with rock riprap (upstream) and fish sluices (downstream)	Whitefish, Walleye	11.4 m	$22.7 - $32.7 million	$620,000,000	**3.8-5.5%**	100

The Katopodis Ecohydraulics Ltd. report also provided a breakdown of the costing for the development of what is characterized as an “innovative fish passage system” for the 100 MW Dunvegan Hydroelectric Project, which is currently under construction. Below is a detailed breakdown of the cost:

Dunvegan Hydroelectric Project – Total and Fish Passage Costs[76]

Items	Cost
Research and Development - Hydraulic modeling, Fisheries Study, Engineering Support	$2.66 million
2 upstream fish passage ramps (cost estimate)	$20-30 million
Downstream bypasses	$1 million

[75] Katopodis Ecohydraulics Ltd. *Fish passage considerations for developing small hydroelectric sites and improving existing water control structures in Ontario.* May 2013. Accessed in 2013. (http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@renewable/documents/document/stdprod_109381.pdf)
[76] Ibid.

Based on the historical analysis of 'Fishway Costs as a Percentage of Total Project Cost' in the table above, and given the MWs and total rise of the Keeyask project, we estimate the cost of the fishway for the Keeyask Generating Station to range between **$12 million and $50 million.** At 4% of total project cost, it is calculated that a fishway could be much more expensive (see table below). However, we believe that the relationship between total cost and fishway cost becomes less linear as size increases. The approximate cut off of $50 million is a reasonable assumption for analytic purposes of this NFAT. We also anticipate the fishway cost for Conawapa to fall in the same range based on the total rise and MWs of the project.

Three Cost Estimates for the Keeyask Fishway

Scenario	Key Species	Total Rise	MW	Total Project Cost	*Fishway % of Cost*	*Estimated Total Fishway Cost*
Keeyask 1	Sturgeon, Brook Trout, Whitefish	27 m	695	$6,200,000,000	*0.2%*	**$12,400,000**
Keeyask 2				$6,200,000,000	*2.1%*	**$130,200,000**
Keeyask 3				$6,200,000,000	*4.0%*	**$248,000,000**

6.5.3 Operational Costs

The Off-ladder Adult Fish Trap facility at Priest Rapids Dam diverts fish from the fish ladder into a holding tank for research and management activities before returning them to the fish ladder. Completed in 2007, the facility costs $4.2 million to operate annually and is operational from July to mid-October each year[77]. The fishway at Keeyask is not expected to exhibit this level of overall operational complexity. Therefore, the ongoing operational costs would likely be something less that noted for the Priest Rapids Dam.

6.5.4 Ongoing Improvements

In February 2013, the fish lift at the St. Stephen Powerhouse and Dam on Santee River in South Carolina underwent a $2 million redesign and renovation[78]. In this system, fish are lifted and prompted to swim up and out of the lift to continue their travel upstream rather than being transported to another location.

More recently in Washington State, the fish trap located ½ mile downstream from the Lower Baker Dam was completely renovated, improved and made larger for returning adult salmon. The facility had a budget of $25 million to construct a facility that allowed higher flows of water into the trap; an automated system for segregating the fish by species; four separate elevated holding ponds; a 3 story, 8-foot-diameter, water-filled elevator with a movable floor for lifting trapped fish and an adjacent survey room for data collection and scientific analysis of fish[79]. The fish are trapped and transported upstream by truck past two high-wall dams.

We believe the ongoing improvements to fishway technologies will improve the effectiveness in the long-term. Since MH is not planning to construct a sturgeon fishway until after Keeyask is constructed, this will

[77] Grant PUD. *Adult Fishways and Detection – Off-ladder Adult Fish Trap.* Accessed in 2013. (http://www.grantpud.org/environment/fish-wildlife/fish-survival/adult-fishways-and-detection)
[78] Puget Sound Energy. *Puget Sound Energy investing $50 million on new hatchery, fish trap to further aid Baker River salmon.* 1 April 2009. Accessed in 2013. (http://www.sac.usace.army.mil/Media/NewsStories/tabid/5721/Article/10326/passing-600000-fish.aspx)
[79] US Army Corps of Engineers. *Passing 600,000 Fish.* 19 February 2013. Accessed in 2013. (http://pse.com/aboutpse/PseNewsroom/NewsReleases/Pages/Puget-Sound-Energy-investing-$50-million-on-new-hatchery,-fish-trap-to-further-aid-Baker-River-salmon.aspx)

be beneficial from a cost perspective and improves the likelihood of success in increasing the lake sturgeon populations in the long-term.

6.5.5 Conclusion

Fishways are a common and often necessary feature for new hydro developments. Costs for designing, constructing and maintaining a fishway can vary greatly depending on the specifics of the site but should be aligned with the size and complexity of the facility. In this case, it is difficult to ascertain whether a fishway is necessary due to the lack of understanding about the movement of mature lake sturgeon in the study area. Despite this, MH has agreed to study fish movement during operation and include elements in their design to facilitate the retrofit of a technically sound and economical fishway should it be required. MNP believes that based on the information available and the related constraints discussed in this section, the “wait and see” approach is appropriate.

6.6 OBSERVATIONS

MH’s overall approach is to maintain and enhance lake sturgeon populations in the study area through stocking, conservation and habitat reconstruction. This supports the province’s goal to recover and sustain lake sturgeon populations long term. While MH has made efforts to develop a comprehensive strategy to enhance the lake sturgeon population, insufficient data on the effectiveness of these methods in this particular area makes it difficult to ascertain if these strategies are will be successful. It will also take 25 years or more to see results, which is substantial relative to the MH planning horizon of 78 years.

Since there is much uncertainty about whether the fish will return to the reservoir and Stephens Lake post-construction and since the fish passage systems lack supporting evidence of success in other regions, it is prudent to monitor sturgeon behaviour, which includes their use of the altered and constructed habitat prior to finalizing the design of the structure. While the First Nations partners recognize the negative impact hydroelectric development has had on sturgeon populations in the region, they support MH’s approach to mitigating further declines with the development of Keeyask.

Ultimately, MH’s plans will bolster and add additional resources to the role currently being played by the Saskatchewan and Nelson River Lake Sturgeon Management Boards, Split Lake Resource Management Board, academia and the government on lake sturgeon protection and conservation.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 61

PREAMBLE: MNP discusses stocking as a mitigation measure.

QUESTION:

What is the expected capital cost, if any, to establish the necessary infrastructure for stocking, including a new hatchery, if necessary?

RESPONSE:

Manitoba Hydro did not provide the estimated capital costs for establishing the infrastructure for stocking or for a new hatchery.

Based on subsequent research, we found the following historical costs and estimates:

Hatchery	Location	Cost	Year Built
Grand Rapids Fish Hatchery - incubates walleye, whitefish and trout eggs.	Manitoba	$1.125 million[i]	Early 1970s
Wildrose Fish Hatchery - cold water hatchery - salmon and trout	Wisconsin	$33.6 million[ii]	2009
Chief Joseph Hatchery	Washington	$900K-$1.2M[iii]	2013
Lost Valley Fish Hatchery - warm/cool water culture facility	Missouri	$21 million[iv]	2000
Priest Rapids Hatchery	Washington	$15.7 million[v]	To be completed end of 2014

Proposed Facilities	Location	Estimated Cost	Completion Date
New cold water fish hatchery to address species of concern including lake sturgeon.	Wisconsin	~$20-$24 million[vi]	TBD
New cold water facility (part of French River Hatchery Updgrade Study)	Minnesota	$15-$25 million[vii] (not including land acquisition costs)	TBD

In addition to the hatchery and stocking program, KHLP will provide annual funding in support of mitigation and stewardship activities identified by the Committee formed by the Lower Nelson River Sturgeon Stewardship Agreement. The new additional base funding will commence at approximately $110,000 annually, one-third of which would come from the Project and will continue for 30 years.

[i] https://www.hydro.mb.ca/corporate/facilities/brochures/grand_rapids_1107.pdf
[ii] http://wsfr75.com/content/renovation-wisconsin%E2%80%99s-wild-rose-state-fish-hatchery
[iii] Grant County Public Utility District Hatchery Program Status. September 10, 2012
[iv] Inside Region 3, Special Edition - Division of Federal Aid Sport Fish and Wildlife Restoration Programs. "Preserving Our Hunting and Fishing Heritage". U.S. Fish & Wildlife Service. Pg 9.
[v] Grant County Public Utility District Hatchery Program Status. September 10, 2012
[vi] Executive Summary. Comprehensive Study of Wisconsin's Fish Propagation System. December 19, 2011. http://dnr.wi.gov/topic/fishing/documents/hatcheries/Volume1ExecSumm.pdf
[vii] http://files.dnr.state.mn.us/areas/fisheries/lakesuperior/HDR-Report.pdf

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 61

PREAMBLE: MNP discusses stocking as a mitigation measure.

QUESTION:

What is the expected annual operating cost related to stocking operations, including operation of the fish hatchery, that can be attributed to the PDP?

RESPONSE:

Maintenance and Operational Costs may include supplies and materials, electricity, fuel costs, and other contractual costs (such as egg take) the hatchery might incur[1].

Based on subsequent research, we found the following costs:

Hatchery	**Cost**	**Notes**
Estimate for a facility producing 5200 LBS of lake sturgeon annually.	Staffing**: $158,400 O&M: $60,000 Food*: $92,375 **Total:** $310,775 **Cost per fingerling:** $3.13	*Depends on type of diet **permanent and temporary Does not include costs associated with egg take
French River Hatchery[2]	$635,544 (2009) $627,885 (2010) $520,027 (2011)	

[1] Farrell, John M. Lake Sturgeon Population Enhancement as a Strategy for Improvement of Ecosystem Function and Controlling Invasive Species. 2009. http://www.nysturgeonfortomorrow.org/documents/Farrell09FEMRF_Final_Sturgeon_Report_2009_.pdf

[2] http://files.dnr.state.mn.us/areas/fisheries/lakesuperior/HDR-Report.pdf

Manitoba Lake Sturgeon Management Strategy

2012

Conservation and Water Stewardship
Fisheries Branch

Species at Risk Act (SARA)

In 2008, COSEWIC recommended that most lake sturgeon populations in Manitoba be listed as Endangered. SARA defines a process that leads to a recommendation to the Federal Minister and a decision on listing. Fisheries Branch contributes to this process by providing information and expertise, preparing summary documents, and participating in the development of Recovery Strategies for each DU. These documents are a valuable contribution to the understanding of the current status of lake sturgeon in each area.

After a species is listed under SARA, DFO can enter into a Conservation Agreement with *any government, organization or person to benefit a species at risk*. These agreements can be used as a *mechanism to achieve legal and effective protection of species at risk and their critical habitat*.

Manitoba considers the management measures currently in place to be sufficient and that listing under the federal *Species at Risk Act* is not necessary at this time - specifically, closure of all commercial lake sturgeon fisheries by 1998 and the restriction of recreational fisheries to catch and release - to be effective and suitable for recovering lake sturgeon populations in areas where sufficient lake sturgeon and habitat are available to support a natural recovery. In general, domestic harvest of lake sturgeon is considered to be sustainable. Conservation Closures have been applied in areas that were not considered sustainable.

Management Activities

Management Guidelines

The experience of managing lake sturgeon in Manitoba has shown that limiting mortality is the single most effect means of sustaining lake sturgeon stocks. The failure to do this effectively during the historical commercial fishery lead to the dramatic declines that left lake sturgeon stocks throughout most of the province in the state they are in today. Protecting habitat is also important - lake sturgeon in several parts of the province have demonstrated they can adapt to fairly severe habitat alterations while proving unable to adapt to excessive levels of harvest.

Lake sturgeon stock management in Manitoba now focuses on ensuring that anthropogenic mortality is kept low enough that populations remain sustainable. In areas with populations that are already depleted, continuing a low level, sustainable harvest will maintain populations, but will also prevent any recovery of the stock. Recovery only occurs once the mortality is reduced. There is mounting evidence that the combination of Conservation Closures, closure of the commercial fishery and elimination of recreational angling harvest is allowing some stocks to start recovering.

significant amounts of suspended sediment from erosion on the Lake Winnipeg shoreline into Playgreen Lake. This sediment is carried north towards the Eight Mile Channel and is thought to have affected spawning reefs on that route. There were anecdotal accounts of lake sturgeon being caught in the Lake Winnipeg whitefish fishery on Mossy Bay when the Two Mile Channel opened, along with accounts from Norway House of the remaining remnant population of lake sturgeon largely disappearing from Playgreen Lake at that time.

Lake sturgeon continue to be observed in the tailrace below Jenpeg Generating Station, in Eves Rapids below the Cross lake Outlet Weir, and below Sea Falls near Norway House. Sea Falls is the site of a cable ferry crossing and is also a popular local boat launch. There is a large amount of local traffic in this area, including subsistence fishing targeting other species that results in excellent local observations.

This area was targeted for experimental stocking which began in 1994. The stocking is conducted in partnership with the Nelson River Sturgeon Board. The Board conducts the spawn taking in association with Regional Fisheries Branch staff, owns and operates a rearing facility located at Jenpeg and has one of its staff working at Grand Rapids Fish Hatchery raising lake sturgeon. As of 2011, 35,163 lake sturgeon fingerlings and 1,104 yearlings have been stocked at various locations in this reach, with the majority of them being stocked below Sea Falls (Appendix B, Table B-3). The source of all of the stocked fish was the Nelson River near the mouth of the Landing River in the next reach downstream (MU 2).

While there has been no formal study of the effectiveness of this stocking effort, there are many anecdotal accounts of incidental lake sturgeon catches in the Sea Falls area in recent years. Most of these accounts are of smaller lake sturgeon (40 to 60 cm).

Fishing pressure for lake sturgeon is minimal in this area. There is no targeted recreational angling. The bycatch of lake sturgeon in the Playgreen Lake commercial fishery approaches zero. There is almost no targeted subsistence lake sturgeon fishing by members of the Norway House Cree Nation and almost all of the reported bycatch has been released. There is some occasional targeted subsistence fishing in the Jenpeg Generating Station tailrace and in Eves Rapids by Cross Lake First Nation members. The level of fishing pressure is not considered high enough to have a significant impact on recovery, although given the status of stocks in this area, minimal harvest is desirable.

This reach is within the Norway House and Cross Lake resource areas. The Norway House Resource Management Board is kept informed on the activities of the Nelson River Sturgeon and ensure that it is both adequate and necessary to conserve stocks with the minimum level of infringement possible.

- Monitor the current population in this area and continue to assess the effectiveness of the management measures in place.
- Increase education and outreach to ensure that as the young lake sturgeon forming the basis of the population increase start to reach catchable size, they are not harvested. Assess the flow regime in the stretch from Whitemud Falls to Sipiwesk Lake to ensure that it does not affect lake sturgeon spawning and nursery success.

Kelsey Generating Station to Kettle Generating Station (MU 3):

The historical commercial fishery was considered to have depleted this area by the time of the 1960 closure. When the fishery reopened in 1970 this area never produced a significant commercial catch. By the time the commercial fishery was closed again in 1992, this area had not produced any lake sturgeon in many years.

The completion of Kelsey Generating Station in 1961 separated stocks in Split Lake from the Nelson River upstream. The completion of the CRD in 1976 increased discharges from the Burntwood River and increased the amount of suspended material entering Split Lake at its mouth. The increased inflow also increased water levels and flows in Split Lake and the Nelson River downstream.

The completion of Kettle Generating Station in 1974 separated stocks in this area from the lower Nelson River. Kettle GS back flooded Moosenose Lake and the Nelson River as far as Gull rapids, creating Stephens Lake, the Kettle forebay. The forebay is a significantly altered environment, with large flooded areas.

The reach from Split Lake downstream to Stephens Lake, includes Clarke Lake and Gull Lake as well as Birthday Rapids and Gull Rapids. This reach is affected by increased flows arising from the CRD, in particular increased winter flows which also affect ice formation. In 1995, the Split Lake Resource Management Board initiated a study that found lake sturgeon in Gull Lake. Studies funded by Manitoba Hydro as part of the planning for the proposed Keeyask Generating Station have added substantially to the knowledge of lake sturgeon populations and habitat use in this area.

Manitoba Hydro has also funded studies that have examined spawning utilization of potential spawning habitat near Kelsey Generating Station, at the mouth of the Grass River and the mouth of the Burntwood and Odie rivers. Anglers fishing near the mouth of the Odie River frequently report incidental catches of smaller lake sturgeon.

This reach is entirely within the Split Lake Resource Area. The Split Lake Resource Board has had some involvement in lake sturgeon management activities. There is potential for this role to be expanded, especially if development of Keeyask Generating Station is approved.

Although Tataskweyak Cree Nation and York Factory Cree Nation are members of the Nelson River Sturgeon Board, the Board was formed to address issues upstream of Kelsey Generating Station, and is not active downstream.

Current Status:

- This reach is considered historically depleted by the commercial fishery. By the 1950s it was not considered a commercially productive reach and never produced significantly once the fishery reopened in 1970.
- Construction of Kelsey Generating Station in 1960 would have cut off upstream movement of the remaining remnant population.
- However, recent studies have shown that there is a significant population in Gull Lake. Lake sturgeon in Split Lake appear to move to First Rapids near the mouth of the Burntwood River, presumably to spawn.
- Manitoba Hydro continues to fund studies in this area in support of future development plans.
- The only harvest is subsistence harvest.
- Commercial by-catch is thought to be extremely low.

Management Approach:

- Work to expand the engagement of the Split Lake Resource Management Board in lake sturgeon management.
- Over the long term, it would be preferable to have Tataskweyak Cree Nation and York Factory Cree Nation also bring lake sturgeon management discussions in this area to the Nelson River Sturgeon Board. They are already members, and the information being gathered in this area is of interest to the other Board members.

Kettle Generating Station to Longspruce Generating Station (MU 4):

Kettle Generating Station was completed in 1974 on the site of large rapids. There is some debate about the degree to which lake sturgeon would have traversed the rapids, although it seems likely that the rapids were capable of allowing fish movement. The generating station separated lake sturgeon in the lower Nelson River from upstream reaches. This is a short reach of river between two generating stations (Kettle and Longspruce). Habitat is thought to be limiting and it is not known if sufficient habitat exists for all life history stages. Manitoba Hydro is funding investigations in this area and assessing the potential for enhancement. The ability of this reach to support a self sustaining population is not known, although there are examples in the Winnipeg River of self sustaining populations in reaches smaller than this one.

This area is fully within the Split Lake Resource Area.

Current Status:

- Lake sturgeon are known to exist in this reach, but it is considered unlikely that there is a self sustaining population. The potential for a self sustaining population to establish is considered low, and dependant on there being suitable habitat to support all life history stages. Lake sturgeon in this area are isolated by the generating stations both upstream and downstream.
- Harvest is thought to be minimal.

Management Approach:

- Other areas continue to be a higher priority with more potential to recover stocks.
- Manitoba Hydro continues to fund studies in this area in support of future development plans.
- The Split Lake Resource Management Board may wish to consider the future management direction for this area.

Longspruce Generating Station to Limestone Generating Station (MU 5):

Longspruce Generating Station was completed in 1979 on the site of a rapids. This is a short reach of river between two generating stations (Longspruce and Limestone). Habitat is thought to be limiting and it is not known if sufficient habitat exists for all life history stages. Manitoba Hydro is funding investigations in this area and assessing the potential for enhancement. The ability of this reach to support a self sustaining population is not known, although there are examples in the Winnipeg River of self sustaining populations in smaller areas. Based on the Winnipeg River example, it is thought that the limiting factor will be the availability of habitat to support all life history stages as opposed to the size of the reach.

This area is fully within the Split Lake Resource Area.

Current Status:

- Lake sturgeon are known to exist in this reach, but it is considered unlikely that there is a self sustaining population. The potential for a self sustaining population to establish is considered low, and dependant on there being suitable habitat to support all life history

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 64

PREAMBLE: MNP states that "MH plans to install a temporary, experimental catch and transport system and conduct studies of fish habitat and behavior for a minimum period of 3 years to determine the requirements for a more permanent fish passage system."

QUESTION:

Please provide the capital and annual operating costs for such a system, if available.

RESPONSE:

Based on subsequent research, the following cost estimates were obtained:

Passage System Locaton	Cost	Notes
Baker River Fish Passage	Capital: $4.5 Million[1] O&M: $288,267 annual	Cost for Major Modification of trap and transport system in 2008. Began operation of fish passage in 1958. Salmon and Trout.
Priest Rapids Fish Bypass	Capital $27.4 million[2] O&M: $4.2 Million annual[3]	Off-ladder Adult Fish Trap. No transportation. Will operate July to Mid-October each year. Completion expected 2014.
Mossyrock Dam Fish Passage	Capital: $4.5 million[4] O&M: $135,000 Cost of Tanker Truck will be $100,000 to $200,000	Include installation of electric barrier.

[1] Baker River Fish Passage http://www.pse.com/aboutpse/HydroLicensing/Documents/2010_Annual_Reports/100/BAK%20SA%20103%20Annual%20Report%202010.pdf

[2] http://www.grantpud.org/environment/fish-wildlife/fish-bypass

[3] Grant PUD. *Adult Fishways and Detection – Off-ladder Adult Fish Trap.* http://www.grantpud.org/environment/fish-wildlife/fish-survival/adult-fishways-and-detection

[4] Hells Canyon Complex http://www.idahopower.com/pdfs/Relicensing/hellscanyon/hellspdfs/techappendices/Aquatic/e31_02_ch09.pdf page 30-31

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 66

PREAMBLE: MNP references the operational cost of the Priest Rapids Dam of $4.2 million per year and expects the operational costs for a Keeyask fish way to be "something less."

QUESTION:

Please confirm that MNP expects the worst-case scenario for a fish way (fish ways at both Keeyask and Conawapa, maximum operating cost) to be combined annual operating cost of $8.4 million.

RESPONSE:

Based on the limited public data available, $8.4 million annually is a reasonable worst case scenario for fishways at both the Keeyask and Conawapa project.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 66

PREAMBLE: MNP references the operational cost of the Priest Rapids Dam of $4.2 million per year and expects the operational costs for a Keeyask fish way to be "something less."

QUESTION:

Please advise what components would form part of the operating cost.

RESPONSE:

Operational Costs of the fishway may include, but are not limited to, the following:

- Mitigation and Monitoring Activities
- Cultural Stewardship
- Water and Land Use Fees
- Staffing/Support (portion of HR, security, training)
- Fishway operations,
- Fishway transportation
- Fishway facility maintenance
- Fishway equipment maintenance
- Technology upgrades, as applicable
- Utilities and telephone/ telecommunication infrastructure

TAB 12

impact or change the physical, chemical or biological quality of the environment, and includes, without limitation, risks or injuries to the health, safety, well-being, comfort or enjoyment of **Fox Lake** or **Citizens**, and impacts on interests in lands, pursuits, activities, opportunities, lifestyles and assets of **Fox Lake** and **Citizens**, and does not include any effects caused by the **Pre ISA Development**, or **Future Development** other than the **Keeyask Project**. The effects of **Pre ISA Development** are, subject to certain exceptions, addressed, settled and resolved by the **Fox Lake ISA**.

Keeyask Generating Station means the proposed hydro-electric generating station forming part of the **Keeyask Project** and consisting of a complex of structures, including the powerhouse, spillway, dam, dykes and transition structures, used in the production of electricity.

Keeyask Project means the **Keeyask Generating Station** and all related works, excluding the **Keeyask Transmission Project** and **Bipole III**, but including all channels, excavations, camps, storage areas, local roads and access roads, to be located in the vicinity of Gull Rapids, just upstream from the point at which the Nelson River flows into Stephens Lake, all of which are more particularly described in the **Project Description** and which, if built, will contribute approximately six hundred and ninety-five (695) **MW**, at rated capacity, to the **Integrated Power System**.
Lateral Violence and "Where Do We Go From Here" Program means the **Offsetting Program** described in section 3.8.

Limited Partnership means the Keeyask Hydropower Limited Partnership to be created pursuant to the **LP Agreement** for the purposes of carrying on the **Business**.

New Program means a future **Offsetting Program**, which is developed and agreed upon, pursuant to subsection 5.2.1.

Offsetting Programs means the **Gathering Centre**, **Youth Wilderness Traditions Program, Cree Language Program, Gravesite Restoration Program, Alternative Justice Program, Crisis Centre and Wellness Counselling Program, Alternative Resource Use Program,** and the **Lateral Violence and "Where Do We Go From Here" Program** all of which programs are described in Article 3, and include any **New Program** that is subsequently developed and agreed upon.

Pre ISA Development means all those physical works related to hydro-electric development on the Churchill, Nelson, Rat and Burntwood River Systems and the development of the Lake Winnipeg Regulation System north of the 53rd parallel, to the extent such works have been physically developed and constructed by or on behalf of **Hydro** to December 6, 2004, being the date of the **Fox Lake ISA**; and, without limiting the generality of the foregoing, includes all dams, dikes, channels, control structures, excavations, generating stations, roads, transmission lines and other works forming part of, or related to, all aspects of such hydro-electric development including:

- Lake Winnipeg Regulation,

Keeyask Project means the **Keeyask Generating Station** and all related works, excluding the **Keeyask Transmission Project** and **Bipole III**, but including all channels, excavations, camps, storage areas, local roads and access roads, to be located in the vicinity of Gull Rapids, just upstream from the point at which the Nelson River flows into Stephens Lake, all of which are more particularly described in the **Project Description** and which, if built, will contribute approximately six hundred and ninety-five (695) **MW**, at rated capacity, to the **Integrated Power System**.

Land Stewardship Program means the **Offsetting Program** described in section 3.4.

Limited Partnership means the Keeyask Hydropower Limited Partnership to be created pursuant to the **LP Agreement** for the purposes of carrying on the **Business**.

Member means a person who is, in respect of **TCN**, a "member of a band" as defined in subsection 2(1) of the *Indian Act* (Canada), and **Members** means a group of persons each of whom is a **Member**.

Museum and Oral Histories Program means the **Offsetting Program** described in section 3.10.

New Program means a future **Offsetting Program**, which is developed and agreed upon, pursuant to subsection 5.2.1.

Offsetting Programs mean the **Keeyask Centre**, the **Access Program**, the **Land Stewardship Program**, the **Healthy Food Fish Program**, the **Traditional Lifestyle Experience Program**, the **Traditional Knowledge Learning Program**, the **Cree Language Program**, **Traditional Foods Program** and the **Museum and Oral Histories Program**, all of which programs are described in Article 3, and include any **New Program** that is subsequently developed and agreed upon.

OWL Process means the Overview of Water and Land Process used by **TCN** to assess **Keeyask Adverse Effects** based upon the experience, understanding, knowledge, wisdom, values, beliefs and priorities of **TCN** and **Members**.

PDC means the pre-determined compensation which will become payable to **TCN** under Article 13 when water regime events fall outside of the **Fully Compensated Zone** and within a **PDC Zone**, shown on the graph attached as Schedule 5.

PDC Zones means the ranges of water levels to which the rates and formulae for the payment of **PDC** apply.

Member means a person who is, in respect of **War Lake**, a "member of a band" as defined in subsection 2(1) of the *Indian Act* (Canada), and **Members** means a group of persons each of whom is a **Member**.

Mooseocoot Trust means the trust settled by **War Lake** on the terms and for the purposes set out in the Trust Indenture dated April 20, 2004, made between **War Lake**, the named trustees, **Manitoba** and **Hydro**.

Museum and Oral Histories Program means the **Offsetting Program** described in section 3.7.

New Program means a future **Offsetting Program**, which is developed and agreed upon, pursuant to subsection 5.2.1.

Offsetting Programs mean the **Distribution Centre**, **Community Fish Program, Improved Access Program, Traditional Learning/Lifestyle Program, Cree Language Program,** and **Museum and Oral Histories Program**, all of which programs are described in Article 3, and include any **New Program** that is subsequently developed and agreed upon.

OWL Process means the Overview of Water and Land Process used by **War Lake** to assess **Keeyask Adverse Effects** based upon the experience, understanding, knowledge, wisdom, values, beliefs and priorities of **War Lake** and **Members**.

Program Planning Committee means the joint committee created pursuant to section 6.3 and comprised of members appointed by **War Lake** and **Hydro**, which committee is to discuss issues respecting **Offsetting Programs**.

Project means and includes all **Existing Development** and all past, present and future hydro-electric development or redevelopment on the Churchill, Burntwood and Nelson River Systems, and will include all development or redevelopment of the Lake Winnipeg Regulation System north of the 53rd parallel, and will also include the operation thereof by **Hydro**.

Project Description means the detailed description of the **Keeyask Project**, attached as Schedule 7-1 to the **JKDA**.

Ratification Protocol means the agreement entered into between the **JKDA Parties** dated July 29, 2008, setting out, among other things, agreed upon terms for the filing of the **Environment Act Proposal Form**, agreed upon processes for the ratification of the **JKDA** and, following ratification, agreed upon terms for the execution of the **JKDA**.

Regulatory Authorities means all appropriate federal, provincial, municipal or other governmental or administrative bodies from which any licences, permits, consents, approvals, certificates, registrations and authorizations are required to be obtained in

Keeyask Cree Nation means any one of **York Factory**, **TCN**, **War Lake** and **Fox Lake** and **Keeyask Cree Nations** means all of them.

Keeyask Generating Station means the proposed hydro-electric generating station forming part of the **Keeyask Project** and consisting of a complex of structures, including the powerhouse, spillway, dam, dykes, and transition structures, used in the production of electricity.

Keeyask Project means the **Keeyask Generating Station** and all related works, excluding the **Keeyask Transmission Project** and **Bipole III**, but including all channels, excavations, camps, storage areas, local roads and access roads, to be located in the vicinity of Gull Rapids, just upstream from the point at which the Nelson River flows into Stephens Lake, all of which are more particularly described in the **Project Description** and which, if built, will contribute approximately six hundred ninety-five (695) megawatts, at rated capacity, to the **Integrated Power System**.

Keeyask Transmission Facilities means all incremental transmission facilities and incremental communication-related facilities to be constructed in connection with the **Keeyask Project**, excluding **Bipole III**, but including all northern high voltage alternating current collector transmission lines, switching and transformer stations and related works, as determined by **Hydro** (Transmission and Distribution Business Unit), required to connect the **Keeyask Project** to **Bipole III**, and all north south alternating current transmission lines, switching and transformer stations and related works, as determined by **Hydro** (Transmission and Distribution Business Unit).

Keeyask Transmission Project means **Hydro's** proposed project to develop the **Keeyask Transmission Facilities**.

Limited Partnership means the Keeyask Hydropower Limited Partnership to be created, as provided in the **JKDA**, for the purposes of carrying on the **Business**.

Member means any individual person who is, from time to time, a member of **York Factory** pursuant to the *Indian Act* (Canada), including any members pursuant to a duly enacted custom membership code.

NFA means the Northern Flood Agreement, signed on December 16, 1977, between the Northern Flood Committee, **Hydro**, the Province of Manitoba and Canada, and includes all schedules annexed thereto, and shall include the Economic Development Agreement between the same parties and dated the 1st day of September, 1977.

Offsetting Programs means the Resource Access and Use Program, the Environmental Stewardship Program, and the Cultural Sustainability Program, all of which programs are described in Article 3, and includes any new **Offsetting Programs** that are subsequently developed by **York Factory** for the purposes set out in Article 3 and approved by **Members** pursuant to the community approval process in the **YFFN Trust**.

Project has the same meaning as defined in the **Comprehensive Agreement**.

Project Description means the detailed description of the **Keeyask Project** attached as Schedule 7-1 to the **JKDA**.

Ratification Protocol means the agreement entered into between the **JKDA Parties** dated July 29, 2008, setting out, among other things, agreed upon terms for the filing of the **Environment Act Proposal Form**, agreed upon processes for the ratification of the **JKDA** and, following ratification, agreed upon terms for the execution of the **JKDA** .

Regulatory Authorities means all appropriate federal, provincial, municipal or other governmental or administrative bodies from which any licences, permits, consents, approvals, certificates, registrations and authorizations are required to be obtained in respect of the **Keeyask Project** or the **Keeyask Transmission Project**, including without limitation, the **Closing Licences**.

Residual Compensation means the monetary compensation paid to **York Factory** pursuant to Article 7, but, subject to subsection 7.1.5, does not include the **Guaranteed Annual Amount** being paid to fund the **Offsetting Programs**.

Resource Management Board means the Board established pursuant to Article 4 of the **Comprehensive Agreement**.

Settlement Proceeds means all monies paid by **Hydro** to **York Factory** under this **Agreement,** including the **Residual Compensation** and the **Guaranteed Annual Amount** and any interest earned thereon.

TCN means Tataskweyak Cree Nation, formerly known as Split Lake Cree Nation.

War Lake means War Lake First Nation.

YFFN Trust means a trust to be created and settled by **York Factory** and funded pursuant to this **Agreement** and other agreements.

York Factory means the York Factory First Nation.

York Factory Resource Management Area means the resource management area described in Schedule 4.1 to the **Comprehensive Agreement**, and includes the rivers and lakes therein.

SUBJECT: First Nations

REFERENCE: CAC/MH I-25

QUESTION:

Please summarize the financial terms of the adverse effects agreements and indicate to what extent these costs are included in the econcomic and financial analysis.

RESPONSE:

The following information is taken from the four adverse effects agreements:

Tataskweyak Cree Nation

Residual Compensation - $3,000,000 on signing of agreement (March 2009).

Payment Schedule

All payments shown in 2008 dollars.

Guaranteed Annual Amount

	2009	2010	2011	2012	2013	Annual thereafter for the Life of the Keeyask Project
Guaranteed Annual Amount	$2,350,000[1]	$2,350,000[2]	$734,900[3]	$1,071,900[4]	$2,123,607	$2,123,607

The Guaranteed Annual Amount will be adjusted by CPI as provided in Article 4.

[1] Capital for the Keeyask Centre and funds for the Access Program
[2] Capital for the Keeyask Centre and funds for the Access Program
[3] Keeyask Centre O&M and funds for the Access Program
[4] Keeyask Centre O&M, funds for the Access Program, including trails, and funds for the Museum and Oral Histories Program

War Lake First Nation

Residual Compensation - $255,000 on signing of agreement (March 2009).

Payment Schedule

All payments shown in 2008 dollars.

Guaranteed Annual Amount

	2009	2010	2011	2012	2013	Annual thereafter for the Life of the Keeyask Project
Guaranteed Annual Amount	$146,500[5]	-	-	-	$191,394[6]	$365,575

The Guaranteed Annual Amount will be adjusted by CPI as provided in Article 4.

Fox Lake Cree Nation

Residual Compensation - $375,000 advance pursuant to agreement dated December 19, 2008; $300,000 on March 31, 2009; and $906,100 on March 31, 2010.

Payment Schedule

For period from March 31, 2009 to March 31, 2026. All payments shown in 2008 dollars

Guaranteed Annual Amount

2009	2010	2011	2012	2013	2014	2015	2016	2017
$615,000	$3,730,000	$710,000	$710,000	$710,000	$710,000	$710,000	$610,000	$610,000

2018	2019	2020	2021	2022	2023	2024	2025	

[5] Capital and improvements to road and shelter for the improved Access Program

[6] Funds for the Traditional Learning/Lifestyles Program and capital for the Community Fish Program and Museum and Oral Histories Program

$610,000	$310,000	$310,000	$310,000	$200,000	$100,000	$310,000	$310,000	

The Guaranteed Annual Amount will be adjusted by CPI as provided in Article 4.

York Factory First Nation

Residual Compensation - $490,000 in 2008 dollars paid when the York Factory First Nation Trust is established.

Payment Schedule

All payments shown in 2008 dollars.

Subject to modification under Article 4, all payments are to be made on March 31 of each year.

Guaranteed Annual Amount

	2009	2010	2011	2012	Annual thereafter for Life of Keeyask Project
Guaranteed Annual Amout	$196,078	$196,078	$196,078	$483,676	$483,676

The Guaranteed Annual Amount will be adjusted by CPI as provided in Article 4.

As noted in the response to MIPUG/MH I-017e, Manitoba Hydro is undertaking a review of the amounts included in its analysis for completeness. As a result of this review, Manitoba Hydro has identified certain costs associated with the adverse effects agreements that were inadvertently omitted from the program estimate. Appropriate adjustments will be determined and made in a new cost estimate currently being developed.

SUBJECT: First Nations

REFERENCE: CAC/MH I-25

QUESTION:

Please summarize the protection that is afforded to First Nations communities from the adverse effects related to the proposed developments.

RESPONSE:

The Keeyask Partnership undertook a systematic approach to address potential adverse effects related to the Keeyask Project, first by avoiding and reducing potential impacts (such as substantially reducing the area to be flooded by the project) and mitigating effects that remain (such as constructing sturgeon spawning habitat), while enhancing potential benefits. The First Nations were intimately involved in identifying potential adverse effects and appropriate responses to those effects from their own experiences and Cree worldview. The adverse effects agreements address loss or damage to the First Nations to the extent such effects are not fully addressed through the Partnership's efforts to avoid, reduce or mitigate adverse effects of the project. Under the agreements, the First Nations plan, execute and control the programming to meet their respective needs.

Please see the response to PUB/MH I-064 for a table that summarizes the Keeyask Adverse Effects Agreements.

TAB 13

Life Cycle Greenhouse Gas Assessment Overview

Introduction

Manitoba Hydro contracted the Pembina Institute to prepare a detailed quantitative life cycle analysis (LCA) of the greenhouse gas (GHG) emissions for both the Keeyask and Conawapa Generation Projects (including the associated principal and supporting structures and infrastructure). This document describes both the LCA methodology applied to Keeyask and Conawapa and presents the results of the analyses. The GHG life cycle impact for these projects are compared with that of six other electricity generating technologies. The displacement of GHG emissions due to increased energy exports are also considered and the net positive global life cycle GHG implications of the proposed generating stations are estimated.

LCA Approach and Methodology – Keeyask and Conawapa Generation Projects

LCA studies were used to estimate the GHG emissions resulting from the construction, land-use change, operation and decommissioning phases of the Keeyask and Conawapa Generation Projects. The LCA studies were conducted by the Pembina Institute using the ISO "Environmental Management – Life-Cycle Assessment – Principles and Framework" in ISO 14040:2006. Both the Keeyask and the Conawapa LCAs were based on a project life of 100 years.

The Keeyask and Conawapa G.S. were compared to common electricity generating technologies based on the life cycle GHG emissions produced as a result of delivering one gigawatt-hour (GWh) to the electrical distribution network. By using one GWh of electricity delivered as opposed to one GWh of electricity produced, these assessments took into consideration any losses associated with the transfer of electricity.

The LCA studies conducted for the Keeyask and Conawapa Generation Projects consider global GHG emission implications. The assessments, utilizing activity maps highlighting the major materials and processes, focused on four distinct phases of the projects: construction, land-use change, operation and maintenance, and decommissioning. Considering raw materials required, manufacturing of generating station components and transportation requirements, there are GHG emissions which occur outside of the province of Manitoba but are nonetheless captured in each LCA.

Life cycle GHG emissions associated with all significant materials and activities were accounted for and quantified within these studies. The Pembina Institute used the following principles to determine which activities to include in the analysis:

- Relative mass, energy or volume – If the activity required an insignificant amount of material or fuel, in terms of mass, volume or energy, relative to the whole, then the input was excluded. For this study a significant amount was qualified as greater than 1% of total material mass, volume or energy input to the life cycle.
- Environmental impact – If the material or fuel production is particularly GHG intensive then the material or fuel may be included even if it did not satisfy the relative mass principle. Some activities, such as the production of aluminum, are energy intensive, so while the mass used in the production of the generating station may be small, the environmental impact is comparatively large.
- Data availability – Regardless of the two points above, if the data was readily available then the value was included.

The majority of the data used in each LCA was based on early design stage material estimates provided by Manitoba Hydro in response to inquiries from the Pembina Institute. This data was supplemented with emission factor information from public life cycle data sets as necessary. A custom LCA model was developed to calculate the results and analyze the data.

In general, the LCA model can be broken down into three components: input, calculations and output. The input data includes all the life cycle data sets for activities such as steel manufacture. In addition, key factors such as transport distances, can be varied in the user input section. The analysis combines all the life cycle data and user inputs to calculate emissions for all of the stages of the hydroelectric facilities including construction, operation and decommissioning. The model summarizes the results in various tables and graphs.

GHGs include gases that absorb infrared radiation emitted by the Earth's surface. Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are the principal GHGs relevant to Keeyask and Conawapa.

The LCA for both Keeyask and Conawapa are based on several important assumptions and notable details that influenced the results of the analyses. The most significant assumptions are listed below.

- **Delivered Electricity**: Transmission of electricity over long distances results in losses of energy. Incorporating transmission losses into a LCA reduces the amount of consumable energy at major load centers and correspondingly increase the GHG emission intensity of the project facility. Thermal generation plants, such as natural gas-fired turbines, can be located closer to the actual users of the electricity while the Keeyask and Conawapa Generation Projects are a considerable distance from the consumer. After accounting for these losses, the LCA analysis assumes that the Keeyask and Conawapa Generation Projects will deliver annual energies of 4,000 GWh and 6,300 GWh respectively for use at major load centers.
- **Material Sourcing:** The data used in the LCA was based on the best available at the time of analysis. In general, specific material suppliers (such as concrete and steel) were not known. Therefore, assumptions were made based on past Manitoba Hydro experience and to ensure the analyses were conservative. For example, while steel production contains a significant portion of recycled iron, the analyses assumed 100% virgin material.
- **Land use change**: Manitoba Hydro considered GHG implications associated with the various land areas required for each of the projects. Specific types of land disturbance

are treated differently within each of the studies. The life cycle assessments categorize areas of land use change as either temporary or permanent. Areas such as borrow areas are considered temporary disturbances that are subject to equivalent re-growth within the time frame of the life cycle assessment and as such, are not included in the GHG emission calculations. Areas categorized as permanent include those that would remain permanently cleared or would be permanently changed to a different density of above ground biomass. For these types of disturbances, the net change in above ground biomass (initial minus final) is considered. For example, the biomass cleared for transmission right-of-ways are partially offset by new shrub and grassland biomass. For areas such as the roads and permanent infrastructure areas, the initial above ground biomass is not offset by any re-growth. Reservoirs are another area of permanent land-use change. GHG emissions resulting from flooding are a result of the conversion of a portion of the flooded carbon in vegetation and soils primarily to CO_2 and CH_4. An Intergovernmental Panel on Climate Change (IPCC) methodology was used to determine reservoir GHG emissions. In addition to the aquatic emissions associated with flooding, GHG emission estimates include emissions from the clearing and assumed burning of the above ground biomass prior to flooding.

Comparison Technologies Methodology

The six comparison technologies researched for these assessments were supercritical pulverized coal combustion, coal with carbon capture and storage, natural gas fired combined cycle, natural gas fired single/simple cycle, wind and nuclear. The Pembina Institute determined the life cycle emission intensities for the comparison technologies using a different approach than the one used for the hydroelectric generating stations. The comparison technology intensities were based on the results of a literature survey of published life cycle values. Once the literature review was complete, the list of values (a minimum of six for each technology) was analyzed and the median, average, maximum and minimum values determined. A brief description of the characteristics of the technologies from the literature survey is presented below:

Supercritical and Subcritical Pulverized Coal Combustion (PCC)

In older power plants, coal is combusted to produce subcritical steam, but greater efficiencies can be obtained by using higher steam pressures and temperatures in the supercritical range. Both subcritical and supercritical processes begin with grinding the coal into a fine powder. The powdered coal is blown with air into the boiler through a series of burner nozzles where combustion takes place at over 1,300°C. Higher steam temperature and pressures allow for higher achievable energy efficiencies of 38–45%, compared with 33% for subcritical plants. PCC plants generate a reliable supply of electricity, typically used to provide base load power to the grid, with an average capacity factor of 70–90%. However, coal power plants have limited flexibility to meet peak demand.

Coal with Carbon Capture and Storage (CCS)

CCS may become feasible for large point sources of CO_2, such as new or existing coal-fired power plants. During the CCS process CO_2 is separated from the other exhaust gases by using a commercial capture technology such as chemical or physical absorption. The captured CO_2 is compressed and transported in pipelines at high pressure to a storage location within or outside a plant's boundaries. The CO_2 is eventually pumped underground for storage.

Storage options in Canada include deep saline aquifers as well as depleted gas, oil and bitumen reservoirs. Another Canadian storage option is to inject CO_2 into existing oil and gas reservoirs that are nearing depletion in order to increase oil and gas recovery (i.e. enhanced oil recovery).

Capturing and compressing CO_2 requires a large amount of energy and increases the fuel requirements of a coal-fired plant by 25–40%, according to the IPCC. There are currently four industrial-scale CCS projects in operation worldwide.

Combined Cycle Gas Turbine (CCGT)

A CCGT plant combusts natural gas in a gas turbine to produce electricity. The turbine produces a significant amount of hot exhaust gas, which in a combined cycle power plant is used to generate steam. This steam is then used to produce additional electricity in a steam turbine. A CCGT plant can have efficiencies up to 60% and can be built in modules to accommodate a range of power demands. This type of electricity plant supplies both base load and peak demands. Capacity factors for a natural gas fired power plant are typically between 50-70%.

Simple Cycle Gas Turbine (SCGT)

The SCGT combustion process is identical to combined cycle except excess heat is wasted and not captured for further electricity generation. Single cycle gas turbine plants are sometimes installed as emergency or peaking capacity to help balance electricity production and loads on the electrical grid. The efficiency of a SCGT plant is 35–40%. These plants can be built modularly to satisfy a range of electricity demand.

Wind (Larger than 100 MW)

Wind farms consist of multiple wind turbines that convert wind energy into electricity from blades turning a generator. Turbines are built to adapt to changing wind conditions. The blades can be positioned to face the wind to optimize electricity generation from wind coming from nearly any direction. Wind farms contain individual turbines as large as three megawatts (MW). Since wind speeds are not constant, typical wind farms exhibit capacity factors of 20–40%. Wind power is intermittent therefore one critique is that wind cannot supply reliable base load electricity to the grid.

Nuclear

There are several reactor technologies used in the world, but all of them operate on the same principle: Fission heat is used to generate steam which is subsequently used to generate electricity in a steam turbine. Canadian nuclear power plants use Canadian Deuterium-Uranium

(CANDU) reactor technology to generate electricity. The Enhanced CANDU 6 design delivers a gross output of 740 MW per unit. Nuclear power generation is a consistent source of electricity for base load power, but there is almost no flexibility to meet peak demand. Nuclear power plants have capacity factors from 60–100%. There are currently five commercial nuclear power generating stations in Canada, all using CANDU reactors.

Results

The quantitative LCA results are disaggregated into emissions from construction (material production, transportation and construction of the facility), land use change, operation and maintenance and decommissioning of the generating station after 100 years of operation. The comparison technology life cycle data are based on a literature survey of published life cycle journal articles. Some of the journal articles are themselves literature surveys. The results below are therefore based on the median of many LCAs.

Table 1 summarizes the GHG emissions per project phase for the proposed Keeyask and Conawapa G.S. The construction phase includes all emissions on and off the project site released while the facility is being constructed. The operation phase includes all emissions from the first day of operation to when the facility is decommissioned, namely material replacement related GHG emissions. The decommissioning phase includes only emissions associated with decommissioning the facility and recycling available materials. Land use change emissions include carbon stock changes that occur during the construction phase due to clearing for permanent project features and reservoir emissions during the operation phase including biomass decomposition.

Table 1. SUMMARY OF LIFE CYCLE GHG EMISSIONS FOR THE PROPOSED KEEYASK AND CONAWAPA GENERATION PROJECTS

Construction			Land Use Change	Operation	Decommissioning	Total
Building Material Manufacture	Transportation	On-Site Construction Activities	Reservoir and Carbon Stock Changes	Maintenance and Refurbishment	Decommissioning and Recycling Activities	
Keeyask Generation Station						
0.68 t CO_2e/GWh	0.12 t CO_2e/GWh	0.34 t CO_2e/GWh	1.24 t CO_2e/GWh	0.03 t CO_2e/GWh	0.05 t CO_2e/GWh	**2.46 t CO_2e/GWh**
Conawapa Generation Station						
0.76 t CO_2e/GWh	0.15 t CO_2e/GWh	0.32 t CO_2e/GWh	0.15 t CO_2e/GWh	0.01 t CO_2e/GWh	0.04 t CO_2e/GWh	**1.43 t CO_2e/GWh**

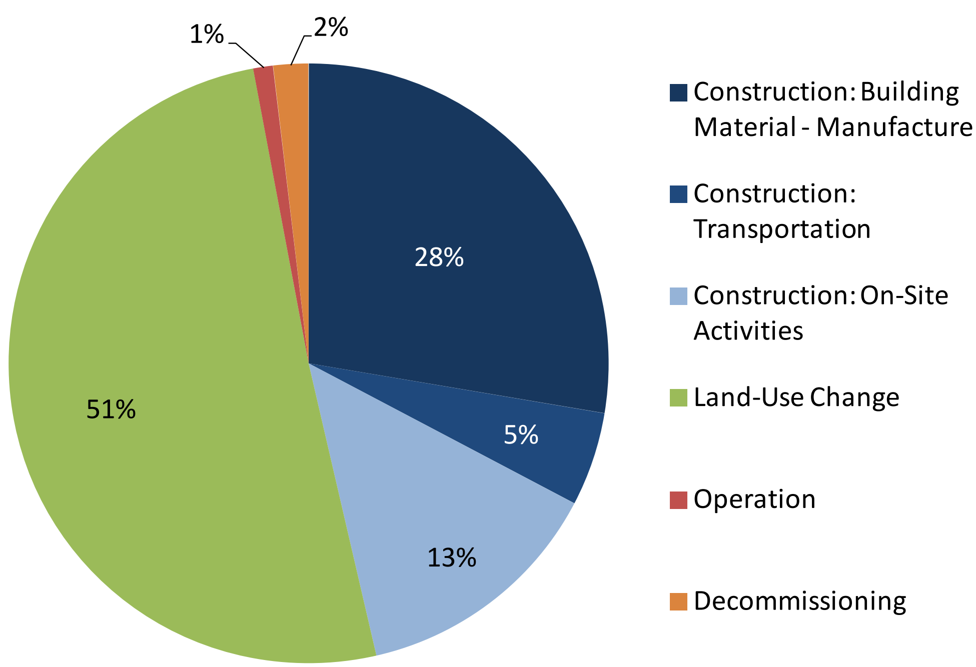
Keeyask Generation Project GHG LCA Results

Over its 100 year life, the Keeyask Generation Project is estimated to produce approximately 980,000 tonnes of CO_2e (carbon dioxide equivalent. GHG emissions associated with the construction phase of the project account for approximately 46% of the life cycle GHG emissions. The majority (60%) of the construction phase emissions result from building material manufacture. GHG emissions from the transportation of the materials and components to site are significant contributors to the construction phase emissions. The lengthy transportation distances assumed (the quantity of steel sourced from overseas for example) are responsible for the conservatively high life cycle transport related emissions. Emissions from onsite construction activities result from diesel combustion in construction equipment including trucks, backhoes, excavators and bulldozers.

Estimated land use change emissions account for 51% of all GHG emissions. The majority of land use change emissions are associated with the flooding of the reservoir (95%). The remaining 5% result from land cleared for roadways, transmission lines and the dykes. GHG emissions during the operation phase of the Keeyask project are primarily associated with offsite activities such as the production of replacement equipment, recycling of the damaged or worn steel components and concrete replacement. The majority of the GHG emissions associated with decommissioning result from recycling of steel components and onsite diesel combustion in demolition equipment.

Figure 1 presents the life cycle Keeyask GHG emissions disaggregated by project phase.

Figure 1. **KEEYASK GENERATION PROJECT - BREAKDOWN OF GHG EMISSIONS PER PRIMARY ACTIVITY**



Conawapa Generation Project GHG LCA Results

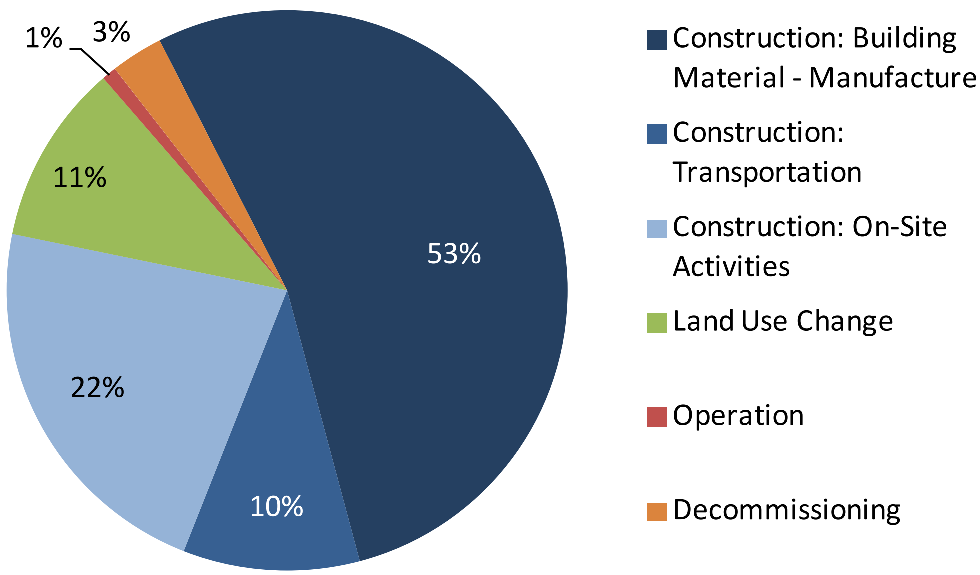
Over its 100 year life, the Conawapa Generation Project is estimated to produce approximately 900,000 tonnes of CO_2e. The construction phase is responsible for the majority (86%) of life cycle GHG emissions. Within the construction phase, 62% of emissions result from building material manufacture. Steel production including mining and processing is responsible for 33% of construction emissions and 28% of total life cycle GHG emissions. GHG emissions resulting from on-site construction activities, namely combustion of diesel for construction equipment, amount to 25% of construction emissions. GHG emissions from the transportation of the materials and components to site contribute roughly 12% of construction phase emissions. As with Keeyask Project, the lengthy transportation distances assumed (the quantity of steel sourced from oversees for example) are responsible for the conservatively high life cycle transport related emissions.

Land use change emissions account for 10% of all GHG emissions. This is significantly lower than the results of the LCA completed for the Keeyask Project. Conawapa is expected to produce more electricity but the area flooded is less than 25% of the area flooded by the Keeyask Project. The lower ratio of flooded land to electricity produced yields a much lower contribution of land use to overall GHG emissions in the Conawapa LCA. Land use change emissions associated with reservoir flooding and burning of biomass accounted for the majority (77%) of overall land use change emissions. The remaining 23% result from land cleared for roadways, portages, the dam and cofferdam, work areas and other terrestrial areas not associated with the reservoir.

As with the Keeyask Project, GHG emissions during the operation phase of the project are primarily associated with off-site activities such as the production of replacement equipment, and recycling and transportation of the damaged or worn steel components. The majority of the GHG emissions associated with decommissioning result from recycling of steel components and on-site diesel combustion in demolition equipment.

Figure 2 presents the life cycle Conawapa Generation Project GHG emissions disaggregated by project phase.

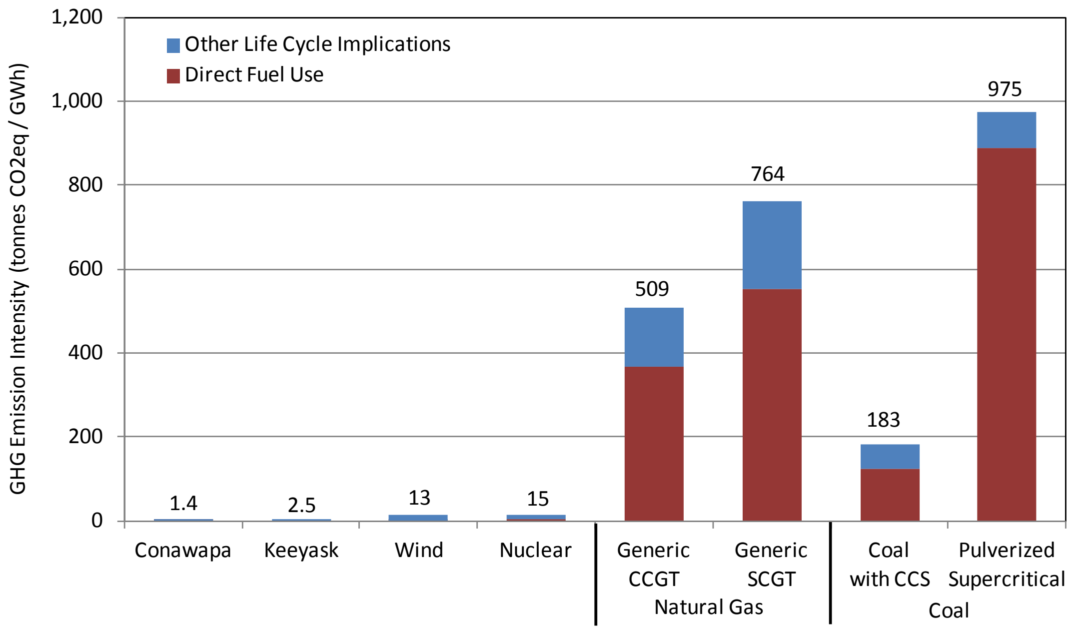
Figure 2. CONAWAPA GENERATION PROJECT - BREAKDOWN OF GHG EMISSIONS PER PRIMARY ACTIVITY



Comparison with Other Power Generation Technologies

As shown in Figure 3, life cycle GHG emissions on a per GWh basis are significantly lower for the proposed hydro electric generation projects than for all of the fossil fuel alternatives (supercritical PCC, CCGT, SCGT, coal with CSS). In addition, the life cycle GHG results for both Keeyask and Conawapa projects indicate lower emission intensities than the two non-fossil fuel options: nuclear and large commercial scale wind generation. To illustrate the magnitude of the difference between technologies, consider that over its 100 year life, the Keeyask project is estimated to result in 980,000 tonnes of CO_2e. Using the data from Figure 3, an identically sized combined cycle natural gas fired generation facility would release the same GHG emissions in less than half a year of continuous full capacity operation. Gross life cycle GHG emissions from the Conawapa project were determined to be even lower. For Conawapa, an identically sized combined cycle natural gas fired generation facility would release the same GHG emissions in less than 100 days of continuous full capacity operation.

Figure 3. **COMPARISON OF LIFECYCLE GHG EMISSIONS FOR ELECTRICITY GENERATION**



Greenhouse Gas Displacement

It is assumed that the energy produced by Keeyask and Conawapa Generation Projects (less transmission losses) will displace a variety of fossil-fuelled generation. The electricity sector is well integrated and changes to the Manitoba Hydro system have effects beyond the provincial borders of Manitoba. The U.S. mid-west, which Manitoba Hydro is interconnected with and exports energy to, relies heavily on fossil fuel generation. Analysis of the electricity market allows an estimate of the avoided GHG emissions due to energy being injected into the regional energy markets from Manitoba.

Conventional coal generation is typically on the order of 900 to 1,100 tonne CO_2e/GWh while natural gas can range from about 300 to 800 tonnes CO_2e/GWh depending on the specific technology and its efficiency. Manitoba Hydro currently assumes that its net exports displace and its imports result in 750 tonnes CO_2e/GWh. This reflects a marginal generation mix of various fossil-fuels and technologies. Given that the current marginal generation remains primarily coal the 750 tonnes of CO_2e/GWh factor used by Manitoba Hydro is considered to underestimate the emissions displaced by exports.

Comparing the 750 tonnes CO_2e/GWh displacement intensity with the 1.4 and 2.5 tonnes CO_2e/GWh (see figure 3) LCA GHG intensities of the proposed projects, there is a clear net GHG emission displacement benefit of approximately 748 tonnes CO_2e/GWh. The net positive effect of the Keeyask and Conawapa Generation Projects on climate change reflects the small life cycle GHG emissions of the proposed projects versus the much more significant emission reductions that will result from the displacement of high GHG intensity sources of generation.

3.3 GHG Emissions Life Cycle Assessment

A life cycle assessment (LCA) of GHGs and select criteria air contaminants was prepared for the Keeyask Generation Project by the Pembina Institute and submitted on February 16, 2012 as part of the EIS for the project. This section of the critical review performs an objective analysis of the LCA completed for Keeyask to confirm the reasonableness of assumptions, inputs and results.

3.3.1 Pembina Institute LCA and Critical Review

The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance[15]. Given the expertise of the organization and a strong reputation for high quality research and analysis, Pembina is well suited to analyse the long-term climate-related impacts of energy infrastructure projects. However, the organization's mandate and position with respect to climate change mitigation and renewable energy advancement could bring objectivity into question when evaluating hydro and renewable-based plans against alternatives relying on other clean and/or lower emitting forms of generation, such as gas.

The Pembina Institute engaged a critical reviewer to assess the quality of their LCA report. The critical reviewer was Maryse Lambert, Senior Advisor – Air Quality with Hydro Quebec. Ms. Lambert reviewed the Keeyask report and life cycle model and provided quality review comments to Pembina. This aligns with best practice guidance on LCA methodology under *ISO 14040: Environmental Management – Life Cycle Assessment – Principles and Framework*. In her review comments, Ms. Lambert identified an inconsistency regarding the assumptions on steel replacement. The Pembina report is unclear on whether the steel replacement emissions reported are based on a 10% or 100% steel replacement over the life cycle.

It is MNP's opinion that the inconsistency identified is of limited materiality to the overall calculation of life cycle GHG emissions. The result of 10,025 tonnes of CO_2e representing emissions associated with steel replacement is likely attributable to replacing 10% of steel. Replacing 100% of the steel components would result in a much higher volume of GHG emissions given that the initial steel manufacture and transportation to site alone (not counting assembly and construction activities) results in over 164,000 tonnes of CO_2e.

Actual steel replacement would contribute a volume less than 164,000 tonnes as 100% steel replacement in unrealistic. Mechanical steel may be replaced, but the majority of steel used in the project as rebar within the damming structures would not be assumed to be replaced, lowering the percentage of steel replacement to a much lower figure, likely closer to 10%.

3.3.2 Assumptions and Inputs Assessment

MNP reviewed several material qualitative and quantitative inputs applied in the Keeyask LCA, specifically focusing on the following sections of the LCA report:

- Section 4.5 – Limitations of Study.
- Section 4.3 – Key Assumptions and Notable Facility Details.
- Section 6 – Sensitivity Analysis (qualitative descriptions provided).

[15] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants.* 16 February 2012. Accessed in 2013.

- Section 8.7 – Appendix 7 – Sensitivity Analysis (quantitative information provided).

In a number of cases, material assumptions were identified to have inherent limitations regarding the availability and/or potential accuracy of supporting data. In these cases, as well as with all LCA components determined to be material, the Pembina Institute performed sensitivity analysis to gauge the potential impact of differing driving factors. MNP also conducted a materiality assessment of LCA component calculations and performed sensitivity testing, as summarized in the following sections. A high-level scan of immaterial assumptions and inputs included in the LCA report was also carried out. We do not note any unusual or disconcerting assumptions, inputs or sources applied by MH or Pembina Institute.

Under each of the following analyses, a brief overview of the reported sensitivity information from the LCA is provided, followed by our assessment of the reasonableness of the impacts to overall life cycle emissions estimates of the project.

In our assessment and quantification, MNP was constrained by the lack of transparency regarding the LCA report's assumed activity-based emissions factors, or how they were derived for both the base case and sensitivity analyses. All of the sensitivities below required MNP to estimate reasonable emissions factors in order to calculate impacts on total emissions. Where possible, we have recalculated the base case using the information throughout the LCA report. In other cases, we have utilized emissions factors based on credible and independent sources of publicly-available information. These sources include, but are not limited to, the International Energy Agency (IEA), the Environmental Protection Agency (EPA), the Clean Environment Commission (CEC), the Organization for Economic Cooperation and Development (OECD), IHS CERA, ICF International and the UNFCCC.

Sensitivity #1: Transportation Distances

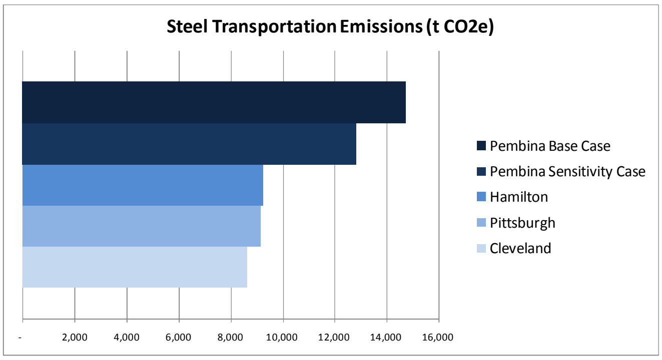
Transportation distances of materials and equipment required for construction and operation of the Keeyask and Conawapa projects can have material impact on the total life cycle emissions estimates. Specifically, the sources of steel materials and components may come from many different global suppliers. Differences in sourcing locations may result in significant differences in transportation-based emissions due to the high emissions intensity of transporting steel. At the time of this NFAT review, MH has not fully contracted suppliers for all materials and equipment. Therefore, an inherent limitation of the analysis is that all transportation related emissions can only be quantified based on estimated distances travelled. The transports of other materials are deemed to be more trivial and are therefore not tested with sensitivity analysis.

Limitation Identified:	Transportation Distance
LCA Approach	MH provided some insight on the expected distances of key transported materials. However, the final sources of many materials, such as steel, are unknown. In place of actual data, the assessment uses plausible and conservative transport distances based on previous MH experience. A list of all transport distances is available in Appendix 2 of the NFAT– Scoping.
MNP Impact Assessment & Conclusion	MNP reviewed the transportation distances assumptions. Based on our review, the distances assumed are conservative and estimate plausibly considerable distances based on MH's previous experience building hydroelectric generating stations. **Overall, we are satisfied that this limitation will *not* result in a *material understatement* of life cycle emissions for preferred plan projects.**

The LCA report analyzes the percentage reductions in life cycle emissions by life cycle phase if steel is transported from a plant in North America instead of China[16].

Assumption Category:	Transportation Distance
LCA Base Case Assumptions	Base case assumes all steel used in the manufacture of the generating station to come from China. Steel transportation route includes: • Ocean transport from Shanghai to Vancouver (9,797 km). • Rail transport from Vancouver to Winnipeg (2,202 km). Truck transport from Winnipeg to Keeyask (1,071 km).
LCA Sensitivity Assumptions	Some steel will come from North American sources. This sensitivity *reduces* life cycle emission intensity. 13% decrease in transportation emissions during the construction phase when shipping from China is removed.
MNP Sensitivity Assumptions	• All steel is assumed to be produced in North America in either Pittsburgh, Hamilton or Cleveland.[17] • Transportation distances assumed are 3,199 km for Pittsburgh, 3,231 km for Hamilton, and 3,013 km for Cleveland.[18] • Trucking emission factor used for all three = 71.6 tons of CO_2 per million ton-miles.[19] • Conversion factor of 0.621371[20] for kms to miles.
MNP Conclusion	Across the three cities assumed, we calculated an average 30% reduction in steel transportation emissions by sourcing all steel from North America vs. China. Our analysis indicates that Pembina's sensitivity case is at the low end of the range of potential transportation emissions reductions. Based on the results of both analyses, the range of possible transportation emissions reductions is approximately 13% to 30% if some or all of steel is sourced from North America. **Overall, a further reduction beyond the 13% in transportation emissions within the LCA sensitivity analysis could be realized if all steel is sourced from Pittsburgh, Hamilton, or Cleveland.** ***The figure below provides summary of the transportation emissions across the various cases. These findings indicate that the Base Case calculations, assuming steel transportation from China, is sufficiently conservative and provides the panel with a view of the highest level of emissions likely possible, as associated with this factor.***

Figure 3.1: Steel Transportation Emissions



[16] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. (*Appendix 7, Table 28). 16 February 2012. Accessed in 2013.
[17] Selected based on proximity to Winnipeg.
[18] Calculated based on Google Maps driving distances between the city and Winnipeg plus truck transport distance of 1,071 km from Winnipeg to Keeyask, consistent with the base case.
[19] Texas Transportation Institute. *Sustainability and Freight Transportation in North America*. Prepared for the Commission on Environmental Cooperation. March 2010. Accessed in 2013.
[20] Conversion factor according to Google.

Sensitivity #2: Steel Source and Emissions Factor

Offsite steel production is the most energy-intensive and therefore emission-intensive activity associated with the construction of the hydro generating stations. The steel components used are produced in many different countries including South East Asia, Eastern Europe, South America and North America.

Limitation Identified:	Steel Production Emissions Factor
LCA Approach	Pembina assumes all steel is produced in China so that transportation related emissions are as conservative as possible (particularly with transportation distances and described above). However steel production emission factors for China are known to be uncertain and non-transparent. Pembina has therefore opted to use a generic North American steel emissions factor based on typical steel production and forging including mining, transportation of raw materials, processing and steel production. Although this emission factor is likely representative of emissions from steel facilities it may be different than the actual emissions factor from the facilities used to produce the final components and is likely different than those facilities in China where the materials are assumed to derive from. For average global steel production, up to 67% of iron in steel comes from recycled sources. The LCA analysis assumes 100% virgin material. This assumption ensures the analysis is *conservative*.
MNP Impact Assessment & Conclusion	The following two conflicting assumptions used with respect to steel production create the potential for flawed estimation: 1. All steel is assumed to come from China. 2. Steel production emissions are based on a North American emission factor. The scale of the potential misstatement in life cycle emissions depends on the following factors: 1. Difference between China steel emissions factor and North American steel emissions factor (tested below). 2. Transportation distances (discussed in a separate section below). 3. Specific company contracted to provide steel for construction due to facility-specific nature of steel making emissions intensity (i.e. percentage of virgin vs. recycled iron used in production). In assuming 100% of iron in steel is virgin material, the potential impact of this key assumption can only be to *reduce overall life cycle emissions*. Since this is a *conservative* approach by MH in their assumptions, we have not quantified the potential reductions in overall life cycle emissions intensity as this only serves to *improve* the economics of the project. **The inconsistency results in the *potential* for life cycle emissions to be *materially erroneous*. However, overall, we are satisfied that this limitation will *not* result in a *material understatement* of total life cycle emissions.**

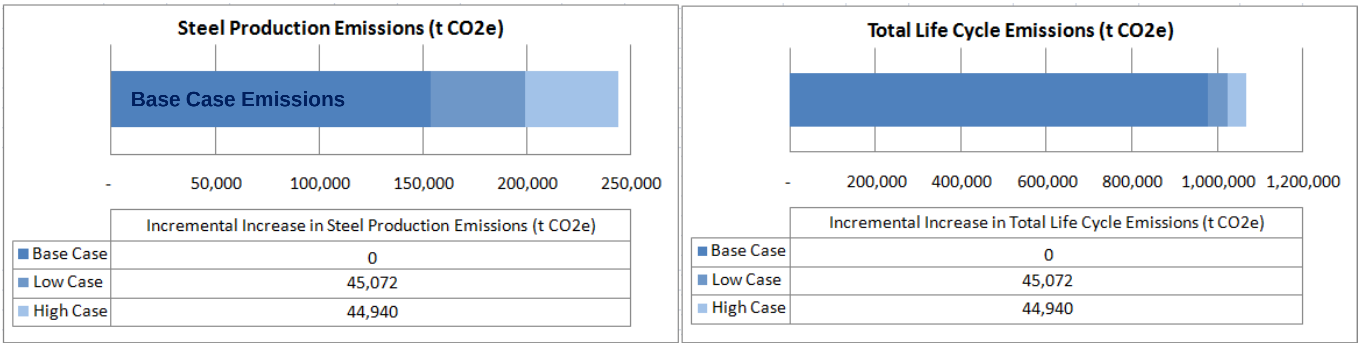
The LCA analyzes the percent increase in life cycle emissions assuming 30% more intensive steel production as a sensitivity case[21] to proxy typical Chinese producers. Other factors impact steel making emissions and some data limitations are addressed as below.

Assumption Category:	Steel Production Emissions Factor
LCA Base Case Assumptions	• Emission factor used is for North American steel production. • Total amount of steel required to build Keeyask = 64,200 tonnes. • Total emissions from steel production = 153,948 tonnes of CO_2e.
LCA Sensitivity Assumptions	Steel is assumed to come from China. Assumes 30% more intensive steel production as a sensitivity case to proxy typical Chinese producers. This sensitivity *increases* life cycle emission intensity.

[21] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. (*Appendix 7, Table 29). 16 February 2012. Accessed in 2013.

Assumption Category:	Steel Production Emissions Factor
MNP Sensitivity Assumptions	- Implied US emission factor of 2.40 t CO_2e/tonne of steel in base case. - Chinese emission factor between 3.1 and 3.8 t CO_2e/tonne of steel in sensitivity case. - Low case scenario assumed 3.1 t CO_2e/tonne of steel emission intensity. - High case scenario assumed a 3.8 t CO_2e/tonne of steel emission intensity. [22]
MNP Conclusion	The low case scenario resulted in a *29% increase in steel production emissions (consistent with the LCA report findings)*, with a *5% increase in total life cycle emissions* for the Keeyask project. Overall, it is a *reasonable sensitivity result,* but on the low end of the range. The high case scenario resulted in a *58% increase in steel production emissions*, with a *9% increase in total life cycle emissions* for Keeyask. **Overall, producing steel in China could increase total life cycle emissions between 5 and 9%, which is material to the LCA calculation. However, it is immaterial in comparison with other generation technologies included in development plans reliant on gas generation.** ***The figure below provides a visual summary of the low, base and high case life cycle emissions.***

Figure 3.2: Impact of Steel Sensitivity Cases on Steel Production & Total Life Cycle Emissions



These graphs demonstrate that steel production emissions could be at least 45 Kt, or as much as 90 Kt greater if emissions factors representative of Chinese steel production are applied. This could represent a material change in the total life cycle emissions of the Keeyask project. However, when compared to the emissions produced by alternative project types in gas plans, the amount becomes immaterial.

Sensitivity #3: Cement Emission Factor

Emissions from cement production are significant contributors to total life cycle emissions of Keeyask. However, individual cement production facilities experience significant variability in their emissions intensities. This is also the case from state to state and country to country cement production emissions intensities.

Limitation Identified:	Cement Supplier
LCA Approach	MH has not contracted cement suppliers at this design stage. The base case assumes that all cement is produced in Edmonton and transported to the construction sites by truck. MH has, in the past, sourced cement from Edmonton for the construction of hydro facilities.
MNP Impact Assessment &	There are 2 key considerations in this assumption, which are both dependent on the supplier contracted to provide cement:

[22] Global Carbon Capture and Storage Institute. *CCS for Iron and Steel Production*. 23 August 2013. Accessed in 2013. (http://www.globalccsinstitute.com/insights/authors/dennisvanpuyvelde/2013/08/23/ccs-iron-and-steel-production)

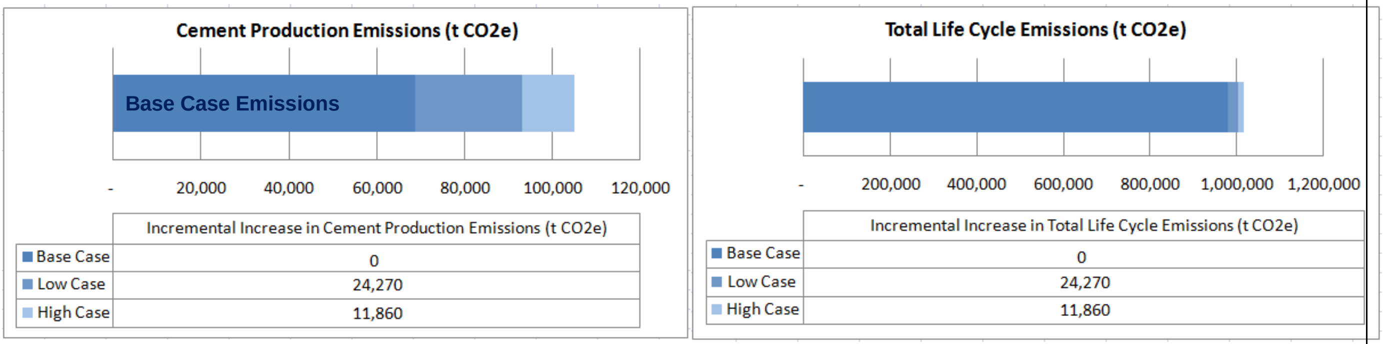
Limitation Identified:	Cement Supplier
Conclusion	1. Emission intensity of production. 2. Emission intensity of transportation. Other plausible locations for cement suppliers could include: 1. Southern Ontario. 2. Illinois. 3. Wisconsin. Production and transportation of cement represents 7.03% and 1.39% of total life cycle CO_2 emissions, respectively. Therefore, the risk of material error comes from production rather than transportation. In the LCA calculation, Pembina applied the assumption that cement used by MH is produced in a manner similar to the average Portland cement manufacture in the US. This assumption is plausible as the majority of large cement producers in Canada and the US manufacture Portland cement. **The selection of a cement supplier will impact the actual cement emissions factor as it varies by plant. See conclusion and results of the sensitivity assessment in the table below.**

The LCA report analyzes the percentage increase in life cycle emissions by life cycle phase if cement manufacturing is 30% more emission intensive than the base case[23] as a proxy for a more intensive supplier.

Assumption Category:	Cement Emissions Factor
LCA Base Case Assumptions	The base case analysis uses a generic concrete emissions factor for the average emissions intensity of producing cement in the United States. • Total amount of cement required to build Keeyask = 124,100 tonnes. • Total emissions from cement production = 68,805 tonnes of CO_2e.
LCA Sensitivity Assumptions	Individual cement production facilities may have higher or lower emissions. This sensitivity assumes emission intensity from cement production is 30% higher. This sensitivity *increases* life cycle emission intensity.
MNP Sensitivity Assumptions	• Base Case Implied US emission factor of 0.55 t CO_2/tonne of cement. • US Average Cement Emission Intensity = 0.95 t CO_2/tonne of cement.[24] • High Case Cement Emission Intensity (Kansas) = 1.4 t CO_2/tonne of cement.[25] • Low Case Cement Emission Intensity (Michigan) = 0.75 t CO_2/tonne of cement.[26]
MNP Conclusion	The low case scenario resulted in a *35% increase in cement production emissions*, with a *2% increase in total life cycle emissions* for the Keeyask project. Our *low* case emission factor is 0.20 t CO_2/tonne *higher* than the emission factor applied in the Pembina report. We feel the use of 0.55 t CO_2/tonne is questionable. The high case scenario resulted in a *58% increase in cement production emissions*, with a *11% increase in total life cycle emissions* for Keeyask. **Overall, the cement emission factor could increase total life cycle emissions between 2 and 9%, which is material to the LCA calculation. However, it is immaterial in comparison with with other generation technologies included in development plans reliant on gas generation.** ***The figure below provides a visual summary of the low, base and high case life cycle emissions.***

[23] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. (*Appendix 7, Table 31). 16 February 2012. Accessed in 2013.
[24] Loreti Group. *Greenhouse Gas Emissions Reductions from Blended Cement Production*. 19 December 2008. Accessed in 2013.
[25] Ibid.
[26] Ibid.

Figure 3.3: Impact of Cement Sensitivity Cases on Cement Production & Total Life Cycle Emissions



In our analysis, we found that emission intensity for cement manufacturing varies by more than 60% from state to state in the US based on 2004 EPA data[27]. In addition, the US national average emission intensity for cement manufacturing is 21% higher than the state with the lowest emission intensity. The US national average emission intensity for cement manufacturing is 47% lower than the state with the highest emission intensity.

Variability in cement manufacturing emission intensity is attributable to:

- Kiln technology used to produce the cement clinker (i.e. fuel efficiency).
- Carbon intensity of kiln fuel (i.e. use of coal to fire kiln).[28]

Ultimately, we caution the Review Panel that dependent on the cement manufacturer selected for the construction of Keeyask, the emissions from cement manufacturing will likely be *higher* than reported by Pembina in this high case sensitivity.

Sensitivity #4: Fuel Source

The construction of the generating station will require significant amounts of diesel fuel. Diesel is refined from crude oil which can come from many sources. However, crude oil derived from oil sands is replacing conventional crude oil sources in the analysis. The LCA report analyzes the percentage increase in life cycle emissions by life cycle phase if 100% of crude oil is sourced from heavy oil sources[29].

Assumption Category:	Fuel Source
LCA Base Case Assumptions	The base case uses the average volume of crude oils produced in Alberta to estimate the emissions associated with overall crude production for the diesel used in the project. • Assumes 40% of the crude comes from heavy oil and 60% from light oil sources. • Total amount of diesel fuel required to build Keeyask = 47,800 m^3.
LCA Sensitivity Assumptions	Assumes all crude used to produce diesel comes from heavy crude oil sources. This sensitivity *increases* life cycle emission intensity. Inputs summarized here are derived from Pembina's LCA report. • Emissions intensity to produce light crude = 300,024 g CO_2e/m^3. • Emissions intensity to produce heavy crude = 836,274 g CO_2e/m^3. • Emissions intensity to upgrade bitumen = 458,232 g CO_2e/m^3. • Emissions intensity to refine crude = 176,438 g CO_2e/m^3. • Emission allocation factor of 0.36:1 for diesel: crude based on volume (1 barrel).

[27] Ibid.
[28] Ibid.
[29] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants.* (Appendix 7, Table 30). 16 February 2012. Accessed in 2013.

Assumption Category:	Fuel Source
MNP Sensitivity Assumptions	General Assumptions: • 10 gallons of diesel fuel from a barrel (42 gallons) of crude oil[30], resulting in an emissions allocation factor of 0.24 based on volume. • Total amount of crude oil required to produce 47,800 m^3 of diesel fuel = 200,760 m^3. Emission Intensities: • Produce light crude[31] = 180 t CO_2e/1000 m^3. • Produce heavy crude[32] = 675.8 t CO_2e/1000 m^3. • Upgrade bitumen[33] = 8.3 g CO_2e/MJ. • Refine crude[34] = 8.6 g CO_2e/MJ.
MNP Conclusion	We calculated a 63% increase in total emissions from diesel fuel production. Overall, this translates to a 7% increase in life cycle emissions during the construction phase attributed to building materials manufacturing. The Pembina report calculated an 86% increase in total emissions from diesel fuel production. Overall, this translates to a 10% increase in life cycle emissions during the construction phase attributed to building materials manufacturing. **Overall, the approach taken by MH in the sensitivity case calculation is *conservative*, by overestimating the likely emissions level. Therefore, MH calculation is *not* reasonably likely to result in a *material understatement* of life cycle emissions.**

3.3.3 Untested Data Limitations

As part of any life cycle assessment of GHG emissions, inherent data limitations and uncertainties exist. For development projects, limitations are most often derived from unknown or undecided upon elements of the plan or capital budget. For example, for the Keeyask and Conawapa projects, many of the materials and equipment suppliers have not yet been contracted. As a result, only estimates of sources and related operational activity can be used in the LCA. Other data limitations include the amount and nature of component replacements over time and the effects of temperature, humidity and other environmental conditions, as well as the expected design and performance of comparison technologies. Comparison to theoretic facilities allows for only reasonable estimates and not for inputs based on historical performance. These limitations present some intrinsic uncertainty in final estimates.

For most limitations of this nature, the LCA did not provide scenario or sensitivity testing. The materiality of the potential differences is likely low and we believe this approach to be reasonable. MNP did however provide some testing comparison technology emissions intensities as noted below as a key factor in determining each plans' overall emissions displacement potential.

[30] US Energy Information Administration (EIA). *Frequently Asked Questions.* 2013. Accessed in 2013. (http://www.eia.gov/tools/faqs/faq.cfm?id=327&t=9)
[31] Canadian Association of Petroleum Producers. *A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry, Volume 1, Overview of the GHG Emissions Inventory."* 246: CAPP, 2005. Accessed in 2013.
[32] Ibid.
[33] Jacobs Consultancy. *EU Pathway Study: Life Cycle Assessment of Crude Oils in a European Context.* 2012. Accessed in 2013.
[34] ICF International. *Independent Assessment of the European Commission's Fuel Quality Directive's "Conventional" Default Value.* 9 October 2013. Accessed in 2013.

Limitation Identified:	Comparison Data			
LCA Approach	The life cycle data for the comparison technologies is based on a literature survey. The data are therefore not specific to Manitoba, or in some cases North America. The difference between the maximum and minimum values is in some cases quite significant. For example, published life cycle SO_2 emissions for a coal fired power plant ranged from 114 kg/GWh to 12,271 kg/GWh. The actual emission intensities will depend on a number of different factors such as the type of coal, pollution control technologies, equipment efficiencies and maintenance programs.			
Quantitative Sensitivity Test Performed (Y/N)?	Pembina Institute:	N	MNP:	Y
Pembina Impact Assessment	The number of literature sources reviewed provides a reasonable analysis. It is likely that facilities constructed in Manitoba or in its export markets will fit within the minimum or maximum values.			
MNP Impact Assessment & Conclusion	We performed further extensive independent research to assess the range values of emission intensities of some comparison technologies, based on both theoretic performance and actual in-field performance. **Our results show that the LCA report findings are generally reasonable.**			

3.3.4 Comparison Technologies

To evaluate preferred plan technology options against alternatives, six comparison technologies were examined as part of the Keeyask LCA report. The comparison technologies' life cycle emissions, as reported by Pembina Institute are based on the results of a literature review of published life cycle values, assuming a 100 year life cycle, which is consistent with Keeyask's life cycle. There were a minimum of six values for each technology and the median, average, maximum and minimum values were reported in *Appendix 5* Keeyask LCA report.

Overview of Comparison Technologies[35]

Technology	Overview and Description
Pulverized Coal Combustion (PCC)	As generation facilities, coal plants have achievable energy efficiencies are between 38-45%. These plants generate a reliable supply, which is typically used to provide base load power to the grid. Average capacity factor ranges from 70-90%.
Coal with Carbon Capture and Storage (CCS)	During the CCS process, CO_2 is separated from other exhaust gases by using a commercial capture technology such as chemical or physical absorption. This captured CO_2 is compressed and transported in pipelines at high pressure to a storage location. Capturing and compressing CO_2 requires a large amount of energy and increases the fuel requirements of a coal-fired plant by 25–40%, according to the IPCC.
Natural Gas Combined Cycle (NGCC)	Combusts natural gas in a gas turbine to produce electricity. The turbine produces a significant amount of hot exhaust gas, which, in a combined cycle power plant is used to generate steam. This steam is then used to produce additional electricity in a steam turbine. Typically used for base load and peak demands. Capacity factors for a natural gas fired power plant are typically between 50-70%.
Single Cycle Natural Gas	Combusts natural gas in a gas turbine to produce electricity. Excess heat is wasted and not captured for further electricity generation. Sometimes installed as emergency or peaking capacity to balance production and loads on the grid. The efficiency of a simple cycle natural gas plant is 35–40%.

[35] Pembina Institute. *Keeyask Generation Project – A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. (*Chapter 3). 16 February 2012. Accessed in 2013.

Technology	Overview and Description
Wind (Larger than 100 MW)	Wind farms consist of multiple wind turbines that convert wind energy into electricity from blades turning a generator. Turbines are built to adapt to changing wind conditions. Since wind speeds are not constant, typical wind farms exhibit capacity factors of 20–40%. Wind power is intermittent therefore one critique is that wind cannot supply reliable base load electricity to the grid.
Nuclear	Fission heat is used to generate steam which is subsequently used to generate electricity in a steam turbine. Nuclear power generation is a consistent source of electricity for base load power, but there is almost no flexibility to meet peak demand.

3.3.5 Assessment

The median values found in the literature review were used to compare the life cycle emissions of other technologies to Keeyask. The table below contains a summary of the median values reported. Based on our research, we have identified the 2012 Intergovernmental Panel on Climate Change (IPCC) report as a reasonable and robust source of information for this assessment. We have summarized the values from the IPCC report in the table below as well. This table identifies areas where the comparison technologies life cycle emissions in the Pembina report may be subject to uncertainty or material differences.

Life Cycle Emission Intensity (t CO_2e / GWh)[36]

Technology	Keeyask LCA Median	IPCC Report Minimum	IPCC Report Median	IPCC Report Maximum	MNP Assessment
Pulverized Coal Combustion (PCC)	**975**	675	**1001**	1689	IPCC median values reported for coal are aligned with the Pembina Report (IPCC +3%).
Coal with Carbon Capture and Storage (CCS)	**183**	98	**N/A**	396	Pembina reported values are within the range of minimum and maximum values and the two reports are aligned overall.
Natural Gas Combined/ Single Cycle	**509/764**	290	**469**	930	This includes both single cycle and combined cycle natural gas plants. Thus, the difference between minimum and maximum values is substantial. Overall, both single and combined cycle natural gas reported values are aligned and within the ranges outlined by IPCC.
Wind (Larger than 100 MW)	**13**	2	**12**	81	IPCC and Pembina values are strongly aligned for wind technologies. Pembina's median value is only 1 tonne higher than the IPCC's median value.
Nuclear	**15**	1	**16**	220	IPCC and Pembina values are strongly aligned for nuclear technologies. Pembina's median value is only 1 tonne lower than the IPCC's median value.

For each technology, Pembina reviewed between 6 and 11 literature studies and used between 5 and 10 life cycle emission intensity values from these studies. In contrast, IPCC reviewed between 231 and 273 literature studies for each technology and used between 90 and 181 life cycle emission intensity values from these studies. The IPCC report is significantly more comprehensive than the Pembina report given

[36] Special Report of Intergovernmental Panel on Climate Change (IPCC). *Renewable Energy Sources and Climate Change Mitigation*. 2012. Accessed in 2013.

its global scope. This explains the variations in the minimum, maximum and median values between the two reports.

In performing our independent research, we have been able to assess the overall reasonableness of comparison technology values reported in the Keeyask LCA. We are comfortable that the median values reported and used to assess the life cycle emissions of Keeyask relative to other comparison technologies are reasonable.

3.3.6 Other Air Pollutants

As a related issue, regional air emissions will also be impacted by development choices in Manitoba. Our examination of GHG emissions finds that the preferred plan results in significantly fewer total life cycle emissions than alternative plans with high levels of gas generation and specifically, the all gas plan.

Although some NO_x and SO_2 emissions would be associated with the manufacture, delivery and construction of hydro project components, electricity generation at Keeyask and Conawapa would result in no significant air pollutant release. Conversely, natural gas generation projects result in direct NO_x emissions and some life cycle SO_2 emissions.

As determined in the LCA, a project like Keeyask is estimated to result in about 4 Kt of NO_x emissions and less than 1 Kt of SO_2 over its lifetime. We are confident that the data inputs on which these estimates rely are reasonable and conservative for the analytic purposes of this NFAT. Combined-cycle facilities, like those expected to be used in alternative plans, could lead to the following levels of air pollutant emissions. It is clear in direct comparison, that the preferred plan hydro projects are more attractive from an air pollutant production perspective.

Air Pollutant	Average EI[37] (Kg/GWh)	Average Annual Generation Expected (GWh)[38]	Annual Emissions (tonnes)	Estimated Total Emissions for All Gas Plan Gas CC Projects (tonnes over 68 years)
NO_x	970	613	594	40,392
SO_2	360	613	220	14,960

Given the expected emissions intensity of MH exports, there will also be incremental regional benefit to the preferred plan versus the all gas plan. Exports will displace marginal generation in MISO, known to be a mix of coal and gas generation, both of which will have substantially high NO_x and SO_2 emissions profiles. Therefore, preferred plan exports will also lower regional air pollution by direct displacement.

3.4 GHG AND CARBON PRICE MODELLING

As an export product, MH's generation enters a dynamic market in MISO, influenced by investment decisions in new generation, natural gas prices and environmental charges (i.e. carbon prices) over the long-term. As a low or non-emitting source of electricity, hydro generation from the preferred development plan could hold incremental value in its environmental attributes, as discussed in the Policy Review (section 3.2) above.

In order to assess the economic impacts of climate change, MNP has modelled the GHG emissions and carbon prices to 2090 (end of the project life). The outputs of these two models are interrelated inputs to

[37] Average of LCA Report market survey of facility EIs
[38] Average of annual new combined cycle output for Plan 1 (All Gas)

the financial impact assessment. The objective of modelling is to provide the PUB with the potential impact of changes in underlying macro-environmental factors within the preferred development plan on project economics.

3.4.1 GHG Modelling (NFAT filing Appendix 9.1)

According to MH, the *Cumulative GHG Operating Emissions* are the summation of the direct domestic GHG emissions from existing and proposed thermal generating stations associated with each of the development plans listed over the lifetime of the plan. For the preferred development plan, the value of 7.5 Mt CO_2e includes the cumulative direct GHG emissions from existing gas and coal-fired facilities within MH's system.

The *Cumulative GHG Operating Emissions* values are distinct from the Pembina LCAs for the Keeyask and Conawapa projects. The LCA for Keeyask also includes indirect GHG components beyond the borders of Manitoba, as well as land-use change GHG implications. These are *not* considered in the *Cumulative GHG Operating Emissions* calculation in Appendix 9.1 of the NFAT.

3.4.2 Assumptions in GHG Modelling

Assumption	MH	MNP
New Build Plant Emissions Intensities	Simple Cycle = 506 t CO_2e. Combined Cycle = 333 t CO_2e.	Simple Cycle = 557 t CO_2e.[39] Combined Cycle = 413 t CO_2e.[39]
Export Displacement Emission Factor	According to the NFAT filing, this assumes coal marginal generation of 93% for the entire duration of the projects. Assumes an export GHG displacement factor of 750 tonnes CO_2e/GWh reflecting a mixture of fossil-fuel resources and a variety of technologies and efficiencies.	Assumes coal marginal generation of 85% in 2014 declining to 50% in 2050 due to MISO energy mix shift away from coal and wind energy expansion. Assumes an export GHG displacement factor of 890 tonnes CO_2e/GWh in 2014 declining over time to 649 tonnes CO_2e/GWh in 2050.

3.4.3 MISO Capacity Mix

Several driving factors are expected to change the generation mix in MISO over time. As noted in our policy review, several US federal and other regional environmental policies are growing in importance for electricity generators and will increase the level of coal retirement as regulations bind and compound. At the same time, state level renewable portfolio standards drive wind and solar investment to meet utilities' efforts to achieve renewable generation targets. MISO is expected, by all of MH's market forecasting consultants, to be a significant region for wind development with strong resources in several areas.

By 2020, as coal plants grapple with compliance of CO_2 policy, mercury policy, new water use regulations and more stringent air pollutant regulations, many will choose to retire. As a result, the consultants and others expect between 10 and 20 GW of coal to retire by 2025, representing a likely reduction in coal generation of at least 17%. As a result, energy requirements will be met with a combination of gas combined cycle and wind investments over the period 2015 to 2037. Net outcomes will dampen the amount of coal setting marginal prices in the MISO market and move more gas to the marginal fuel. Substantial increases in wind generation have the opposite effect and push the supply stack upwards moving lower merit coal plants to the margin. Overall, we expect some increases in gas generation on the margin and therefore reductions in average marginal emissions intensity given that MISO currently reports coal on the margin more than 90% of the time[40]. By 2020, we expect a 20% decline in marginal coal generation, growing to a 35% decline in the later years of study.

MH's conservative assumption of a 750 tonne/GWh displacement factor is reasonable for analytic purposes and controls the potential net upside emissions displacement. Our testing shows that even conservative sensitivities accounting for the changing supply mix toward natural gas and wind all result in annual average marginal intensities that remain higher than 750 tonne/GWh and therefore serve to the benefit of preferred plan economics.

3.4.4 Carbon Price Modelling

MH engaged six independent consultants to prepare carbon pricing forecasts as part of their *2013 Electricity Export Forecasts*. Each of the independent consultants prepared their carbon price forecasts based on their respective policy outlooks as discussed in the Policy Review (section 3.2). Each consultant prepared a low, reference (base) and high case carbon price forecast. MNP has developed an alternative

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[39] New build plant emissions intensities are based on data from 34 facilities' actual emissions performance, augmented by technical specifications from EIA, NETL (DOE), EPRI and California Energy Commission data.
[40] Potomac Economics. *2011 State of the Market Report for the MISO Electricity Markets.* June 2012. Accessed in 2013.

set of carbon pricing cases to compare against MH's analysis from the NFAT filing, based on our expectations of policy stringency and timing.

Each carbon price trajectory is considered an indicator of the carbon price premium embedded in the respective electricity price forecasts and was not determined as a discrete financial instrument valuing avoided emissions. The table below outlines the assumptions applied to determine the carbon price forecasts of MH and MNP.

3.4.5 Assumptions

Assumption Category	MH	MNP
Average Annual Real Growth Rate	MH does not apply an average annual real growth rate in their carbon price forecast. Growth is based on consultants projection.	• 5% based on EIA reference cases for the period from 2014/15 to 2041/42 (inflation of 2% thereafter).
Low Case Assumptions	MH determined the consensus forecast cases by applying the same percentage weightings as were applied to the electricity price forecast. In both situations, an equal percentage weighting is given to each of the six independent consulting firms. This is the methodology applied for the low, base and high case carbon price forecasts.	• Assumes no federal cap-and-trade legislation comes into effect until 2030. • Assumes a $10 floor price based on our judgement considering a number of low case carbon price forecasts, including the consultants and publicly available trends and escalating using the EIA 5% growth factor. Our forecast is an aggregate of several sources.
Base Case Assumptions		• Assumes a federal cap-and-trade legislation comes into effect in 2021. • Assumes a $13.14 floor price based on our judgement considering a number of reference case carbon price forecasts, including the consultants and publicly available trends and escalating using the EIA 5% growth factor. Our forecast is an aggregate of several sources.
High Case Assumptions		• Assumes a federal cap-and-trade legislation comes into effect in 2020. • Assumes a $15.80 floor price based on our judgement considering a number of reference case carbon price forecasts, including the consultants and publicly available trends and escalating using the EIA 5% growth factor. Our forecast is an aggregate of several sources.

The data table below is a condensed version of MNP and MH's carbon price forecasts. The carbon prices for 2034/35 are highlighted as this represents the end of MH's actual forecast. The carbon prices for 2041/42 are highlighted as this represents the completion of the new build generation under the preferred development plan.

Figure 3.5: Range of Carbon Price Outlooks

MH Forecast				MNP Forecast			
CO_2 Price (2013 Real US$/Ton Midwest Region)				CO_2 Price (2013 Real US$/Ton Midwest Region)			
Fiscal Year	MH Low Case	MH Base Case	MH High Case	Fiscal Year	MNP Low Case	MNP Base Case	MNP High Case
[redacted]	[redacted]	[redacted]	[redacted]	2014/15	$ -	$ -	$ -
2019/20	[redacted]	[redacted]	[redacted]	2019/20	$ -	$ -	$ -
2024/25	[redacted]	[redacted]	[redacted]	2024/25	$ -	$ 15.21	$ 19.20
2029/30	[redacted]	[redacted]	[redacted]	2029/30	$ -	$ 19.41	$ 24.51
2034/35	[redacted]	[redacted]	[redacted]	**2034/35**	**$ 12.16**	**$ 24.78**	**$ 31.28**
2041/42	[redacted]	[redacted]	[redacted]	**2041/42**	**$ 17.10**	**$ 34.86**	**$ 44.02**
2049/50	[redacted]	[redacted]	[redacted]	2049/50	$ 21.24	$ 43.29	$ 54.65
2059/60	[redacted]	[redacted]	[redacted]	2059/60	$ 25.89	$ 52.77	$ 66.62
2069/70	[redacted]	[redacted]	[redacted]	2069/70	$ 31.55	$ 64.32	$ 81.21
2079/80	[redacted]	[redacted]	[redacted]	2079/80	$ 38.47	$ 78.41	$ 99.00
2089/90	[redacted]	[redacted]	[redacted]	2089/90	$ 46.89	$ 95.58	$ 120.68
2090/91	[redacted]	[redacted]	[redacted]	2090/91	$ 47.83	$ 97.49	$ 123.09

The timeframe for MH's carbon price forecast is 2014/15 to 2034/35. In order to assess the financial impacts of GHG modelling on the NPV of the preferred development plan, the carbon price forecasts must extend to 2090/91 in line with MH's adjusted planning horizon.

.

For the period from 2034/35 to 2041/42, we have applied the existing growth rate trajectory to MH's forecast.
For the period from 2041/42 to 2090/91, we have assumed a 2% average annual inflation rate for both MH and MNP.

In order to visualize the differences in carbon price trajectories between MH's consensus carbon price forecast and MNP's carbon price forecast, we present the carbon price forecasts graphically below.

Figure 3.6: Comparison of MH and MNP Carbon Price Forecasts

[redacted]

3.5 Financial Impacts of Sensitivities

Our analysis focuses on the potential and direct incremental revenue associated with the environmental attributes of MH derived exports into the MISO market. This analysis provides a representation of the direct NPV benefits to MH of selling electricity into MISO under a variety of reasonable carbon pricing scenarios.

3.5.1 Assumptions in Financial Impacts

There are 2 key assumptions underlying the financial impacts calculation:

1. Net Emissions Displacement.
2. Carbon Price Forecast.

In the table below, we outline the permutations of scenarios applied to test financial impacts of macro-environmental factor sensitivities. Refer to the 'Assumptions in GHG Modelling' (section 3.4.2) and 'Assumptions in Carbon Price Modelling' (section 3.4.4) tables above for detailed underlying assumptions applied.

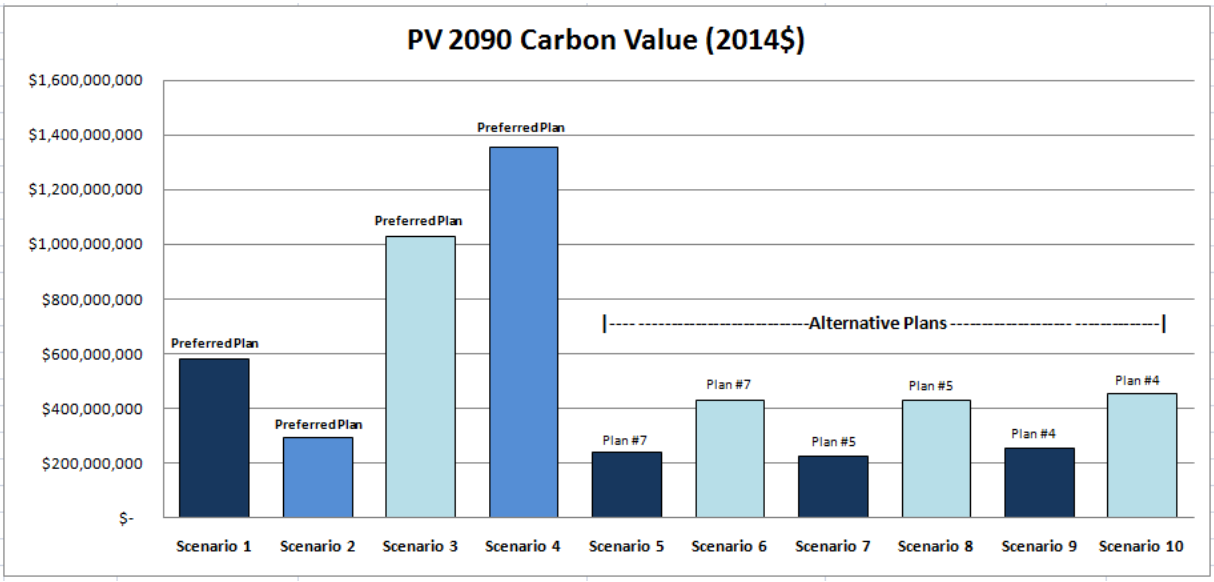
Scenario	Development Plan	Net Emissions Displacement	Carbon Price Forecast
Scenario 1	Preferred Plan #14 K19/C25/750MW (WPS Sale & Inv)	MH Market Displacement Assumptions	MH Base Case
Scenario 2		MNP Market Displacement Assumptions	MNP Low Case
Scenario 3		MNP Market Displacement Assumptions	MNP Base Case
Scenario 4		MNP Market Displacement Assumptions	MNP High Case
Scenario 5	Alternative Plan #7 SCGT/C26	MH Market Displacement Assumptions	MH Base Case
Scenario 6		MNP Market Displacement Assumptions	MNP Base Case
Scenario 7	Alternative Plan #5 K19/Gas25/750MW (WPS Sale & Inv)	MH Market Displacement Assumptions	MH Base Case
Scenario 8		MNP Market Displacement Assumptions	MNP Base Case
Scenario 9	Alternative Plan #4 K19/Gas24/250MW	MH Market Displacement Assumptions	MH Base Case
Scenario 10		MNP Market Displacement Assumptions	MNP Base Case

In order to determine the economic impact of the carbon value to the NPV of the preferred and selected alternative plans, we were required to make some assumptions in the present value calculation as follows:

- ***Discount Rate*** – 7.58% **-** This is based on MH's cost of capital discount rate of 5.05% plus a risk premium of 2.53% to reflect the inherent uncertainty of the outcomes of carbon policy in the long-term.
- ***Total Study Life*** – 2014 to 2090 (consistent with MH).
- ***Annual Net Emissions Displacement Values*** – Displacements have been included in the calculation of carbon value netting out internally derived emissions associated with MH exports.

The figure below outlines the PV in 2014$ of the carbon value associated with exports into the MISO market.

Figure 3.7: Range of Carbon Values



We offer the following observations with respect to the comparative carbon values under the scenarios[41]:

MH Base Case (Scenarios 1, 5, 7, 9):

- Preferred plan carbon value represents approximately $582M (or 9%) of the total PV of revenues for the preferred plan, which is $6,348M according to NFAT filing appendix 9.3 (pg. 496).
- Preferred plan carbon value is approximately $343M *higher* than the average carbon value of the alternative plans, which are in the range of $225M to $251M.

MNP Base Case (Scenarios 3, 6, 8, 10):

- Preferred plan carbon value is approximately $446M *higher* than the MH base case, which results in an *increase* in the total PV of revenues for the preferred plan to $6,794M.
- Preferred plan carbon value is approximately $591M *higher* than the average carbon value of the three alternative plans, which are in the range of $427M to $454M.

MNP Low and High Cases (Scenarios 2, 4):

- Under the MNP low case, the preferred plan carbon value is approximately $287M *lower* than the MH base case, which results in a *decrease* in the total PV of revenues of the preferred plan to $6,061M.
- Under the MNP high case, the preferred plan carbon value is approximately $772M *higher* than the MH base case, which results in an *increase* in the total PV of revenues of the preferred plan to $7,120M.

[41] All of our observations are focused solely on the changes in assumptions outlined above. Revised incremental revenue PVs assume all else is equal.

3.6 CLIMATE CHANGE SUMMARY OBSERVATIONS

Based on the analysis performed, the following observations are relevant for the Review Panel:

1. The preferred plan more *strongly aligns* to the current and expected international, Canadian, US and regional/local climate change policies and strategies.
2. The Keeyask LCA includes *inherent risks and limitations* that are found to be *immaterial* to the total lifecycle GHG emissions and relative to the emissions of alternative comparison generation technologies.
3. In comparison with alternative plans and the associated project types, the preferred plan has relatively low expected life cycle emissions.
4. The preferred plan has comparatively low cumulative operating GHG emissions versus all other plans and the *highest* cumulative regional GHG displacement potential relative to the alternative plans that do not include Keeyask and Conawapa hydro developments.
5. The implied preferred plan carbon value (in 2014$) in the MH base case is $582M. The present value of carbon revenues *could increase* to $1,028M under other reasonable policy outcomes. This represents a *potential upside in the total revenues* for the preferred plan.

TAB 14

Focused on What Matters Most:

Manitoba's Clean Energy Strategy

Manitoba


FOSSIL FUEL FREE


RED RIVER COLLEGE

MESSAGE FROM THE MINISTER

Manitoba is in the unique position of having the resources, experience and wherewithal to become Canada's renewable energy powerhouse. Already a leader in developing one of the cleanest and greenest electricity systems in the world, Manitoba plans to build on those successes and move farther down the path towards fossil fuel freedom.

To help chart that path our government is pleased to release the Manitoba Clean Energy Strategy. This strategy focuses on made-in-Manitoba solutions to harness our water, wind, solar and biomass resources in ways necessary to help provide electricity to power our homes, businesses and industries; energy to heat our buildings; and fuel to drive our vehicles. This strategy is consistent with the principles behind Tomorrow Now – Manitoba's Green Plan, which focuses on protecting the environment while ensuring a prosperous and environmentally conscious economy.

Not only does energy play a critical role in almost every part of our society, but in Manitoba's case, it has become a major cornerstone of our economy. Plans for new hydroelectric generation and transmission require a bold capital program of $20 billion over the next decade. If they are approved after environmental and economic reviews, these projects will create thousands of jobs, provide us with affordable power well into the future and support our neighbours' needs for clean electricity in the shorter term.

We recognize that fossil fuels like oil and natural gas will continue to be an important part of our society, but our goal is to reduce our reliance on these imported, greenhouse gas emitting and unpredictably priced commodities sooner rather than later. While most jurisdictions can only set 30, 40 or 50 year targets to reduce reliance on fossil fuels, Manitoba has a head start in developing our renewable energy resources in a sustainable way that is good for the economy and benefits the environment.

Our strategy focuses on building new generation hydro; expanding transmission that improves electricity reliability and security; adding more wind power as economics allow; promoting geothermal, biomass and solar for heating needs; developing our biobased fuels; and leading in new cutting edge electric transportation solutions.

Our government will do this in a way that benefits all Manitobans and ensures that our energy is affordable and clean, that it contributes to job creation and business expansion and allows opportunities for greater First Nation partnerships. As Canada's leader in energy efficiency, our government will also continue to balance new energy generation with strong demand side management programs, including Canada's first Pay-As-You-Save, on-meter financing program for efficiency retrofits.

This strategy is all about making energy choices today that will create a stronger economy and a cleaner environment for our future. Is fossil fuel freedom achievable? We're closer than you might think.

Original signed by

Dave Chomiak

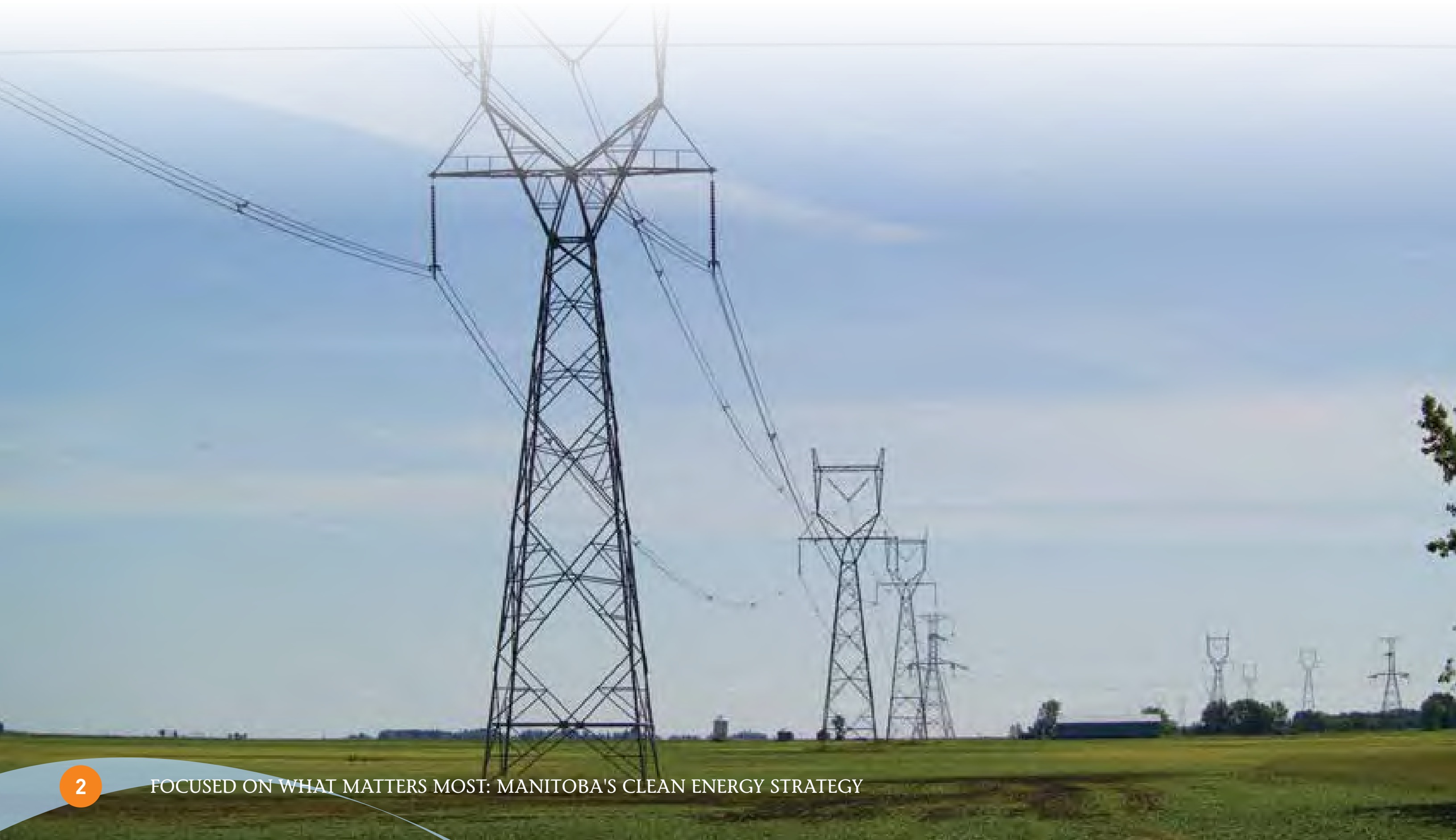
Minister of Innovation, Energy and Mines

HIGHLIGHTS

Highlights of Manitoba's Clean Energy Priority Actions include the following.

Building New Hydro

- Ensure that the planning, design, consultations and negotiations necessary for developing substantial new hydroelectric generation, including Keeyask (695 MW) and Conawapa (1485 MW), proceed through environmental and economic review. These new generation hydro projects are being designed to greatly reduce environmental impacts and will be developed in partnership with First Nations.
- Improve Manitoba's transmission system reliability, increase export capabilities, and enhance the development of new hydro and wind energy by constructing a new Bipole lll line, expanding interconnections to the US, strengthening the Dorsey convertor station, adding the new Riel Station and advocating for a stronger east-west Canadian grid.
- Work to eliminate the dependence of northern off-grid communities on diesel generation and ensure all Manitoba communities have access to clean renewable power.
- Maximize the economic benefits and job creation from new hydro and transmission developments through the $30 million Renewable Energy Jobs Fund, a new Energy Opportunities Office, and training support for northern and Aboriginal communities.



Leading Canada in Energy Efficiency

- Through Manitoba Hydro, implement a new On-Meter Financing program that overcomes the high upfront costs that prevent households from implementing energy saving retrofit measures.
- Enhance Manitoba's successful Low Income Energy Efficiency programming, in partnership with social enterprises, to help build community capacity, create jobs and maximize economic benefits.
- Expand The Green Building Policy so that more government funded building construction, renovation and operations are subject to energy efficiency requirements.
- Expedite adoption of National Building Code energy efficiency updates to ensure Manitoba homes and businesses achieve the lowest lifetime costs for energy.
- Advance vehicle-related efficiency through green fleet purchasing policies, support for higher vehicle fuel efficiency standards and promotion of active transportation.
- Support the expansion of voluntary programs to benchmark, rate and label building energy performance. Manitoba will explore and pilot programs that disclose the energy performance of buildings offered for sale or lease.
- Pursue minimum energy efficiency standards for high-energy consuming products where federal standards are deemed inadequate.
- Develop and publish an annual energy efficiency plan that establishes stronger efficiency targets; identifies an expanded range of programming options; sets out costs and benefits; and reports on performance.

Keeping Rates Low

- Place Bill 18 – *The Affordable Utility Rate Accountability Act* – into law to ensure the lowest cost in Canada for a bundle of utility services – that is, the combined rates for electricity for home use, natural gas for home heating and automobile insurance.
- Within the context of *The Affordable Utility Rate Accountability Act*, support predictable, moderate rate increases for Manitoba Hydro over the coming years. The rates should be sufficient to fund the renewal of existing infrastructure; develop new generation, transmission and distribution capacity to serve growing demand; and assure continued reliable service to Manitobans.

Growing Renewable Energy Alternatives

- Continue to develop 1000 MWs of wind power as economically viable. In total, 1,000 MWs is expected to generate $2 billion in new investment and $400 million in lifetime revenues to rural communities.
- Accelerate adoption of geothermal heating and cooling systems through Manitoba's Green Building policy, available financial incentives and by promoting community scale district heating opportunities.
- Grow the province's biomass heat industry by directing revenue from the Emissions Tax on Coal to the Manitoba Biomass Energy Support Program.

- Evaluate new production opportunities and increased biofuels content requirements to pursue reductions in gasoline and diesel imports even beyond the $100 million value currently realized in Manitoba each year.
- Prepare for and accelerate the adoption of electric vehicles in Manitoba by supporting informed decision making by consumers; incorporating electric vehicles into provincial and Crown corporation fleets; providing charging infrastructure support; and expanding electric vehicle demonstration projects.
- Continue to support development of the all-electric battery transit bus and expand the project into a multi-bus and charging demonstration.

Freedom From Fossil Fuels

- Launch a Fossil Fuel Freedom campaign that promotes a path for families to move away from fossil fuel use to clean energy sources for their electricity, heating and transportation needs. This path would help more and more Manitoba families reap the benefits of lower bills, create more local jobs and improve the environment.

TABLE OF CONTENTS

INTRODUCTION

Energy is critical to contemporary society. How we supply energy and how we use it has a major impact both on the prosperity of our economy and on the future health of our planet.

Since the industrial revolution and the advancement of the coal burning steam engine, the world has relied primarily on fossil fuels – coal, oil and natural gas – to meet its energy needs. Today, recognizing the need to reduce the impacts of climate change and better protect the environment, human health and the well-being of their own economies, more and more countries are committed to reducing their dependence on fossil fuels and developing cleaner energy sources. Manitoba is not a mere follower in this movement, but rather a recognized leader for its efforts to become fossil fuel free.

To build on Manitoba's clean energy successes, an energy strategy must incorporate both a clear plan for the future, while at the same time meeting current needs for electric power, heat and transportation fuels. This strategy charts that path forward for Manitoba, setting out practical, clean energy steps and strengthening our position as a renewable energy powerhouse.

Looking Forward

Manitoba will capitalize on its renewable energy strengths and through innovation, will tap its homegrown clean energy resources allowing more Manitobans to transition to fossil fuel freedom, beginning today, and in the decades to come. It will do this by encouraging more efficient use of energy and by increasing production of clean, renewable energy sources. It will do so while growing its clean energy economy for the benefit of its own citizens as well as neighboring customers.

The Strategic Objectives

- Supply sufficient energy for our needs and deliver it reliably and securely.
- Provide affordable energy, particularly for those in low income, remote or vulnerable situations.
- Produce and use that energy cleanly, sustainably and in ways which reduce our greenhouse gas (GHG) emissions. This means in ways which do not degrade the world, at home or abroad, either today or for future generations.
- Ensure that energy is used efficiently, for environmental and economic reasons.
- Maximize the economic benefits from: constructing and operating energy generation facilities; manufacturing energy related equipment; low rates and improved efficiency; selling energy and expertise abroad; and reducing the economic leakage from the overall Manitoban economy due to imported fossil fuels.
- Increase local control. The value of energy independence and the need for more made-in-Manitoba energy has been made clear by recent decades of volatile energy prices.

Manitoba's clean energy strategy is a focused strategy, one which will demonstrate the government's commitment to build on our underlying and historic comparative advantage in low cost, renewable hydro electricity. It will also build on our newly arrived advantages in ground-source heat pumps, plug-in electric vehicles and other emerging renewable sources. Together, as these energy sources grow, they will offer Manitobans an increasing array of clean, cost effective, non-fossil alternatives for heating our homes, powering industry and fuelling our vehicles. Finally, woven through these power, heating and transportation initiatives is the constant need to increase energy efficiency and reduce the costs of energy waste.

We have the resources. We have the knowledge. We have the infrastructure. And we're already on the move.

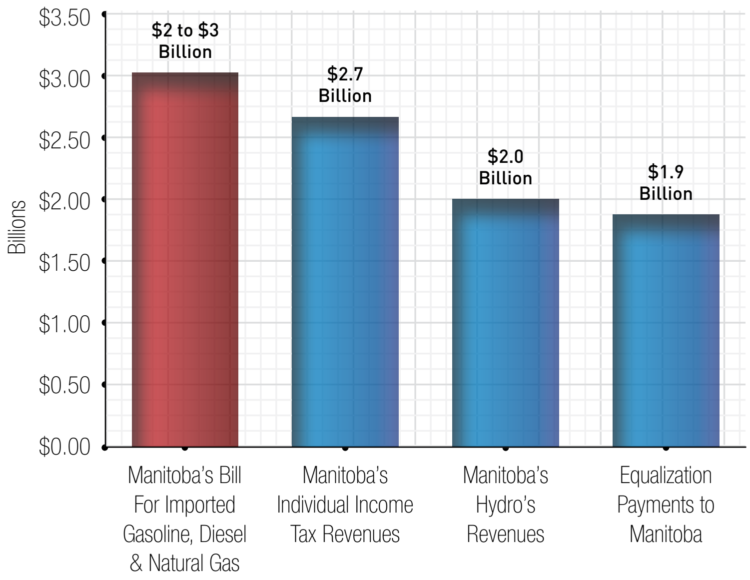
Global Challenges

The world's energy supplies have become exceedingly complicated and volatile, with four global forces in particular having significant implications:

1. Oil and natural gas prices have been enormously volatile in the 2000s. For example, natural gas prices fluctuated by as much as 600 per cent in the past decade. The rise of Asia's industrial powerhouses, with their energy needs, make it unlikely that these pressures will lessen in the years to come.

2. Economic leakage from high energy prices has challenged economies globally, with jurisdictions around the world responding by pursuing greater energy independence.

The Annual High Cost of Manitoba's Gasoline, Diesel & Natural Gas Imports



Manitoba has significant oil production in the southwest portion of the province. This oil is not refined in Manitoba but is exported as a commodity for processing. Although this oil is not directly used in Manitoba as an energy source, the industry is a significant contributor to the provincial economy. The industry pays over $100 million annually to private oil and gas rights owners and has seen investment in the province rise to $1 billion annually.

3. Energy security has frayed as grid black-outs, oil blow-outs, wars, hurricanes and tsunamis have threatened energy supplies and repeatedly triggered price spikes.

4. Climate change has been accelerated by the GHG emissions from continued fossil fuel use.

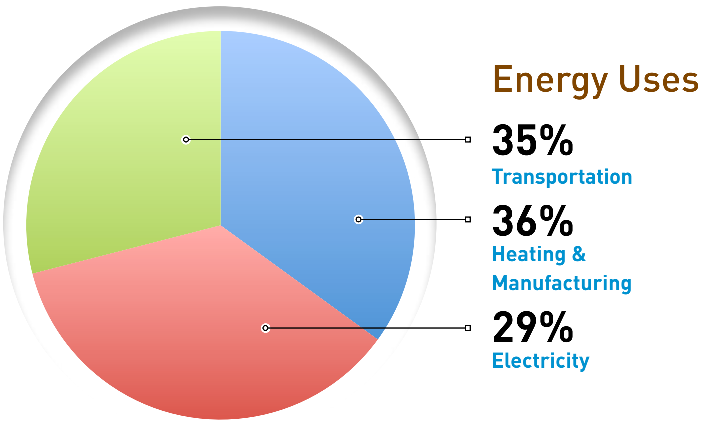
Many jurisdictions throughout the world struggle with these forces. While Manitoba has been somewhat insulated because of our strength in renewable hydroelectricity, we all still feel the effects of these forces when it comes time to heat our homes and refuel our vehicles.

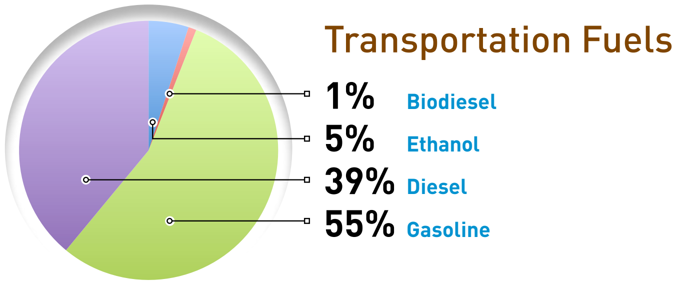
Fortunately, at precisely the same time as these global energy forces have arisen, a series of global clean energy tools and innovations have begun to emerge into the mainstream. For example:

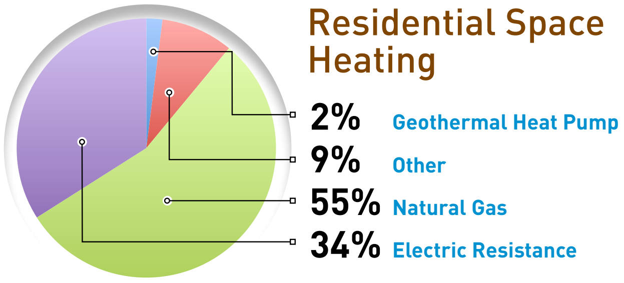
- In electricity, the past decade saw more wind-power capacity added in the US and in Europe than new coal, nuclear and hydro combined.
- In transportation, four million hybrid, plug-in hybrid and electric vehicles hit global roads.
- In heating, more than three million heat pumps have been installed globally since 2005.

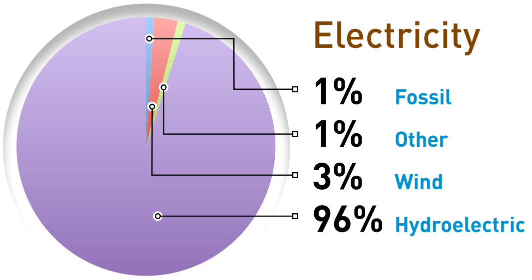
Energy in Manitoba

The following charts provide a snapshot of how we use energy in Manitoba.









Notes: i) "Other" in residential space heating represents a mix of renewable wood/biomass, as well as heating oil and propane. ii) The top chart on Energy Uses reflects overall energy use within Manitoba, as outlined by data from Statistics Canada. iii) The lower charts provide energy source breakdowns for selected application uses only.

Because of extreme climate conditions, a relatively large land area, growing population and significant resource based industries, energy is critical to our way of life. Like other jurisdictions, fossil fuel use is woven into that way of life and will continue to be for decades to come. This is because vehicles, heating systems and buildings have lifespans lasting decades, which makes a too rapid change-out uneconomic. However, this timespan also provides Manitobans with the opportunity to customize the shape and timing of their own personal shifts, allowing them to choose clean energy and fossil fuel free technologies when and as they feel the time is right.

Although fossil fuels will be with us for decades to come and we will continue to maintain access to those fuels, Manitoba is in the enviable position of reducing our dependence on them and becoming a renewable energy powerhouse.

- Manitoba has already taken bold steps to ensure our electricity production is more than 98 per cent renewable using hydro and wind resources.
- Manitoba is a Canadian leader in terms of renewable heat (and cooling) with 11,000 geothermal installations.
- Manitoba took early steps with biofuels in terms of production and use to reduce reliance on imported gasoline and diesel.
- Manitoba consistently rates number 1 in Canada in energy efficiency programs and policies.
- Manitoba is breaking new ground in the electrification of transportation, from hybrid taxis to the first plug-in hybrid conversions through to advanced electric bus designs.
- Manitoba is home to well positioned manufacturing and energy service sectors as well as academic institutions that will help produce the innovative technologies and services needed going forward.

Manitoba will not rest on its past accomplishments, but will focus on five strategic areas that will strengthen our position as a renewable energy powerhouse and move us down the pathway towards fossil fuel-freedom. With so much at stake with our energy future, it is important to understand the case for moving forward.

THE CASE FOR MOVING FORWARD AND TODAY'S PRIORITY ACTIONS

1 BUILDING NEW HYDRO

When Manitoba made the long term, strategic decision to develop its own northern hydroelectric assets – rather than going for the quick fix of expanding the use of low cost, but imported and polluting coal – it faced potentially higher costs, as well as a series of risks that seemed, at the time, insurmountable.

Manitoba Hydro Meets and Overcomes the Challenges

Through innovation and determination, Manitoba Hydro met the challenges and constructed a series of new, northern hydroelectric sites, in the face of some of the world's harshest climates. They opted to develop new technology employing the long, high-voltage, DC transmission lines that reliably deliver Manitoba's power over enormous distances. They produced dependable power from highly variable hydraulic flows. And they managed and financed multi-billion dollar, decade-long megaprojects.

Benefits for Manitobans

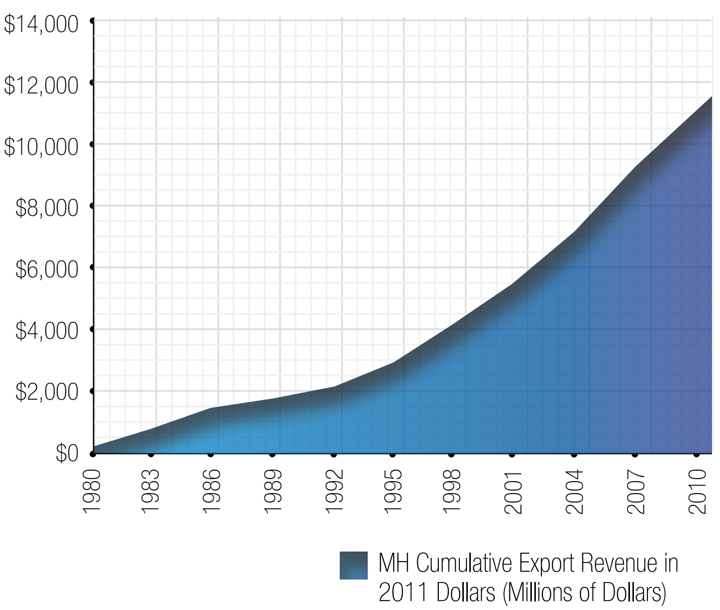
The benefits we enjoy today were built on these decades of hard work and innovation. But, at their source, was the long term, strategic decision to build on Manitoba's own renewable resources, rather than consume imported fossil fuels. The benefits of that decision have been many and have risen steadily over the years.

- Manitoba Hydro's rates have been among the lowest on the continent, saving Manitoba families and businesses $13 billion on their bills since 1998, compared to the average Canadian's rates.
- Through its operations, Manitoba Hydro annually creates 16,580 person-years of employment and adds $1.4 billion to Manitoba's GDP.
- More than 98 per cent of Manitoba's electricity is renewable, GHGs have been slashed at home; and electricity exports cut 178 million extra tonnes of GHGs from our neighbours' emissions.

Manitoba Hydro's performance provides strong evidence for the value of a fossil fuel free strategy. Using made-in-Manitoba, renewable energy, the province minimizes the need for fossil fuels to generate electricity, while creating huge economic and environmental benefits.

Manitoba Hydro's exports don't just benefit others. Since 1980, export revenues have risen to more than $11 billion, funds which have helped pay down the costs of the hydro projects themselves and kept rates low for Manitobans. For comparison, this amount is many times the $1.43 billion cost of the Limestone Generating Station, the last large hydro development prior to the Waskwatim dam.

MH Cumulative Export Revenues 1980 to 2011



Why Build New Hydro?

More electric generation is needed to meet Manitoba's rising demand. Even with the addition of the Wuskwatim dam, wind projects and energy efficiency measures, electricity load growth in Manitoba has outpaced the growth of new supply since the Limestone Generating Station came on stream in 1990.

This situation places increasing pressure on Manitoba's hard won energy independence in electricity. It makes us more dependent on fossil fuel imports during droughts and reduces export surpluses even in higher water years.

Manitoba's electricity demand today is growing by approximately 80 MWs per year. This rising demand requires the equivalent of a new Wuskwatim every two and a half years. Given the historic and sustained upsurge in Manitoba's population and housing starts, as well as continued economic growth, the pressure from rising load appears likely to continue. As domestic demand increases, exports are decreased and the revenue derived from exports – that aids in reducing domestic electricity rates – erodes over time.

Many of Manitoba's export customers have also experienced growth in electrical demand, but they too no longer view coal fired generation as a desirable alternative, whereas hydroelectricity from Manitoba is seen to be clean, renewable and stably priced. However, for export customers to be able to buy new hydro in the future, they often require lead times of many years to build the necessary new transmission.

Manitoba needs new generation to supply rising domestic load, while export customers wish to buy new hydro from Manitoba. By advancing the construction of new hydro plants ahead of domestic needs, Manitoba can both earn additional export revenues and expand valuable interconnection transmission, while also building the plants it will need to meet its own future requirements.

Windows of Opportunity

There are limited windows of opportunity within which Manitoba can sign new, long term export contracts, and receive vital new transmission links. If these windows are missed, customers will lock in with other suppliers, new transmission along with its market expansion and domestic reliability benefits will not be built and the window will close and be lost.

The past few years have offered just such a window, with the decision now before Manitoba.

Why Not Fossil Fuels, Like Coal or Natural Gas, Instead?

Decades ago, the largest fuel source used to generate electricity in North America and the world was coal. It was thought North America possessed endless coal reserves at unbeatable low prices. Manitoba Hydro, at the time, took a minority stand in the region with its decision not to use coal to generate most of its electricity. Over the decades, Manitoba's choice of hydroelectricity has proven itself to be the better one – for the environment, the global climate and the economy.

Manitoba Hydro's electricity is made from more than 98 per cent clean, renewable sources.

Today, the use of coal for electricity generation is being replaced by a new fossil fuel source– shale gas. Although coal plants still generate 44 per cent of the electricity in the United States, power generated by natural gas has doubled to 21 per cent. It is now the dominant source of new electricity in the United States and is rising quickly as old coal burning plants are shut down.

As once was said about coal, natural gas is said today to be available in the same near-endless quantities, and at the same unbeatable low prices. Natural gas has even been positioned as a cleaner fossil fuel than coal.

Manitoba's hydroelectric advantages over natural gas - jobs, stability and sustainability

When considering options, Manitoba's hydroelectricity has clear cut advantages over natural gas:

- Construction of new hydro power will create more jobs and more new business activity for Manitoba than natural gas fired imports or local plants.
- New hydro will emit far fewer GHGs than natural gas over its lifetime.
- While a natural gas plant has a life of 25 to 30 years, a key advantage of hydroelectric plants is that, once built, they will generate power for 100 years. For example, a new project like Keeyask, would likely still be generating power in the year 2100.
- Locally generated hydro will provide greater energy security for Manitoba than imported natural gas.

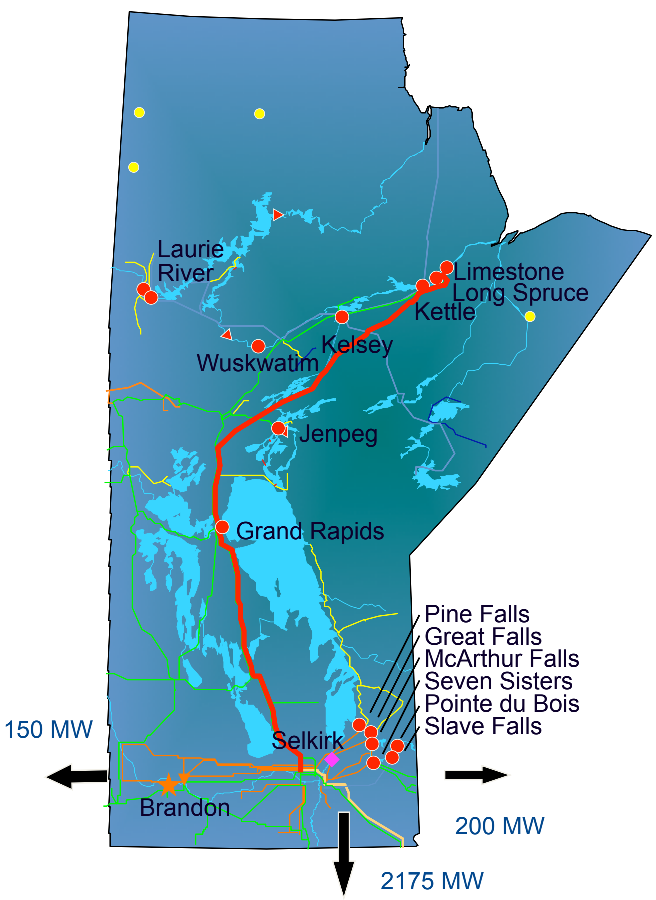
On the other hand: At 2012's natural gas prices of $2 to $3 per gigajoule (GJ), it can be used to produce electric power more cheaply than Manitoba's new hydro plants. But the price of natural gas is extremely volatile – the most volatile of any electricity source, cycling through a range of 600 per cent just over the past decade.

While prices are currently low, natural gas suppliers can't guarantee today's prices for the next 10 years, much less for the next 20 or 30 years or beyond – the years when Manitoba wishes to add new power. The difficulties this poses for long term energy planning in Manitoba can be seen clearly in the forecasts of the major energy planning bodies in North America. These bodies forecast natural gas prices ranging from $5 to $11 per GJ in the coming decades. With today's prices at $2 to $3 GJ, and Manitoba potentially looking at billions of dollars in investments, this uncertainty leaves Manitoba facing the risk of price swings of hundreds of percentage points if it chooses natural gas supplied projects.

Additional uncertainties surrounding natural gas and in particular shale gas include:

- the level of increased demand flowing from natural gas-powered electricity generation, expanded industrial end uses, transportation and Liquefied Natural Gas (LNG) exports
- the accuracy of estimates of shale gas reserves, production and depletion rates
- the long term sustainability of today's exploration and development business model, in the face of extremely low natural gas prices
- GHG emissions from shale gas exploration and production

With Manitoba's next two major hydro projects potentially coming online from 2019 to 2025, and then earning their major revenues in the decades to follow, natural gas prices in 2012 are of less relevance than the prices in 2032 or 2042. In the long term, Manitoba expects that hydroelectricity will continue to be the better option. Hydro's wide and long-lasting range of benefits – lower GHGs, more jobs and business in Manitoba, more stable prices and greater energy security – will still make hydroelectricity the superior choice.



Generating Stations and Interconnections

2011/12 - Energy

80%	Nelson River
9%	Winnipeg River
7%	Saskatchewan River
3%	Wind
1%	Thermal & Imports

- HVDC
- Other Transmission
- Selkirk - Natural Gas
- Brandon - Coal
- Brandon - Gas Combustion Turbine
- Control Structures
- Diesel Sites
- Hydraulic G.S.'s

Today's Hydroelectric Priority Actions

Clean Energy Portfolio

Given the high costs of focusing development on a single new project at a time, Manitoba has made the decision to move a portfolio of diverse, new hydro projects through to the readiness stages. As a result, the province and Manitoba Hydro are taking several projects forward through planning and design, consultation and negotiation with Aboriginal communities, environmental approvals, licensing and permitting.

This means that as and when Manitoba's load or forecast load passes certain thresholds, and as sufficient, firm export contracts are signed, and the economic case moves in favour of approving new supply, Manitoba will be equipped with at least one, and potentially more, projects ready for development. In the same way, if domestic load declines or proposed export contracts are altered or capital costs escalate, Manitoba has the tools to flexibly adapt.

Adopting a Clean Energy Portfolio has also enabled Manitoba to add wind power and other emerging, renewable energies – as well as energy efficiency, improved transmission and the rehabilitation of older hydro projects – to its potential new supply-side projects.

Finally, use of a portfolio approach allows Manitoba to develop its hydro construction in a staged manner that promotes stability of training and employment opportunities for northern and Aboriginal communities. This allows the province to maximize the overall economic and social benefits.

New Generation Hydro

Each new hydro project has been redesigned to better meet the needs in Manitoba's northern communities and also in a way that ensures projects meet and exceed customer expectations not just today, but over the next 40 or more years. Recent years have made clear that changing customer expectations and political debate elsewhere can dramatically impact Manitoba's long term access to export markets. A new hydro project intending to sell into export markets over a period of decades could lose hundreds of millions of dollars – not by failing to meet the legal standards in place when the contract was signed, but by failing to consider long term future issues and trends.

Manitoba export earnings have surpassed $11 billion, keeping rates low and supporting the cost of hydro projects.

With this long term view in mind, Manitoba's New Generation Hydro projects embody two major shifts from historic practices:

1. Aboriginal communities are engaged from the earliest stages of planning, as participants during construction, as well as standing to become long term, financial beneficiaries. Aboriginal people are also consulted through the province's Crown consultation process on any action or decision that might affect an Aboriginal or treaty right.

2. The Manitoba government is responsible for environmental and water licensing processes that outline the responsibilities of Manitoba Hydro to be good stewards of the environment. With that in mind, each project has been redesigned to dramatically reduce its environmental impact. Wuskwatim, for example, experienced just 50 hectares (or half a square kilometre) of additional flooding – a fraction of the size of an average Manitoban farm, while Conawapa will flood an area about the same size as an average farm (500 hectares). Many modern shopping malls, residential developments and energy plants take as much or more land than is lost through a New Generation Hydro project.

The New Generation Hydro components of the Clean Energy Portfolio that are under development or potentially available for development include:

- Wuskwatim – a 200 MW project that saw construction launched in 2008 and began generating power in 2012.
- Keeyask – a 695 MW project awaiting final licensing. Construction could run from 2014 to 2021, with first power potentially flowing in 2019.
- Conawapa – a 1,485 MW project, if approved, would see full project construction run from 2018 to 2026, with first power potentially flowing in 2025.

This expansion, of as much as 2,300 MWs, would be large enough to replace the demand growth of recent decades and to meet the expected domestic demand beyond 2020. It would also provide Manitoba with a surplus large enough to support large long term firm contract sales and to gain other revenues from the opportunity export markets.

The potential economic benefits of the total expansion are as impressive, as in previous generations of hydro development.

- The province is looking at $20 billion in new economic activity over the next decade, with Keeyask and Bipole lll alone expected to create 18,000 person years of direct and indirect employment.
- New export contracts worth over $4 billion are already on offer, with the potential to be added to, if desired. The proceeds will help pay down the cost of the projects, while helping sustain Manitoba's low rates for decades.
- This path offers a reduction in any long term dependency on coal or natural gas, and will reduce long term payments to fossil fuel producers.
- Manitoba's clean, stably priced, hydro exports would add real value to neighbouring systems – being available on-peak if desired, offering greater price stability and reducing their GHG emissions by millions of tonnes a year.

Transmission - Moving Power to Market

Manitoba Hydro's transmission network is large with 11,700 kilometres of transmission lines and 75,000 kilometres of distribution lines. The transmission facilities are developed and operated as an integrated system, with the backbone being two 800-kilometre, high voltage, direct current (HVdc) transmission lines (Bipole I and II). The lines were historically located in a common corridor and transmit over 70 per cent of Manitoba Hydro's annual energy production from its northern hydro stations on the Nelson to southern load centres. The direct current is converted back to alternating current at Dorsey station, northwest of Winnipeg, before being transmitted to the transmission and distribution system, as well as to Ontario, Saskatchewan and the US.

Most of the transmission and distribution facilities are exposed to the elements and can be affected by severe winds, lightning, ice storms and forest fires. The system is planned and built to achieve a high degree of reliability and maintain the delivery of power to its customers.

Manitoba's electric system is dependent on its two backbone HVdc facilities. Should these two facilities suffer a simultaneous catastrophic loss, it could result in extensive, wide spread, lengthy power outages. The number of customers affected, and the duration of their interruption of electrical service, would mainly depend on outside temperatures, with the most severe and extensive power outages occurring during the coldest winter months. Should such a loss occur at the winter peak, Manitoba Hydro has estimated that it could result in a supply interruption of up to 300,000 customers until repairs are completed. As a result, a third HVdc transmission facility, Bipole III, has been proposed to be constructed to assure the reliability of delivery of power to Manitobans.

More widely, new interconnection capacity to electricity markets increases both the reliability of Manitoba's own system, as well as Manitoba's reach into export markets. Should new generation to service additional sales in Minnesota and Wisconsin be approved, new interconnection transmission would be also be required.

Today's Transmission Priority Actions

Manitoba Hydro's transmission work includes developing Bipole III for reliability purposes (expected to be commissioned in 2017), as well as new export transmission interconnections, of different sizes and configurations, to the United States (to be available by 2019.) In addition, strengthening the Dorsey Convertor Station will increase reliability, and developing a new Riel Convertor Station will provide a second delivery point for northern power.

Manitoba has also forged a national leadership position by advancing the idea of a stronger east-west Canadian grid. The timing and size of Manitoba's enhanced, east-west grid interconnections with Saskatchewan and other provinces will ultimately be determined by the results of ongoing power sale talks. Manitoba will continue to advocate for an improved national electrical grid that can transport clean, renewable energy to every region in Canada.

Taken together, these transmission projects will:

- dramatically improve the long term reliability of Manitoba's system in the face of climatic instability and extreme weather
- enhance the development of new northern hydro as well as southern wind development
- reduce the potential cost of imports by achieving greater market access
- boost both the range and the scale of Manitoba's exports
- strengthen Canada's east-west ties

Reducing Coal Fired Power

In recent years, Manitoba closed most of its old, polluting coal fired capacity. Some units were converted to burn natural gas, while two new natural gas generators were installed. In order to reduce GHGs, *The Climate Change and Emissions Reductions Act* stipulated that by 2010, coal fired generation was capped under normal conditions and could only be used in emergency situations. Today, of Manitoba Hydro's 5,500 MWs of capacity, there are 364 MWs of natural gas fired capacity in Selkirk and Brandon, and just 97 MWs of emergency, coal fired backup in Brandon.

Natural Gas to Complement Clean Energies

Manitoba's natural gas based generation is used for a range of purposes: generate power during emergencies and droughts; help during transmission outages; and respond to short term variations in the output of our renewable generation. Used in these complementary ways, natural gas not only helps the system run more smoothly, but can actually increase Manitoba's installed capacity of new hydro and wind energy. By integrating, backing up and stabilizing new hydro or wind, natural gas generation can ultimately allow more renewable energy to be produced here.

Store It Away for Another Day

Manitoba has historically used imported power during droughts. Manitoba Hydro also buys off-peak, imported power at a low cost, stores it, then resells the power back to our trading partners at lower rates than they could make it for themselves – and earns a profit performing the service. This exchange is built on another Manitoba advantage – the large storage capability of our system's reservoirs – an asset which new hydro and new wind also need as they are further developed. The province has also, traditionally, shared these storage and support services with neighbouring utilities, helping the regional grid to run smoothly and supporting wind development in the US. At the same time, Manitoba's first priority moving forward is to use these assets to ensure the development of made-in-Manitoba new hydro and new wind, thus maximizing economic benefits for Manitoba and strengthening its energy security.

Today's Gas, Coal and Import Priority Actions

Coal

The remaining coal fired electricity generator in Brandon will continue to be used only in emergency situations and droughts. The generator will need to be "exercised" on a very limited basis to ensure it is operational when needed in emergencies. Manitoba will also comply with the federal government's new regulations that will phase out the use of conventional coal generation across the country.

Natural Gas

Manitoba's existing natural gas generating capacity continues to play a number of complementary roles in the system and will be maintained. Similarly, new natural gas plants will only be added to respond to short-term variations in renewable output, thus allowing Manitoba to integrate more new hydro and wind – or to augment the complementary roles described. Decisions on whether to add natural gas will also depend on consumer demand, renewable supplies and market conditions.

Imports

Imported power can provide value to Manitoba during droughts and through sales related to peak shifting and similar variations. However, given the limits of Manitoba's system to integrate, store, firm and shape energy, these capabilities will be used in ways which do not inhibit the development of Manitoba's own high priority hydro, wind and other renewable resources.

Off-Grid Diesel Communities

The northern communities of Brochet, Lac Brochet, Shamattawa and Tadoule Lake are currently not connected to the Manitoba Hydro transmission grid. They are supplied by stand alone, diesel generating facilities. For too long, these communities have struggled with high operating costs and the environmental concerns associated with the diesel generation.

All Manitoba communities deserve access to clean, renewable power – especially those in northern Manitoba, the heart of the province's renewable generation. As with many off-grid communities across Canada, the cost of grid connection is very high. However, depending on the local situation and advantages, the addition of small scale renewable energy could potentially help reduce their reliance on diesel generation.

Today's Off-Grid Community Priority Actions

Working closely with the off-grid communities, and the Canadian government and other partners, Manitoba Hydro will reduce dependency on diesel fuel by implementing renewable alternatives to diesel generation and improving energy efficiency. Manitoba will also show national leadership on this complex issue, working with our counterparts in other territories and provinces that have off-grid communities to share best practices and seek solutions.

Energy for Jobs

With the major expansion of hydro generation and transmission over the next decade, new economic opportunities will unfold for Manitoba companies and those looking to invest here. Capital expenditures, estimated at $20 billion by Manitoba Hydro, represent a significant opportunity to increase local job creation – in the construction of new generation and transmission capacity, but also in the supply of equipment, components and construction materials for these projects.

Today's Energy for Jobs - Priority Actions

In April 2012, Manitoba established a $30 million Renewable Energy Jobs Fund to help maximize industrial benefits (including local content and industrial offsets) from these major projects. The fund will provide loans to eligible manufacturers of equipment, components or construction materials used in the generation, or transmission, of renewable energy. This includes hydro, geothermal, wind, next generation biofuels, biomass heating, solar and smart grid technologies.

An Energy Opportunities Office will also be created to work with companies looking to expand, or locate for the first time, in Manitoba. This office will serve as a one-stop business support centre for companies wishing to tap these opportunities, and seek out partnerships with other companies in the renewable energy supply chain. In addition, the Manitoba government and Manitoba Hydro will work together to ensure that northern hydro developments result in good jobs for Aboriginal communities.

Premier Greg Selinger announces the Energy Jobs Fund at Winnipeg-based Crompton Greaves (CG) Power Systems, one of the top electric transformer manufacturers in the world.

❷ LEADING CANADA IN ENERGY EFFICIENCY

Manitoba Leads Canada in Energy-Efficiency

As energy prices began to rise in the early 2000s, the Manitoba government and Manitoba Hydro fast-tracked an expansion of the Power Smart program. They launched new programs to cover all sectors, regions, income groups and fuels. By the end of the decade, 350,000 families, businesses, schools, churches and farms had participated in the newly expanded Power Smart programs. One example is Manitoba Hydro's Power Smart Loan, which provided $267 million in financing to over 65,000 Manitoban customers.

The government launched its new Green Building Policy in 2007. The policy requires that provincially funded new buildings and major renovation projects meet energy and environmental requirements including: a minimum level of energy efficiency that is 33 per cent better than the Model National Energy Code for Buildings (MNECB.) To date, approximately 297,000 square meters (3.2 million square feet) of new construction in Manitoba incorporates green building standards and practices affecting almost 40 per cent of the industrial/ commercial/ institutional construction sector.

Building codes have also been improved on an ongoing basis, provincial energy efficiency standards for gas furnaces have been raised and incentives by the province and Manitoba Hydro helped many thousands of Manitoba families retrofit their homes.

Manitoba's Power Smart Program saved Manitoba families, firms, facilities and farms more than $600 million on their utility bills since it was launched.

Manitoba Seizes # 1 Ranking in Canada

In two short years, Manitoba's energy efficiency programs shot up in the Canadian Energy Efficiency Alliance (CEEA) rankings, from 9th place in 2002 to 1st place in 2004 – a ranking Manitoba has successfully maintained for nearly a decade. In environmental terms, these energy efficiency improvements brought a reduction of 1,350,000 tonnes of GHGs in Manitoba and its export customers, annually. This is equal to taking 250,000 cars off the road.

$600 Million in Bill Savings for Manitobans

Perhaps even more importantly, Manitoba's homes and businesses have achieved direct, energy bill savings which surpassed the $600 million mark in 2011. This amount continues to rise and, in another testament to Manitoba's long term thinking on energy, is expected to exceed $2 billion by the next decade.

Manitoba Hydro's forecast energy and power savings achieved through energy efficiency are included in its planning as a resource option alongside hydro, wind and other resource options. Today, the energy saved by the Power Smart efficiency power plant is more than 575 MWs – equal to that of all the hydro projects on the Winnipeg River.

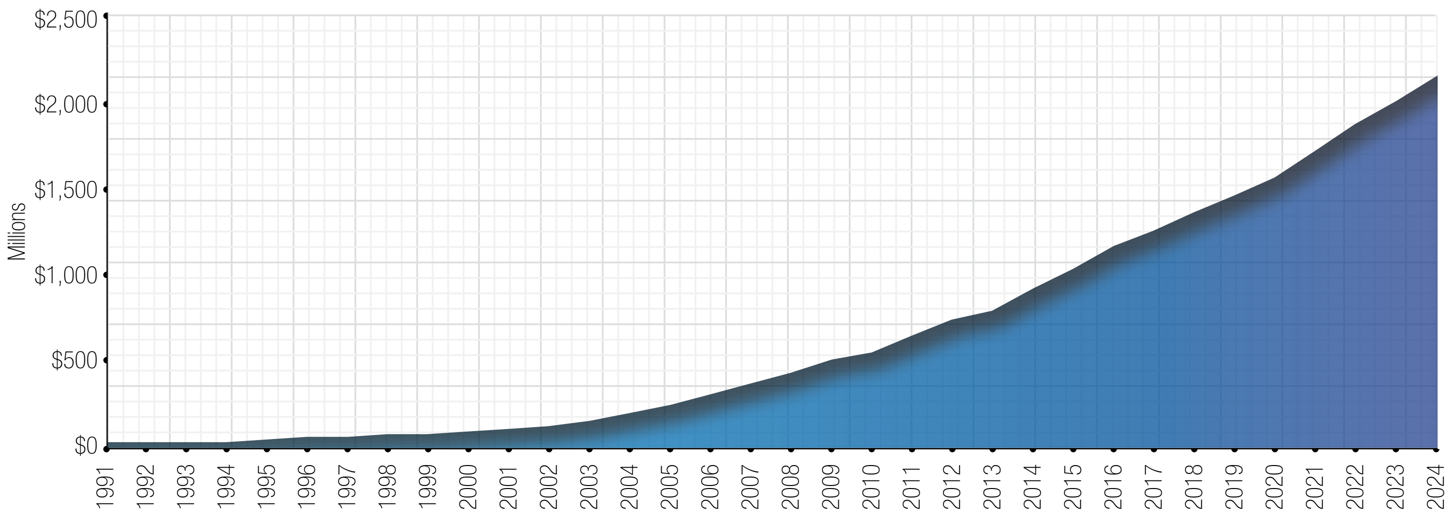
These efficiency savings have cost Manitoba Hydro, on average, just 1.9 ¢/kWh (kilowatt hour), well below the cost of other methods. This saved energy is then resold on the export market by Manitoba Hydro, earning profits and helping keep domestic rates down.

Incentives and Standards Have Cut Manitoba's Natural Gas Use

Manitoba's energy efficiency achievements are also seen in our natural gas sector through the use of incentives for high efficiency gas furnaces and insulation, higher product standards for furnaces and incentives for heat pumps. This effort more than offset any new demand from Manitoba's population increase, so that natural gas use has fallen by 17 per cent in our homes and nine per cent in the commercial sector. As a result, GHGs from residential and commercial natural gas use have fallen by 700,000 tonnes this past decade.

Manitoba ranked number one in Canada for energy efficiency.

Manitoba's Cumulative Bill Savings From Power Smart Programming



Low Income Communities – More Than Meeting the Challenge

Energy efficiency is a major opportunity in low income areas, where homes are often poorly insulated, and energy and water bills take a high share of family income. Social enterprises such as Building Urban Industries for Local Development (BUILD), and the Brandon Energy Efficiency Project (BEEP) in partnership with the Manitoba government and Manitoba Hydro, developed a successful business model that combines social, economic and environmental objectives.

The Manitoba Hydro head office tower in downtown Winnipeg is the most energy efficient tall building in North America.

These enterprises sought not only to address energy waste and unnecessary high bills, but also to employ local people with barriers to employment. Once trained, these employees have conducted the energy and water retrofits in their own neighbourhoods. The benefits have been huge – lowering utility bills for thousands of low income families and providing training and jobs for more than 150 Aboriginal youth and others marginalized from the mainstream labour market.

BUILD's Made-in-Manitoba Model Wins Scotiabank Award for Business Leadership

In 2011, BUILD's made-In-Manitoba model of community development was recognized by Scotiabank and awarded the national EcoLiving Award in Business Leadership. The Manitoba government and Manitoba Hydro backed BUILD and BEEP, and are aiming to raise the bar further by working with the Manitoba Housing Authority on 400 single-family units – each of which is expected to see utility bills cut by $450 a year.

Manitoba Hydro's New Head Office - An Energy Efficient and Architectural Showpiece

Perhaps the high point of the recent decade's efficiency efforts has been Manitoba Hydro's new, 22-storey, head office in downtown Winnipeg. After setting world leading performance targets, Manitoba Hydro challenged Manitoba's architectural, design, engineering and construction sectors to meet them. The result is an edifice that not only has a stunning appearance, but one that uses 70 per cent less energy than a conventional building.

Most of its remaining energy needs are met by heat pumps which draw heat and cooling from 280 bore holes – each drilled 122 metres beneath the site – as well as its many solar features. The new facility has been named North America's most energy efficient tall building. It is also the first large office tower in Canada to receive the LEED® Platinum certification from the Canada Green Building Council.

Today's Energy Efficiency Priority Actions

The Energy Savings Act

Even with significant achievements in energy efficiency, Manitobans are still using large amounts of energy, as a result of our climate, distances and building age. This means efficiency opportunities remain. As a result, Manitoba passed *The Energy Savings Act* (ESA) to ensure that investment in efficiency continues to expand and Manitobans continue to save more.

- **On-Meter Finance**

  The most powerful new tool the ESA enables Manitoba to use is On-Meter Finance. For decades, the number one barrier to energy efficiency savings has been the difficulty of financing the upfront capital costs. Most homes have energy and water savings opportunities. The problem has been that many of these opportunities are not acted upon because of high, upfront costs. Because of this, households paid higher bills than necessary, local retrofit jobs were lost and more money flowed out of Manitoba to pay for fossil fuels.

  The new financial tool developed to overcome this sees energy saving retrofit measures paid for upfront, but by the utility directly. The retrofit cost is then repaid by the residents on their regular utility bill utilizing energy savings to pay for the difference. The ongoing repayments are tied to the meter, not the individuals – thus the name, on-meter financing. This means families can make large and long-lasting efficiency investments, such as in-home insulation or on heat pumps – knowing the investment will be paid off over the measure's lifetime, by whoever is living in the home.

  The program includes plans not just for owner occupied, single family dwellings, but also for the low income sector, rental accommodations and public sector buildings.

More than 350,000 Manitoba families, firms, schools, farms and churches have participated in Power Smart programs.

- **An Energy Efficiency Plan**

  The new ESA requires Manitoba Hydro to set energy efficiency targets for the future. The act will ensure that Manitoba Hydro, the province, industry, community partners and the public are on the same page, by publishing an annual Provincial Energy Efficiency Plan. This plan will include details of stronger efficiency targets for electricity and natural gas use and an expanded range of programs; set out costs and benefits; and report on performance.

- **The Affordable Energy Fund**

  The ESA also extended the Affordable Energy Fund, to make sure all Manitobans, regardless of region, income or fuel source, are able to reap their share of energy and water savings.

Green Building Policy

Manitoba's Green Building Policy will be expanded to include provincially funded residential construction and renovation projects, operation and maintenance of provincially funded existing buildings and government leased accommodations and will include expanded program support.

Low Income Energy Efficiency

Manitoba Hydro's On-Meter Financing program and the Affordable Energy Fund will provide significant support to social enterprises in efforts to make deep retrofits in homes and buildings in low income areas. Manitoba Hydro will work closely with these community groups on a street-by-street approach to retrofit neighbourhoods, rather than one home at a time. Similar to the partnership approach Manitoba Hydro has taken with First Nations on new dam developments (but smaller scale), their partnership with social enterprises will help build community capacity, create jobs and maximize economic benefits.

Green Schools and Education for Sustainability

A centerpiece of the government's longer term energy efficiency efforts is its commitment to make every school a green school. While the Green Building Policy has led the way in building energy savings into new school construction and major renovations, efforts will also be supported to make school grounds green and access energy saving opportunities in school transportation (ex: walk to school, idle-free zones, biodiesel buses). Daily operations of schools are expected to become more energy and water efficient as sustainability school plans, including energy efficiency measures, will be encouraged to be in every school in Manitoba by 2015.

Building Codes

Building codes ensure that homes and businesses achieve the lowest costs for energy over their lifetimes. Subject to completion of consultations and upon final review and approval, Manitoba will adopt the 2011 National Energy Code for Buildings (NECB) to make new construction and major renovations in the commercial and institutional sector more energy efficient. Following this work, Manitoba will review and consider potential adoption of interim amendments to the 2010 National Building Code of Canada (NBC) related to energy and water efficiency in new homes and small buildings.

Net Zero Energy Homes

A growing number of new homes built worldwide are designed to use (or approach) net zero energy. This means they aim to generate as much energy onsite as they draw from the grid. Manitoba supports this direction, but needs to take into consideration our severe climate. The province will promote the design, building and monitoring of net zero energy and near net zero energy homes by Manitobans – for use in Manitoba conditions.

Provincial Buildings Audits

The province owns, controls or funds many public housing units, schools and public buildings, which hold significant opportunities for energy and water savings and renewable heat expansions. Energy and water audits will be encouraged in these buildings to help identify measures to increase energy savings and the use of renewable heating and cooling options such as geothermal.

Disclosure of Energy Performance

Manitoba supports the expansion of voluntary programs to benchmark, rate and label building energy performance. Manitoba will explore and test pilot programs that disclose the energy performance of buildings offered for sale or lease.

Minimum Standards for Energy-using products

Manitoba will pursue minimum energy efficiency standards for high energy consuming products where federal standards are deemed to be insufficient or unlikely.

Active Transportation

The consequences of an ever expanding dependence on car use, and ever increasing vehicle miles travelled, are also seen to be unsustainable over the long term. User friendly alternatives must increasingly be put in place to help support a shift toward reduced travel demand.

Active transportation methods (ex: walking, cycling) can make a real contribution here, while also generating a range of wider benefits. They can improve our quality of life, lower the costs of traffic congestion, enhance our environment and strengthen our economy. They also support Manitoba's energy goals by reducing our reliance on fossil fuels, lowering GHG emissions and helping the overall transport network work more efficiently.

Getting Active - A Smarter Approach

While active transportation embraces several modes of travel, cycling and walking are the most popular. Creating a strong cycling and walking culture, where existing barriers are addressed, convenience is emphasized and safety is vital, is pivotal to advancing Manitoba's active transportation objectives. Manitoba is already making strides by expanding walking trails and cycling paths, putting in better racks and facilities for cyclists, through walk-to-school programs and the Commuter Challenge.

In addition to cycling and walking, Manitobans are using other methods to reduce their fuel use from transportation. And since commuting by car to work each day is the single largest source of GHGs in Manitoba, these actions are often the single largest GHG reduction action individuals can take. Manitoba supports a range of these initiatives:

- car pooling, ride sharing and car sharing through matching and information web sites
- use of Drive Green methods, where drivers learn to reduce sudden accelerations and stops and idling and improve vehicle maintenance
- increased public transit use that has seen Manitoba accelerate its long term investment in transit
- development of technology that supports working from home and telecommuting systems

Today's Active Transportation Priority Actions

Manitoba's three-year action plan, intended to improve the policies, programs and infrastructure that support active transportation, includes the following:

- developing and adopting a provincial active transportation policy including design guidelines for active transportation infrastructure
- launching a new online portal with active transportation resources and an inventory of routes
- working to complete the Borders to Beaches section of the Trans-Canada Trail
- commencing a new active transportation overpass at the north Perimeter Highway in Winnipeg to extend the popular northeast Pioneers Greenway
- providing new funding and technical support to help municipalities integrate active transportation planning, design and use with land use and transportation planning
- working with Manitoba Public Insurance to continue raising awareness of safety issues affecting vulnerable road users (ex: cyclists, pedestrians, children, seniors)

Auto Efficiency

Energy efficiency opportunities extend well outside the home – with one of the greatest opportunities being Manitoba's current fleet of 600,000 to 700,000 light duty vehicles. The fuel consumption of Manitoba's vehicles is relatively high, around 15 litres per 100 kilometres (16 miles per gallon (mpg) US) – about 20 per cent higher than the Canadian average.

This low vehicle efficiency means our drivers pay more for fuel, increased GHG emissions and the Manitoba economy leaks hundreds of millions of extra dollars each year to pay for unnecessary gasoline. While a shift to electric vehicles and plug-in hybrid electric vehicles could potentially change this situation over the longer term, Manitobans' purchase of 40,000 to 50,000 new vehicles each year offers perhaps the fastest way to improve overall fleet efficiency, reduce fuel imports and cut our gasoline bills.

Manitoba Helps Drive North America to Higher Standards

Manitoba decided to help move auto efficiency in the mid-2000s, as consumers were hit by rising prices and oil consuming economies lost billions of dollars to oil producing regions. There had long been debate around increasing auto efficiency standards, but rising oil prices gave more weight to the effort. Since auto manufacturing is integrated continentally, and vehicle standards tend to move hand-in-hand in Canada and the US, Manitoba moved to support a cross-border alliance of states and provinces working toward higher standards.

This alliance won a major victory in 2009, when the US agreed to raise its auto efficiency targets from 25 mpg today to 35.5 mpg by 2016. The arrival and rapid progress of hybrids, EVs and PHEVs has since spurred a further increase, all the way to 54.5 mpg by 2025. The US Government expects that this change will save the average car buyer $8,000 each, and – as Canada shifts its own vehicle standards – will likely save Manitoban drivers a similar amount as they purchase the more efficient models available in years to come.

This doubling of fleet efficiency targets would not have been possible without the growth of hybrids and electric vehicle technologies. Manitoba played a key role, by identifying these technologies as game-changers early on, and launching Canada's first $2,000 consumer-incentive targeting hybrids. The province's taxi companies then put a large number of hybrids to the ultimate test – in Manitoba weather. The Manitoba government also purchased and tested many different models in its own fleet.

In 2010, Canada introduced the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, modeled after the US's Corporate Average Fuel Economy standard. The same kind of progressively improved emissions standards will be applied to Canada's cars and light trucks between 2011 and 2016, with efforts to bring in higher standards for 2017. Further efforts regarding heavy duty vehicles are also underway within Canada.

Over time, these higher auto efficiency standards should reduce the amount of fuel used by new cars in Manitoba annually. However, with the province's recent shift to a higher rate of population growth, the number of cars may also rise quickly. As a result, Manitoba is pushing not only for higher auto efficiency standards, but also for a step change away from gasoline and toward electric vehicles over the medium and longer term.

Today's Auto Efficiency Priority Actions

Just as Manitoba helped support the effort for higher vehicle efficiency standards in the past, it will do so in the future. Higher auto efficiency standards will save Manitoba drivers thousands of dollars in the coming years, while reducing GHGs and increasing our energy security. The province will also work to help those Manitobans who wish to take bolder steps toward using more clean energy and moving off fossil fuels, through the rollout of its Fossil Fuel Freedom initiative.

Green Fleet Purchasing

Manitoba will lead by example by implementing a Green Fleet fuel efficiency standard regulation under *The Climate Change and Emission Reduction Act*. The regulation will apply to new vehicles purchased for use by the Manitoba government. Departments will be guided by a Green Fleet procurement manual that will help them achieve efficiency objectives.

Heavy-Duty Freight Transportation

The freight transportation sector, particularly heavy trucking, is a key contributor to Manitoba's economy. This sector depends on energy to transport people and goods to, from and through Manitoba. The sector operates in a tightly meshed North American operational and regulatory context, and has had to rely primarily on conventional diesel as fuel. Although fossil fuels will be a dominant source of the energy needed for heavy, freight transportation into the foreseeable future, fuel efficiency will be critical in reducing GHG emissions and keeping costs down.

Today's Heavy-Duty Freight Transportation Priority Actions

Manitoba will continue to pursue freight fuel efficiency measures which help reduce fossil fuel use and its associated emissions. Manitoba will also evaluate the potential benefits of alternative fuel options to diesel, while ensuring that any alternatives meet the necessary vehicle performance, economic, environmental, jurisdictional as well as infrastructure requirements.

3 KEEPING RATES LOW

Historically, the cost of electricity in Manitoba has been either the lowest, or among the lowest, in Canada. Manitoba is committed to maintaining this low utility rate advantage.

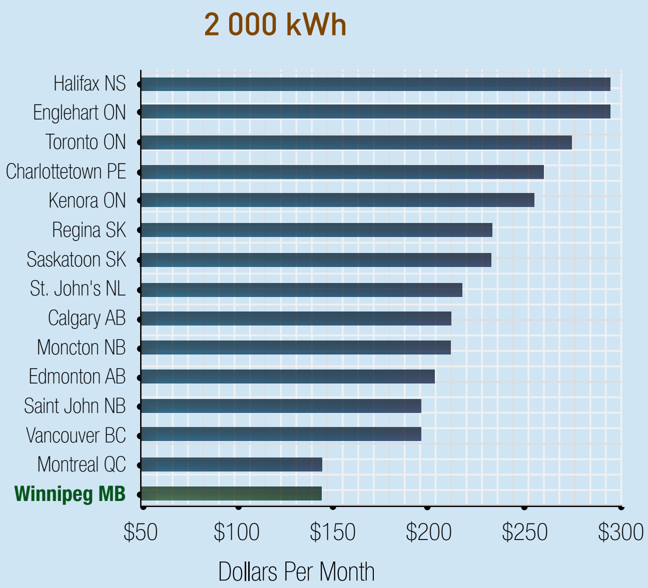
When Manitoba's Bill 18, *The Affordable Utility Rate Accountability Act*, becomes law, it will include a requirement that Manitoba work to maintain the lowest cost, in Canada, for a bundle of utility services – that is, the combined rates for electricity for home use, natural gas for home heating and automobile insurance.

At each fiscal year end, after 2012, the minister of finance must use an independent accounting firm to prepare a report for each province, listing a comparable cost for the same bundle of utility services. For any year in which the cost of the same utility bundle is lower than that of Manitoba, the minister of finance must prepare a plan to return Manitoba to the lowest cost position.

Lowest Rates in Canada

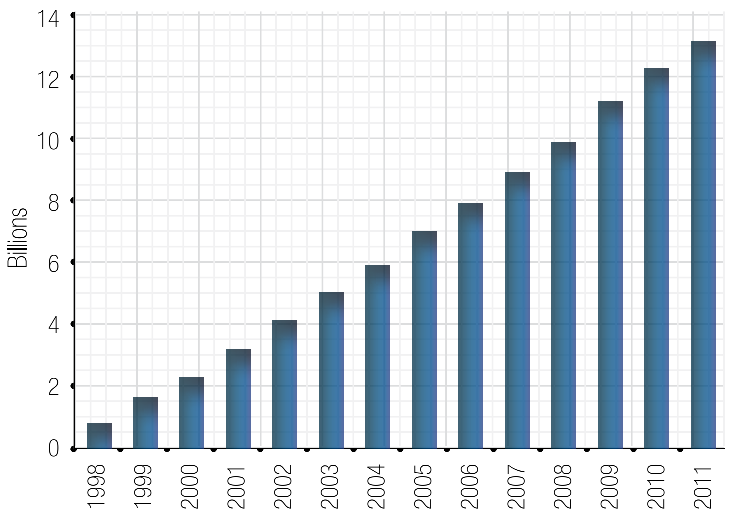
In the past, Manitoba Hydro has used export sales to help finance the cost of large, hydroelectric generating stations. This has helped ensure the low electricity rates Manitobans enjoy today. The average rates in our two neighbouring provinces, Saskatchewan and Ontario, are significantly higher than in Manitoba – approximately 90 per cent higher in Ontario and 40 per cent to 60per cent higher in Saskatchewan, depending on the class of service. In other low cost jurisdictions in Canada, the general average rates are still higher – in Quebec, about eight per cent higher; and in British Columbia, about 17 per cent higher.

Manitobans enjoy some of the lowest electricity rates in Canada and in North America. The chart below shows the comparative monthly cost of service to residential customers in various larger cities in Canada.



The long term benefits to Manitobans of the strategic decisions to invest in hydroelectric power (as well as greater efficiency) include cumulative savings to Manitoba families and businesses of $13 billion on their utility bills, when compared to the average Canadian's rates for the period 1998 to 2011.

Manitoba's Cumulative Hydro Bill Savings 1998-2011 (vs Average Canadian Rates)



Renewal of the Electrical System Assets

Like other electric utilities in Canada, many of Manitoba's electrical system assets were purchased and installed in decades past, and therefore now need to be renewed. However, the system must be renewed and developed at today's costs – which are significantly higher than the capital cost associated with Manitoba Hydro's legacy assets (ex: some of these assets, such as Point du Bois generating station, have been in place for as long as 100 years).

Low electricity rates have provided Manitoba families, firms and farms with savings of $13 billion – more than $10,000 per Manitoban.

Today's Keeping Rates Low Priority Actions

Placing Bill 18 Into Law

Manitoba will move to proclaim Manitoba's Bill 18, *The Affordable Utility Rate Accountability Act*. This act will ensure the provided bundle of combined electricity, natural gas, and automobile insurance rates remains the lowest in Canada.

Predictable Rate Increases

Manitoba Hydro expects it will need predictable and moderate rate increases over the next decade to fund asset renewal, which can still be done in the context of *The Affordability Utility Rate Accountability Act*. These increases will fund the renewal of its existing infrastructure; develop new generation, transmission and distribution infrastructure to serve growing demand; and assure continued reliable service to Manitobans.

❹ GROWING RENEWABLE ENERGY ALTERNATIVES

Recent years have seen a range of new, renewable energy technologies emerge globally (ex: wind power, heat pumps, electric vehicles). As these technologies fell in cost and grew in global sales, it became clear that Manitoba not only held a competitive advantage in clean, renewable hydroelectricity, but increasingly, across a broad range of emerging renewable energy sources.

Manitoba's Emerging Clean Energy Portfolio

Manitoba has taken a leadership role in developing emerging energy sources across all three primary energy uses: electricity, heating and transportation:

- In electricity, Manitoba saw two of Canada's larger, and lowest cost, wind farms constructed at St. Leon and St. Joseph.
- In heating, Manitoba became the Canadian leader in heat pumps, installing 11,000 units to date (including the new Manitoba Hydro head office building).
- In transportation, Manitoba led Canada by:
  - building a 130-million-litre ethanol plant in Minnedosa
  - creating one of Canada's first plug in hybrid electric vehicle demonstrations
  - launching world leading hydrogen and electric bus projects

Manitoba's desire to develop its clean energy resources was accelerated by the global fossil fuel price surges of the 2000s, when Manitoba's annual, out of province payments for fossil fuel consumption began to reach into the $2 billion to $3 billion range.

Today, Manitoba has the opportunity to harness its significant breadth and depth of clean, renewable, energy resources and to use them year by year to reduce the province's reliance on expensive, polluting and volatile imported fossil fuels. At the same time, Manitoba can create new, green jobs and business activity at home.

St. Leon and St. Joseph wind farms produce enough energy to meet the needs of 90,000 homes.

Wind Power in Manitoba

Wind power has long been known to emit almost no GHGs, to have stable prices, and – unlike natural gas or coal – to require no payments to outside fuel suppliers. Beginning in the 1990s, when the global wind industry grew by 20 per cent to 30 per cent each year, it drove the cost of wind down from 40 cents per kWh in the 1980s, to five to seven cents per kWh on the Prairies today.

Just a few years after putting up the first monitoring towers, Manitoba's developers built the 103.5 MW St. Leon project in 2005. Within months, St. Leon proved itself to be one of Canada's lowest cost wind farms (and did so without provincial subsidy). Following St. Leon's success, the province established a long term strategic target of 1,000 MWs, equal to 10 per cent of Manitoba Hydro's average annual generation. Since then, Manitoba has developed its second wind farm – the 138 MW St. Joseph project and the St. Leon facility have been expanded by 16.5 MWs.

The results of Manitoba's two wind farms have been stellar, producing benefits by:

- adding 258 MWs of new capacity and producing 880 GWhs of energy annually – more than the Pine Falls hydro plant, Brandon coal plant and Selkirk gas plant combined
- beginning to generate the more than $100 million in royalties and local taxes that will flow to rural landowners and rural municipalities (RMs) over the projects' working lifetimes – more than $10,000 per rural municipality resident
- creating more than 500 new construction jobs in these rural areas
- triggering $586 million in new capital investment

St. Leon and St. Joseph wind farms will provide more than $100 million in local and school taxes and royalties to local farmers and citizens over their lifetimes, $10,000 per person in these rural areas.

Today's Wind Priority Actions

Manitoba's 1,000 MWs of new wind will add almost 3,000 GWhs of dependable energy to the system – a substantial contribution. Economically, developing these 1,000 MWs will generate more than $2 billion in new investment, and $400 million in lifetime revenues to rural communities.

The location, scale and timing of future utility and community scale wind development in Manitoba will be shaped by circumstances such as exchange rates and export prices, federal support, global turbine prices, rural economic conditions and Manitoba Hydro's evaluation of its supply and demand situation.

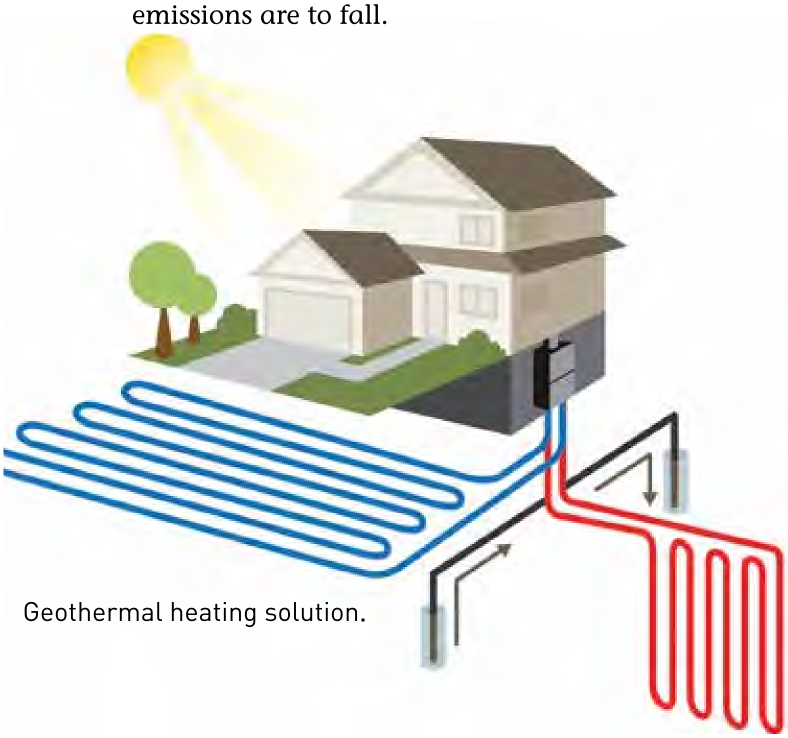
A single 300-700 MW wind farm would provide the electricity required to shift every Manitoba passenger car and truck from gasoline to electricity.

Green Heat

Manitobans in search of clean, low cost, stably priced sources of heating have long faced a dilemma. While natural gas (and propane and heating oil) offered a convenient source for heating space and water, it was also an imported fossil fuel, one which emitted GHGs – and one with highly volatile prices.

While Manitoba Hydro is responsible for most natural gas distribution, it has no direct control over the price of the natural gas itself, which is set outside the province. As a result, 270,000 Manitoban families and businesses pay prices set elsewhere, prices which can be low, but which have also been highly volatile over the past decade.

In fact, $300 million to $600 million leaves the Manitoban economy each year just to pay for natural gas. This money, if redirected and spent locally, would create and support thousands of Manitoba jobs. In addition, the combustion of this fossil fuel results in 2.4 million tonnes of GHG emissions in Manitoba – a full 15 per cent of all the GHGs emitted in the province – and an area needing to be reduced if Manitoba's domestic emissions are to fall.



Geothermal heating solution.

Electric Space and Water Heating – Not the Best Solution

Historically, electric heat was the main alternative for those Manitobans who needed a stably-priced alternative to natural gas. As a result, 130,000 families use all electric heat (especially in rural areas and apartments) today and 230,000 use electric hot water. Even so, using electricity – a high value energy form – to raise air or water temperatures by only a few degrees is considered a wasteful way to create heat. It is often termed, "using a chainsaw to cut butter." As a result, the conversion of buildings heated all-electrically (many of which are in rural areas) to use geothermal heat pumps, biomass or solar sources of renewable energy can produce multiple benefits (ex: lower energy costs, new local jobs, freeing up more electricity for Manitoba Hydro exports).

Heat Pumps– All the Energy You Could Want, Right Beneath Your Feet

Manitobans have increasingly been turning to popular alternatives, often called renewable or "green" heat sources, such as heat pumps, which draw energy from the ground, water or air. A heat pump, for example, can turn one kWh of electricity into three to five kWhs of heat, offering a way to take Manitoba's clean electricity and multiply the benefits. And with almost half of all solar energy reaching the earth being stored in the ground itself, a geothermal heat pump uses the ground beneath our feet to provide a clean, renewable source of heat, or cooling and all at a stable price.

Geothermal Heat Pumps – Once Again, Manitoba Leads the Way in Canada

Beginning in the year 2000, Manitoba began to back this technology and became a Canadian leader by raising its geothermal heat pump installation rate by 400 per cent. Contributing to the industry's rapid growth are innovative policy tools like the province's Green Energy Equipment Tax Credit and Geothermal Grant, the Green Building Policy, support for industry training, quality assurance and education, and Manitoba Hydro's Earth Power loan program.

The result is: as households and businesses had to replace heating systems, more found that their particular circumstances enabled them to invest in heat pumps. There were 11,000 units installed in Manitoba as of 2012. The industry has proven its capabilities by supplying not just family homes, but apartment buildings, arenas, churches, schools, head offices, university residences, credit unions and car dealerships. In particular, Manitoba's pioneering efforts to use heat pumps to supply multi-unit apartments, district systems and commercial projects is opening up a cost effective niche, offering not only lower per unit costs, but long term energy price stability. Today, Manitoba's heat pump industry has annual sales over $35 million, and provides system drilling and installation, design and engineering, component manufacturing and system integration.

Some of the industry's more innovative, showpiece projects in Manitoba include:

- the IKEA store and mall, the largest geothermal installation in Manitoba
- Manitoba Hydro's award winning, 22 storey head office – which has, at its core, 280 heat pump bore holes, each drilled 122 metres beneath the site
- 20 storey, multi-unit apartment towers in Winnipeg
- The Forks Market harnessing heat and cooling from the ground, a well, and a river to heat and cool a central 100 year heritage building, restaurants, offices and retail shops
- Award winning, district geothermal system at Île-des-Chênes, serving the local community centre, arena and fire hall

Moving forward, while individual circumstances and site specific economics will see natural gas fuelled heating systems continued to be installed, a rising percentage of Manitoba's stock of heating systems will likely consist of heat pumps. For those Manitobans, heat pumps offer a tested, made-at-home solution – able to draw on renewable heat and cooling from the ground, water or air; to supply single family homes, apartment blocks and commercial buildings; without emitting GHGs; and all at a stable price.

Today's Geothermal Priority Actions

Manitoba has been accelerating the growth of the geothermal heat pump industry through its Green Building policy, Earth Power Loans and the Green Energy Equipment Tax Credit. The creation of Manitoba Hydro's new On-Meter Finance tool will also provide Manitoba's home and building owners with a new tool to overcome the upfront cost barrier, and to generate a positive cash flow from day one.

The On-Meter financing tool is likely to be of particular value to the 150,000 rural Manitobans who lack access to natural gas and still must rely on fuel oil, propane and all electric heat. Manitoba Hydro estimates that a geothermal heat pump will save these homeowners $750 to $2,500 each year, when compared to these older systems – offering perhaps the single largest energy bill saving available to these families.

Manitoba will continue to provide the popular Green Energy Equipment Tax Credit for geothermal installations throughout the province where equipment is purchased before 2019. It is a refundable tax credit where all Manitobans and eligible corporations can claim this credit, whether tax-paying or tax-exempt (ex: non-profit organizations), to help offset the upfront investment of geothermal.

Recognizing that district heating presents a major opportunity for geothermal and other green heat sources such as biomass, the Manitoba government will work with municipal governments and industry stakeholders to identify and break down barriers to district heating and large scale multi-unit installations, and create a supportive environment that enables community scale and multi-unit biomass and geothermal heating.

The IKEA building is heated and cooled by one of the largest geothermal systems in Manitoba.

Wood

Wood is another renewable heat source widely used in Manitoba, with more than 20,000 homes – especially in rural areas – using wood, often combined with electricity, natural gas, fuel oil or propane. Modern wood stoves have greatly improved their efficiency and now produce more heat with fewer particulates, reducing the volume of wood needed by homeowners as well as the volume of any ash to be disposed.

Biomass – Manitoba's Natural Advantage

Biomass represents a broader and more strategic opportunity for Manitoba, offering the chance to boost economic growth, environmental sustainability and rural diversification. Agricultural residues and forestry waste can be converted into biofuels suitable for heat, electricity or transport. Manitoba has a natural advantage in biomass production with 7.6 million hectares (18.8 million acres) of agricultural land, already producing four million tonnes of biomass each year.

Biomass pellets from wood waste and crop residues have achieved strong growth in Europe, rural eastern Canada and the US, often out competing fuel oil and electricity. Compared to raw wood, pellets are more easily transported, burn more cleanly and produce less ash, create new income streams for farmers, while reducing in-field burning.

The growth of Manitoba's pellet industry will depend on its ability to cut costs along the supply chain – to gather and pack biomass from crop residue or woody debris left after harvest; transform the materials into pellets; install pellet combustion, storage and ash-handling systems in buildings; distribute the pellets; and remove the ash. As a result, the industry is most likely to expand in markets such as on-farm space heating and agricultural drying and processing.

Solar Energy

Solar energy is also on the rise globally, with 200 million buildings now using solar thermal systems for hot water and heat – and solar photovoltaic sales exceeding $90 billion.

In Manitoba, solar thermal heating applications have been found to be most cost effective when built into the design of new buildings (ex: Buhler Versatile tractor manufacturing plant). There, solar energy is captured, stored and transferred throughout the building, to complement other heating sources. Solar walls can also be used to preheat air and have been installed cost effectively at more than 50 Manitoba schools, housing complexes and industrial buildings.

Fred Douglas Place, a multi-unit high rise residential building in the heart of downtown Winnipeg, was retrofitted with a solar thermal wall that compliments its existing exterior brick facade.

47 per cent of solar energy is absorbed by the ground.

Today's Wood, Biomass and Solar Priority Actions

Coal Use Ends in 2014

Manitoba has already established the Emissions Tax on Coal, with revenues being invested to speed the development of systems provided by Manitoba's new, clean energy from biomass industry. Coal was identified because it was the most GHG intensive fossil fuel, but also because many clean energy alternatives were available. Because of the speed at which the few remaining coal burning establishments are converting to cleaner energy, a target end-date on the use of coal for heat has been set for 2014.

Growing Harvest Operations for Biomass Markets

The province's wood and biomass heat industries will continue to grow through the Manitoba Biomass Energy Support Program, which helps develop biomass processing capacity, conversion technology and research and development. Using revenue generated by the Emissions Tax on Coal, Manitoba will support coal users to transition to renewable biomass and work with the forestry and agricultural industries to increase the use of debris from harvesting operations to produce biomass for these emerging markets.

New Technologies Entering Mainstream

Solar will continue to be supported through the Provincial Green Energy Equipment Tax Credit. As wood, biomass and solar technologies move into the mainstream, they will become eligible under Manitoba Hydro's On-Meter Finance program.

Taken together, the shift towards green heat technologies – heat pumps, biomass pellets and solar – should see a growing share of the $300-$600 million that currently leaves the province to pay for natural gas, instead being re-injected at home, creating permanent, new green jobs.

Manitoba's Rural Advantage

Rural Manitoba has been a clear leader in developing new and emerging renewable energy sources. It has not only attracted substantial new investment and created new employment, its entrepreneurs have developed new green businesses and it has shown itself a leader in implementing the new technologies at home and at work.

Examples of this leadership include the exceptional role that local RMs and landowners have taken in partnering with the new wind-farms at St. Leon and St. Joseph (and landing more than $500 million in new investment); the development of Minnedosa's $200 million ethanol plant, including the co-operation of local grain and canola suppliers; the prevalence of heat pumps being installed in rural areas (ex: Île-des-Chênes), as well as the enormous future opportunity On-Meter Finance offers to those using electricity, propane and oil for heat; the rapid conversion off coal by Manitoba's Hutterite colonies; and the research and development work currently going into developing biomass, biofuel and bioproduct applications.

Cleaner Transportation

It is in transportation that fossil fuels have forced Manitobans to pay the greatest cost, with rising global oil prices doubling Manitobans' bills, to $2 billion and more each year. This is money which simply leaves the Manitoban economy. The need for a long term transition off these fossil fuels is particularly underlined by the fact that every 20 cent per litre rise in the price of gasoline and diesel requires Manitobans to pay an extra $500 million – more than Manitoba Hydro's annual export earnings.

By using made-in-Manitoba biofuels and electricity to fuel its vehicles, Manitoba has begun to reclaim the billions of dollars flowing out of province, re-injecting them back into our local economy. Continuing to do so will create thousands of long term, sustainable, local jobs – while enabling more Manitoban families and businesses to regain control over their family budgets.

Homegrown Biofuels

Ethanol – a Cleaner Burning Fuel

Manitoba was home to Canada's first modern ethanol plant, at Minnedosa, in the early 1980s. After 2000, when oil prices rose and ethanol became cheaper to produce, Manitoba worked with industry to create an ethanol strategy designed to help grow local economic opportunities, increase energy security and reduce GHGs. Manitoba has since become a Canadian leader with *The Biofuels Act*, which mandated that 8.5 per cent of gasoline be replaced with ethanol. The province also created an eight year, declining incentive for new ethanol producers, to ensure there would be no impact on drivers at the pumps.

Husky's ethanol plant in Minnedosa produces 130 million litres of ethanol annually.

The results were impressive, and included:

- an investment of $200 million in the construction of Husky's new 130-million litres per year, world class, ethanol plant in Minnedosa
- the creation of a new market for 350,000 tonnes of Manitoba wheat and corn annually.
- the production of 130,000 tonnes of high protein distiller's grain (which livestock producers now use to replace imported soybean meal)
- the re-injection of $100 million that previously leaked away for gasoline payments
- a reduction in transportation emissions of more than 330,000 tonnes of GHG emissions per year

Biodiesel – a Cleaner Burning Fuel

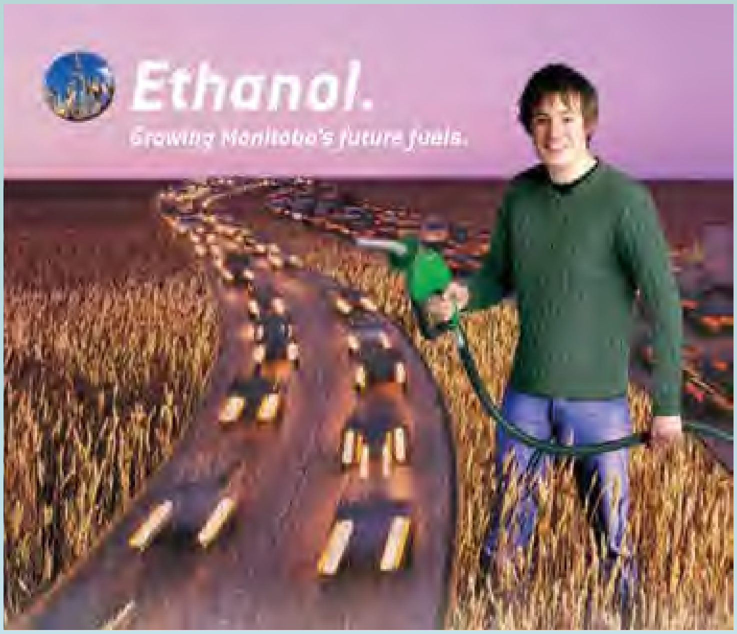
Manitoba developed a strategy for biodiesel in 2005, which led to the creation of a biodiesel testing facility in Selkirk, incentives for producers and demonstration projects in Winnipeg school buses, trucks and underground mines. In 2009, Manitoba again led Canada by introducing its mandate of two per cent biodiesel.

Future Biofuel Technologies

Combined use of these Manitoban biofuels now reduces gasoline and diesel imports by $100 million each year, and cuts GHGs by nearly 400,000 tonnes annually. The next step for the industry is the creation of advanced biofuels from feedstocks such as straw, crop residues, wood waste or algae. There are also new technologies being commercialized today that can produce next generation biodiesel with cold weather properties similar to conventional diesel. Manitoba also now possesses a well equipped biofuel tool kit to help support its development, including fiscal incentives, lab capabilities and mandates.

Today's Biofuel Priority Actions

Manitoba's investment in its biofuel industries over the past decade means that six per cent of our gasoline and diesel fuel is now derived from renewable sources. In the near future, biofuels could grow to supply up to 10 per cent of Manitoba's total liquid fuel consumption. Manitoba, in consultation with stakeholders, will pursue new production opportunities and increased biofuels content requirements. Manitoba will also look for opportunities to increase the production and use of second generation biofuels such as cellulosic ethanol and renewable diesel.



The Electric Transportation Revolution

The electrification of transportation has been described as, potentially, the greatest energy revolution in 100 years. Even though oil still contributes well over 90 per cent of all energy for vehicles and is more energy dense and easier to store, electricity itself has a strong set of advantages:

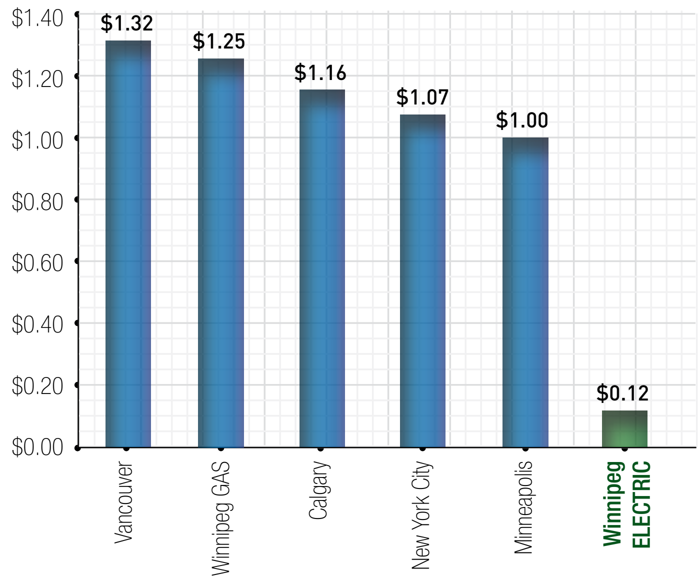
- Electricity can be made from more sources than oil, including from renewable sources.
- Almost every jurisdiction can make its own electricity.
- Electricity costs just a fraction of the price of gasoline.
- When made from renewable sources, electricity emits almost no air pollutants or GHGs.

As a result, electrified transport increasingly offers the world a way out of the energy insecurity, high prices, GHG emissions and economic damage of oil use. Driven in part by these forces, the major automakers have in recent years moved rapidly into this field, making a range of hybrid, plug-in hybrid electric vehicles and all electric vehicles commercially available to the public.

Technological Advances Ongoing

More hybrids and electric vehicles are forecast to be on North American roads in the medium to longer term, with the exact number in any given year heavily influenced by oil prices and battery progress. The major automakers and battery manufacturers have invested tens of billions in developing the new batteries, and have cut prices in half in just the past three years – and with a further halving forecast by 2017 to 2020. This progress means that, with each new model year, more Manitobans will find themselves entering a vehicle sales market with a greater range of hybrid, plug-in and all electric vehicle models, at lower cost and with improved performance. As their personal circumstances dictate, Manitobans who choose to access these vehicles will find the benefits available to them in Manitoba are particularly strong:

The Cost of Vehicle Fuel - At The Pump vs At The Plug



- Manitoban drivers will have North America's lowest-cost vehicle fuel – electricity from Manitoba Hydro – at approximately 12 cents per litre gasoline equivalent
- A young family shifting from two gasoline driven vehicles to two electric ones could therefore expect to save over $100,000 in vehicle fuel payments over their lifetimes.
- For Manitoba as a whole, a shift from gasoline to electricity in the decades to come will:
  - Re-inject a rising share of the $1 billion in gasoline bills back into Manitoba's economy – comparable to Manitobans receiving a $1 billion per year tax cut.
  - Create more than 10,000 new, long term jobs in the economy.
  - Reduce Manitoba's GHG emissions by three million to four million tonnes a year.
  - Convert Manitoba's number one energy weakness (the import of expensive fossil fuel) to its number one strength (its wealth of low cost, renewable electricity)

Switching from gasoline to electricity for vehicles would stop leaks of more than $1 billion from Manitoba's economy each year.

Manitoba's Advantage in Electric Vehicles

This opportunity also stands out for Manitoba because it has such strong assets in this sector:

- The province has an abundance of low cost, clean electricity. For example, given the much higher efficiencies of electric motors versus gasoline engines, a single 300 MW to 700 MW wind farm would provide enough electricity to shift every Manitoba passenger car and truck from gasoline to electricity.
- Manitoba has a prebuilt electric vehicle infrastructure of more than 500,000 plugs in our garages and parking lots. Now used for block heaters, they can also be used for recharging. If Manitoba had to build this infrastructure new (as others do), it would cost $1 billion.
- While others face cultural barriers to plugging in, Manitobans already have a well established plug in culture, driven by the need for block heaters during our winters.

Moving Towards Electrically Powered Vehicles

Manitoba has acted by creating plug in partnerships with automakers like Nissan, Toyota and Mitsubishi, Manitoba Hydro and academic institutions, to better demonstrate plug-in hybrid and electric vehicles under our climatic conditions and ensure that these options are available.

A new Electric Vehicle Technology and Education Centre (EV-TEC) was created at Red River College in Winnipeg, to demonstrate new plug-in hybrids and electric vehicles to Manitobans and train students for the future.

In 2011 Manitoba's Electric Vehicle Road Map identified ways to maximize out-of-the-gate use of Manitoba's $1 billion recharging infrastructure, identified issues around the integration of vehicle charging and the grid, and making links to northern vehicle cold weather testing in Thompson.

Every 20 cent per litre rise in the price of gasoline and diesel drains $500 million from Manitobans.

Today's Electric Vehicle Priority Actions

Building on what we've learned from our early demonstrations, plug in partnerships and work of the Electric Vehicle Advisory Committee – Manitoba will:

- Expand existing, and form new, plug-in partnerships.
- Actively promote at home charging, an option which already exists for 95 per cent of Manitobans; while working with Manitoba Hydro and other partners to ensure parking lots are capable of recharging vehicles, and providing incentives to install some Level-2 recharging systems.
- Expand fleet procurement by the province, the Crowns and others.
- Develop communication strategies to provide objective information to the public and corporations to help make informed electric vehicle purchase and operation decisions in the Manitoba context.
- Launch public participation campaigns to speed the adoption of new generation vehicles, spear headed by the Fossil Fuel Freedom program.

For Manitobans refilling with electricity, it costs just 12 cents for the equivalent of a litre of gasoline.

Hydrogen, Hybrid and Battery Powered Buses

Buses and heavy duty vehicles offer a special opportunity for hydrogen and battery power. This sector is especially significant to Manitoba, as Winnipeg is the bus manufacturing centre of North America. We are home to New Flyer Industries, the leading maker of transit buses, and Motor Coach Industries, the leader in inter city buses. New Flyer has emerged as the number one supplier of alternative fuelled buses, with hybrids, hydrogen, and most recently – in partnership with Mitsubishi Heavy Industries, the Province of Manitoba, Manitoba Hydro, and Red River College – electric buses.

Electric Bus Project – Showcase for North America

The new electric bus project will develop and demonstrate an advanced, battery electric, transit bus plus rapid charge technologies under Manitoba's highly variable climatic conditions. The $3 million project aims to validate the bus's operational capabilities and act as a showcase for potential markets. It has taken one year to develop the prototype bus (including integrating battery technologies from Mitsubishi) that will be followed by two years of operational testing.

Today's Alternative Powered Bus Priority Actions

Manitoba will continue to support development of the electric bus, and work with partners to expand the project into a multi-bus and charging system demonstration. Priority will be placed on seeking value added technology development and component manufacturing. The timing is right for such projects as US transit authorities are considering electric buses in tenders, albeit starting on a small scale. The pathway forward for this ground breaking technology was blazed by hybrid diesel/electric buses, considered cutting edge less than 10 years ago but now making up a significant portion of new bus sales throughout North America.

Hydrogen

In 2003, Manitoba launched its hydrogen strategy, leading to a Winnipeg demonstration of an advanced, fuel cell bus, as well as a bus with a hydrogen hybrid, internal combustion engine. Since then, research partnerships with regions such as Iceland have developed. As well, New Flyer Industries has gained considerable expertise in hydrogen technologies, supplying 20 fuel-cell buses for the 2010 Vancouver Olympics – buses that are still operating today.

❺ FREEDOM FROM FOSSIL FUELS

Over the coming years, a number of Manitobans will be among the first in the industrial world to live their lives without requiring substantial quantities of fossil fuels. Instead, they can meet the vast majority of their three core, daily, energy needs (for electricity, heat and transportation) by using clean, renewable energy and by being energy efficient – not by burning coal, natural gas, gasoline or diesel. These first fossil fuel free Manitobans will be pioneering a path that most nations are hoping their citizens will get to take in future decades – toward a daily life no longer dependent on fossil fuels.

These Manitobans will achieve fossil fuel freedom through a simple three-step process:

1. Their electricity from Manitoba Hydro will already be clean, more than 98 per cent or more fossil fuel free. It will supply their lighting, appliances and other power needs. A clean electricity supply, though difficult to obtain in most other nations, is already here for Manitobans.
2. Their heat will be provided – as it already is for thousands of Manitobans – through clean, renewable, energy systems (ex: heat pumps, biomass, solar), which eliminate the need for fossil fuels like natural gas. While all electric heat is also fossil free, heat pumps use 50 per cent to 70 per cent less electricity, so they're a more efficient choice.
3. The biggest step for most Manitobans will be in transportation. An option chosen by some will be to buy an electric or plug-in hybrid vehicle, which will shift their vehicle energy over to clean electricity, while cutting their gasoline use by 65 per cent to 100 per cent. Others may choose to cut their fossil fuel use by taking public transit, car pooling or ride sharing, while others opt for walking or cycling.

Manitoba currently has more than 500,000 plug in points in garages, parking lots and at businesses. This is a $1 billion infrastructure already in place.

Taken together, these Manitobans will have effectively reduced their use of fossil fuels by more than 90 per cent across the three major energy end uses. They will also have begun to generate a range of benefits for themselves, the environment and the Manitoban economy:

- By moving off gasoline, they will slash their pump price worries and gain the lowest cost vehicle fuel in North America – electricity from Manitoba Hydro at approximately the equivalent of 12 cents per litre.
- By changing to heat pumps and electric and plug-in hybrid vehicles, they will save $3,000 to $5,000 in fuel costs each year. Over a lifetime, this can reach to well over $100,000 per family.
- They will cut their direct GHGs to residual levels (zero to two tonnes.) This can be compared to today's families in North Dakota or Saskatchewan, many of whom emit 15 to 40 tonnes of GHGs a year by using coal fired power, gas heat and gasoline.

When a two gasoline driven vehicle family shifts to using two electric vehicles, they can expect to save more than $100,000 over their lifetimes in vehicle fuel costs.

Fossil Fuel Freedom – A Movement Towards a Healthy Future

Many nations can only set fossil fuel freedom as a visionary goal, for the years 2040 or 2050.

But in Manitoba, a significant number of its citizens can choose to achieve this freedom today. Any such transition, as we have seen, would require decades to move through a society's energy infrastructure. For example, our vehicle fleets alone requires 15 to 20 years to turn over; our furnaces and heating systems require 20 to 30 years; and our building stock and energy generating infrastructure can last another 50 to 100 years.

Nonetheless, for most Manitobans, the opportunity to move from conventional fossil fuel use to clean energy, and even on to fossil fuel freedom is increasingly a reality. More and more Manitobans are taking the quiet steps they need to ensure that their lives are less exposed to the risks and costs of fossil fuels.

And the reason Manitobans are so well positioned to make this transition, and able to consider it now, in an atmosphere free of any particular energy crisis, is because of the strong clean energy economy and infrastructure which we have come together to create, starting decades ago.

But today's good news is that for Manitobans, the fossil fuel free future starts here…and it starts now.

Today's Fossil Fuel Freedom Priority Actions

The province will support a Fossil Fuel Freedom campaign that will initially focus on families. It is expected that many companies, offices, farms and schools, etc. will want to follow in a similar fashion. The campaign will:

A. Create a public path open to all Manitobans, rather than a program designed just for a few. This will enable more and more families to participate, and reap the full benefits of lower bills, more local jobs and an improved environment.

B. Consist of three simple steps:

   Step 1: Use clean electricity – a step Manitoba Hydro has already taken for you.

   Step 2: Use a green heating system – such as heat pumps (or biomass or solar).

   Step 3: Use clean transport – such as an electric or plug-in hybrid vehicle, public transit, car pooling or ride sharing, or active transportation methods like walking, skating and cycling.

C. Focus on promoting a positive, money saving path forward for households.

   - Real world stories of fossil fuel freedom will be communicated to schools and the public, and may include tours as well as special technology demonstrations.

A plug-in hybrid can reduce the number of times you need to refill with gasoline to less than once every two months.

D. Connect to an online fossil fuel free social network, designed to support both early members, as well as to inform and engage those in the next wave who may be interested in joining.

   - Families who participate in programs early on may wish to use the network to exchange experiences, discuss the process with experts, engage with those interested but who have not yet joined, and to organize peer-group activities.

E. Support these families through financial incentives and expert help.

   - A number of organizations – the Manitoba government, Manitoba Hydro, private suppliers and retailers, universities etc. – already offer incentives and supports. These incentives will brought together (and can be topped up) through the Fossil Fuel Freedom campaign.

   - Support from experts is also valuable to people who adopt new technologies early on. The province, Manitoba Hydro and other partners will make sure these families have access to services and expertise in plug-in hybrid and electric vehicles, heat pumps and home retrofits, through in-home visits, expert support and other assistance.

   - For those at an earlier stage, partners can provide opportunities to see these new technologies demonstrated, or to speak directly with experts and participants.

CONCLUSION

Our energy future, in many ways, underpins our economic future. Managing the way we source, deliver and use energy in the years ahead will be key to growing our economy, keeping energy affordable, meeting the province's commitments to sustainability and reducing our impact on global climate change. Manitoba's strategic direction is clear – by seizing our own Manitoba domestic energy advantages we can reduce our exposure to fossil fuels while expanding our clean energy resources, all across the electricity, heat and transportation sectors.

Capturing the economic and environmental opportunities this clean energy strategy provides will require innovation and commitment, as well as a willingness to adjust as our energy options evolve. Most importantly, we need to work together to reach our goal.

With the co-operation and participation of the public sector, the private sector, our farms and our schools, industry experts and informed citizens, Manitoba is leading the way into a clean energy, and – for some pioneers – into a fossil fuel free future.

Although the goal of building on our renewable energy advantages is long term in nature, this strategy will be reviewed and updated on a regular basis and progress reports provided annually. As energy technologies evolve, environmental drivers intensify, and market conditions change, it will be important to be flexible enough to adapt as necessary.

It is equally important that Manitobans have an opportunity to provide input into this living strategy and therefore it will remain open to reflect the views of Manitobans.

To provide advice and comments about the Manitoba Clean Energy Strategy please respond in writing to:

Manitoba Innovation, Energy and Mines

Energy Division
1200-155 Carlton Street
Winnipeg, Manitoba, R3C 3H8

www.manitobaenergy.ca

Or by email to:

mbenergy@gov.mb.ca

APPENDIX I – WHAT IS ENERGY?

The term energy comes from the ancient Greek energeia, meaning activity or to cause activity. Literally, energy is what makes things work, and joules (J) are the official units of energy, whatever the form. Abbreviations are used for short form:

1 kilojoule (kJ)	= 1,000 J
1 megajoule (MJ)	= 1,000,000 J
1 gigajoule (GJ)	= 1,000,000,000 J

Power is defined as the flow of energy, and watts (W) are the official units of power.

Watts and joules are related in that:

1 W = 1 J per second

Natural gas is sold in units of cubic metres (m3) (at standard temperature and pressure conditions) with a typical energy content of 37.8 MJ per m3.

Gasoline and diesel liquid fuels are sold in volumetric units of Litres (L) referenced to a standard temperature.

Gasoline typically has an energy content of about 35 MJ/L

Diesel fuel typically has an energy content of about 37 MJ/L

Vehicle fuel consumption is typically expressed in units of Litres per 100 kilometre (L/100 km). Lower numbers are better in this case.

Fuel economy in the United States is expressed in units of miles per U.S. Gallon (MPG). Higher numbers are better in this case. The conversion between L/100 km and MPG is more complicated given they use different units and are inverse. A fuel consumption of 15 L/100 km equates to fuel economy of 16 MPG.

1 U.S. Gallon = 3.78 L

1 mile = 1.6 km

Electricity in terms of energy is sold in units of kilowatthours (kWh). This has been used for convenience and is an official unit for electricity.

There is a simple relationship to official energy units as follows:

1 kWh = 3,600,000 J = 3.6 MJ

APPENDIX II – ENERGY ABREVIATIONS

List of Commonly-used Acronyms

AT	active transportation
BEEP	Brandon Energy Efficiency Project (social enterprise organization)
BUILD	Building Urban Industries for Local Development (social enterprise organization)
CAFE	U.S. Corporate Average Fuel Economy standard
CEEA	Canadian Energy Efficiency Alliance
DC	direct current
ESA	*Energy Savings Act*
EV	electric vehicle
EVTEC	Electric Vehicle Technology and Education Centre (at Red River College)
FFF	fossil-fuel free family
GDP	gross domestic product
GEMTC	Green Energy Manufacturing Tax Credit
GHG	greenhouse gas
GJ	gigajoule

GW	gigawatt
HVdc	high voltage direct current
km	kilometre
kWh	kilowatt-hours
LEED	Leadership in Energy and Environmental Design
LNG	liquefied natural gas
MB	Manitoba
MHI	Mitsubishi Heavy Industries
MNECB	Model National Energy Code for Buildings
MPG	miles per U.S. gallon
MW	megawatt
NBC	National Building Code
NECB	National Energy Code for Buildings
PHEV	plug-in hybrid electric vehicle
PV	(solar) photovoltaic
US	United States

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December 2012

Schedule A

Principles of Sustainable Development

Integration of Environmental and Economic Decisions

1(1) Economic decisions should adequately reflect environmental, human health and social effects.

1(2) Environmental and health initiatives should adequately take into account economic, human health and social consequences.

Stewardship

2(1) The economy, the environment, human health and social well-being should be managed for the equal benefit of present and future generations.

2(2) Manitobans are caretakers of the economy, the environment, human health and social well-being for the benefit of present and future generations.

2(3) Today's decisions are to be balanced with tomorrow's effects.

Shared Responsibility and Understanding

3(1) Manitobans should acknowledge responsibility for sustaining the economy, the environment, human health and social well-being, with each being accountable for decisions and actions in a spirit of partnership and open cooperation.

3(2) Manitobans share a common economic, physical and social environment.

3(3) Manitobans should understand and respect differing economic and social views, values, traditions and aspirations.

3(4) Manitobans should consider the aspirations, needs and views of the people of the various geographical regions and ethnic groups in Manitoba, including aboriginal peoples, to facilitate equitable management of Manitoba's common resources.

Prevention

4 Manitobans should anticipate, and prevent or mitigate, significant adverse economic, environmental, human health and social effects of decisions and actions, having particular careful regard to decisions whose impacts are not entirely certain but which, on reasonable and well-informed grounds, appear to pose

serious threats to the economy, the environment, human health and social well-being.

Conservation and Enhancement

5 Manitobans should

(a) maintain the ecological processes, biological diversity and life-support systems of the environment;

(b) harvest renewable resources on a sustainable yield basis;

(c) make wise and efficient use of renewable and non-renewable resources; and

(d) enhance the long-term productive capability, quality and capacity of natural ecosystems.

Rehabilitation and Reclamation

6 Manitobans should

(a) endeavour to repair damage to or degradation of the environment; and

(b) consider the need for rehabilitation and reclamation in future decisions and actions.

Global Responsibility

7 Manitobans should think globally when acting locally, recognizing that there is economic, ecological and social interdependence among provinces and nations, and working cooperatively, within Canada and internationally, to integrate economic, environmental, human health and social factors in decision-making while developing comprehensive and equitable solutions to problems.

Schedule B

Guidelines for Sustainable Development

1 **Efficient Use of Resources** - which means

(a) encouraging and facilitating development and application of systems for proper resource pricing, demand management and resource allocation together with incentives to encourage efficient use of resources; and

(b) employing full-cost accounting to provide better information for decision makers.

2 **Public Participation** - which means

(a) establishing forums which encourage and provide opportunity for consultation and meaningful participation in decision making processes by Manitobans;

(b) endeavouring to provide due process, prior notification and appropriate and timely redress for those adversely affected by decisions and actions; and

(c) striving to achieve consensus amongst citizens with regard to decisions affecting them.

3 **Access to Information** - which means

(a) encouraging and facilitating the improvement and refinement of economic, environmental, human health and social information; and

(b) promoting the opportunity for equal and timely access to information by all Manitobans.

4 **Integrated Decision Making and Planning** - which means encouraging and facilitating decision making and planning processes that are efficient, timely, accountable and cross-sectoral and which incorporate an inter-generational perspective of future needs and consequences.

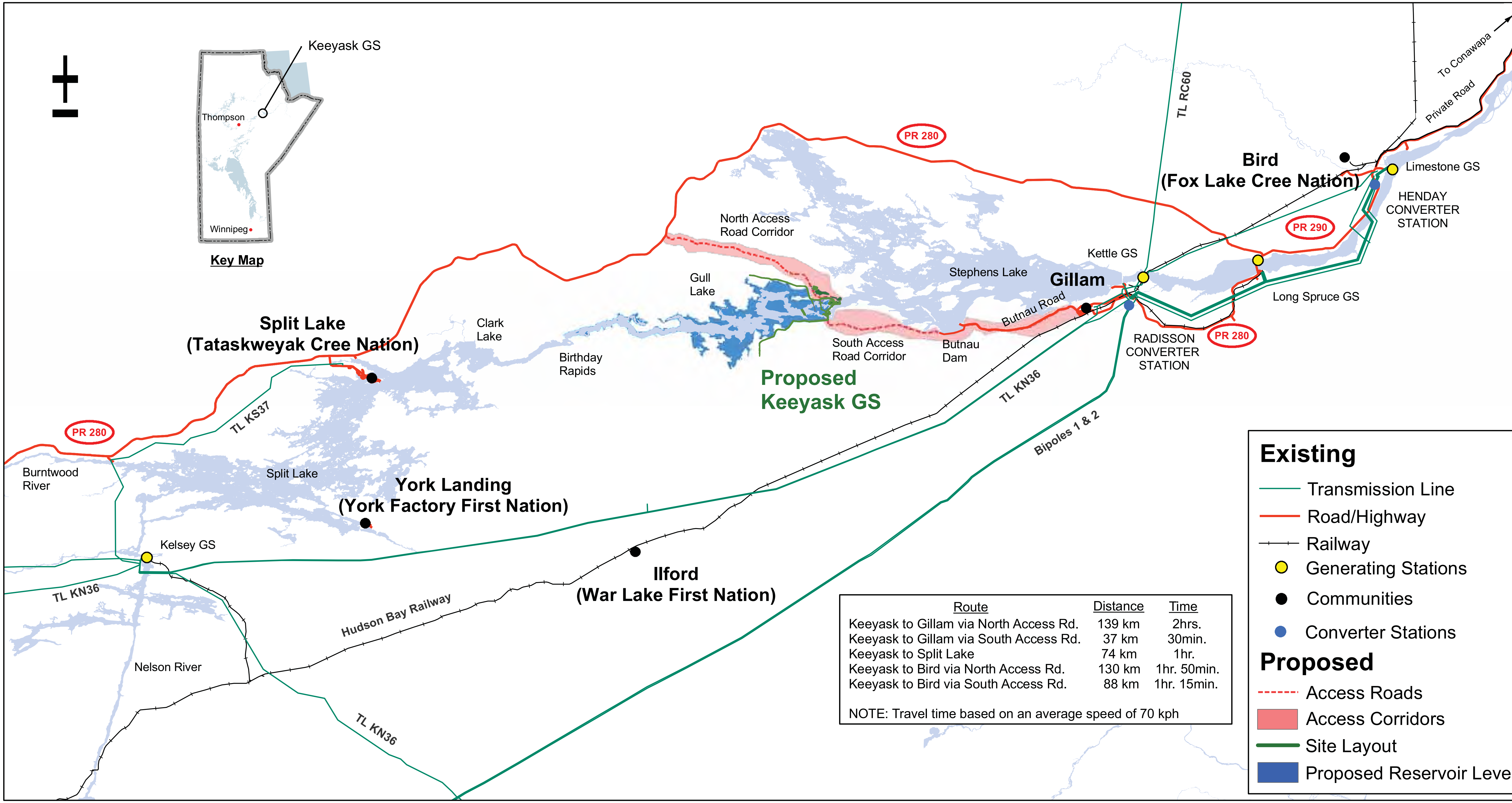
5 **Waste Minimization and Substitution** - which means

(a) encouraging and promoting the development and use of substitutes for scarce resources where such substitutes are both environmentally sound and economically viable; and

(b) reducing, reusing, recycling and recovering the products of society.

6 **Research and Innovation** - which means encouraging and assisting the researching, development, application and sharing of knowledge and technologies which further our economic, environmental, human health and social well-being.

TAB 15



Route	Distance	Time
Keeyask to Gillam via North Access Rd.	139 km	2hrs.
Keeyask to Gillam via South Access Rd.	37 km	30min.
Keeyask to Split Lake	74 km	1hr.
Keeyask to Bird via North Access Rd.	130 km	1hr. 50min.
Keeyask to Bird via South Access Rd.	88 km	1hr. 15min.

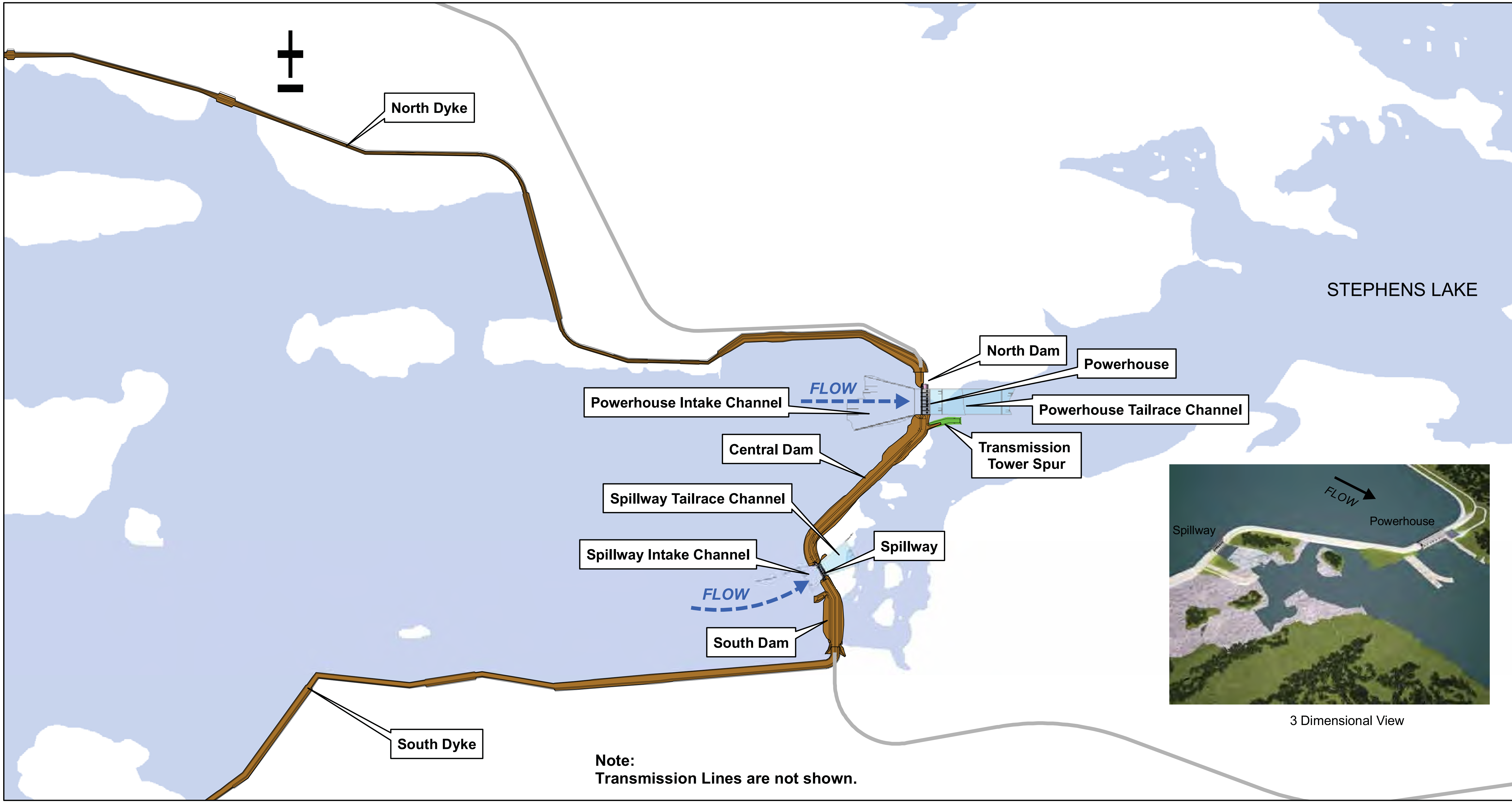
NOTE: Travel time based on an average speed of 70 kph

KEEYASK

10 5 0 10
Kilometers

Date:June 12/08

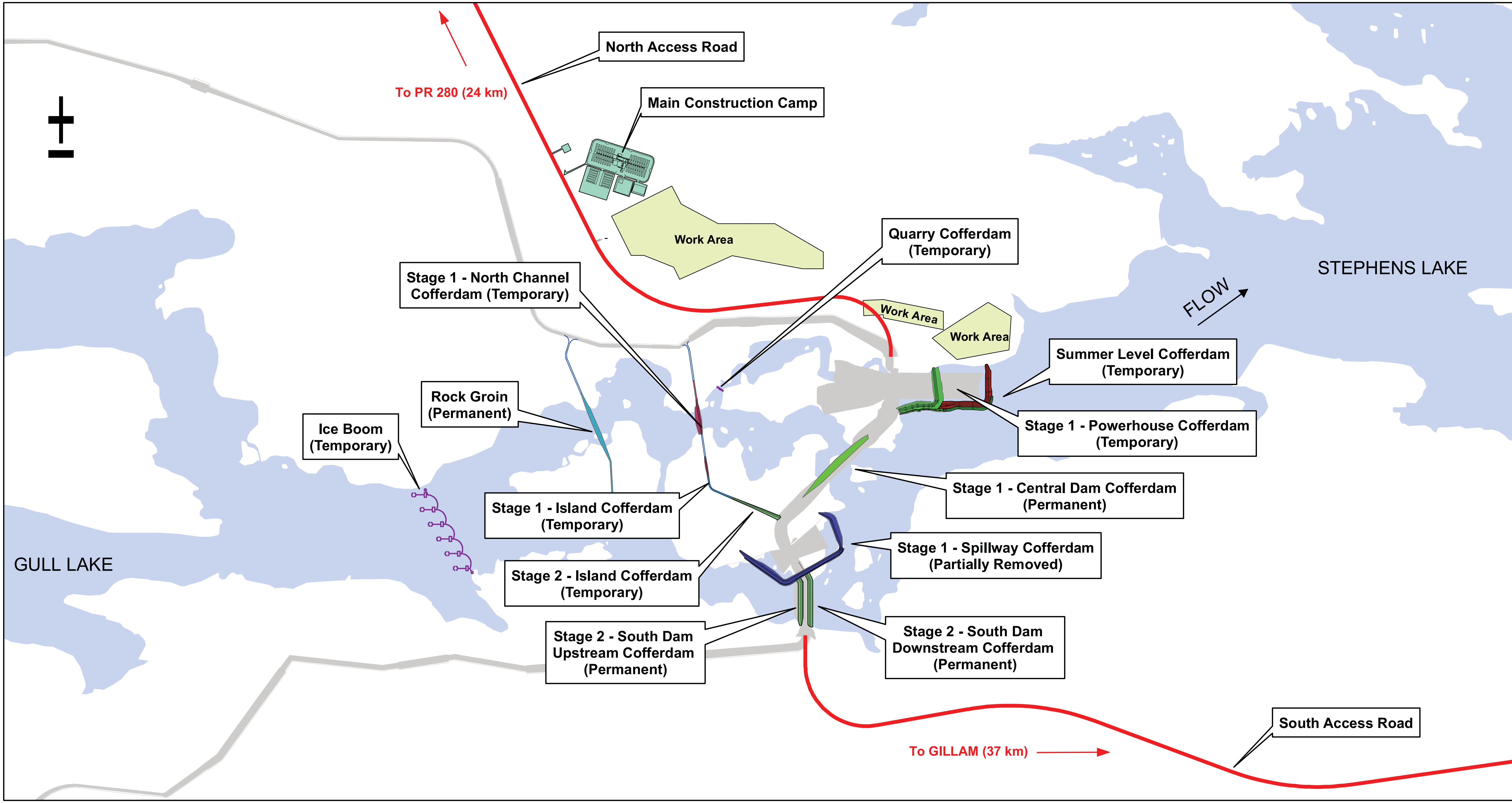
GENERAL LOCATION PLAN FIGURE 1



KEEYASK

Date: June 12/08

GENERAL ARRANGEMENT OF PRINCIPAL STRUCTURES
FIGURE 2

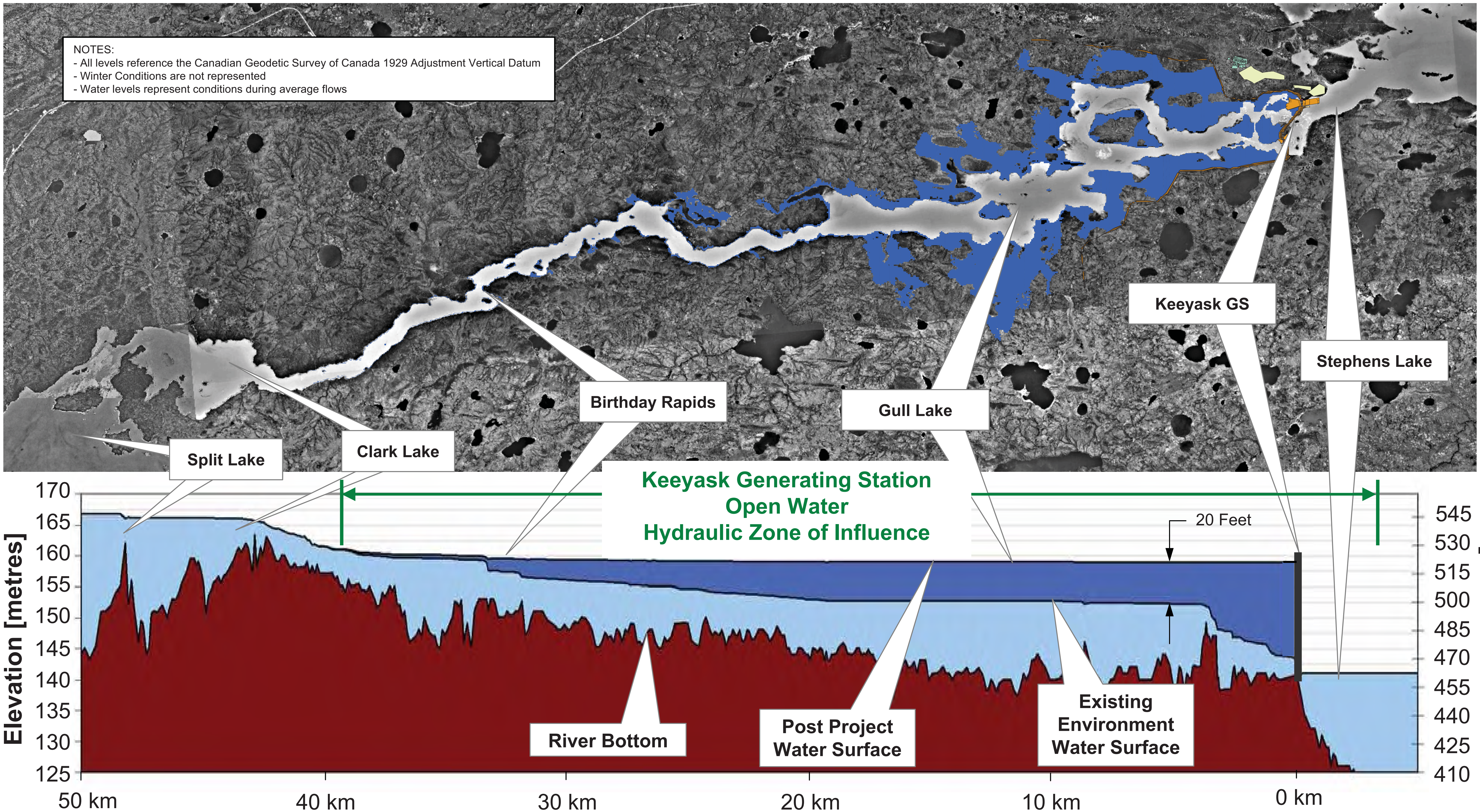


KEEYASK

0.5 0.25 0 0.5
Kilometers

Date: June 12/08

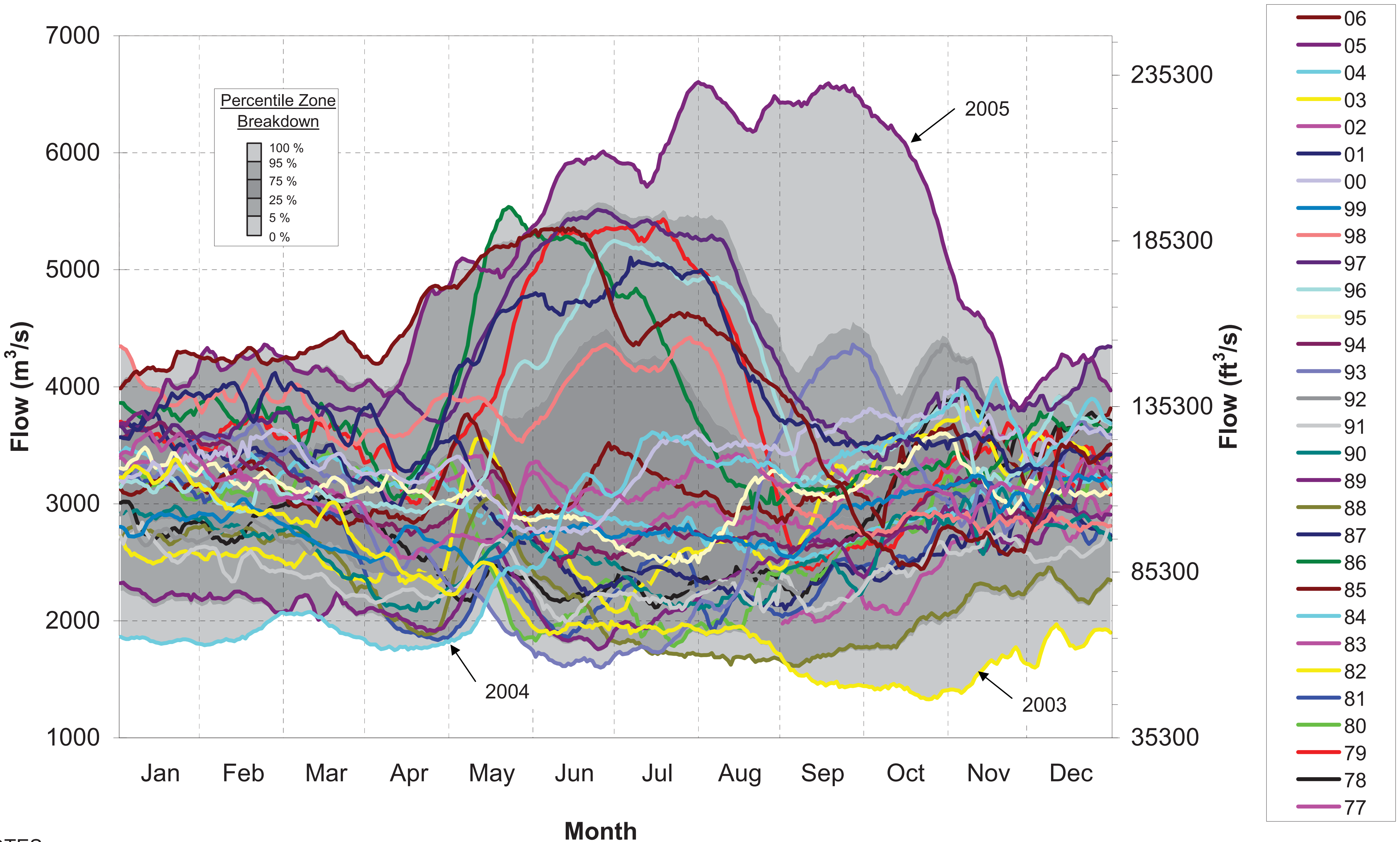
GENERAL ARRANGEMENT OF SUPPORTING INFRASTRUCTURE
FIGURE 3



KEEYASK

Date: June 12/08

WATER SURFACE PROFILES
EXISTING ENVIRONMENT AND POST PROJECT
FIGURE 4



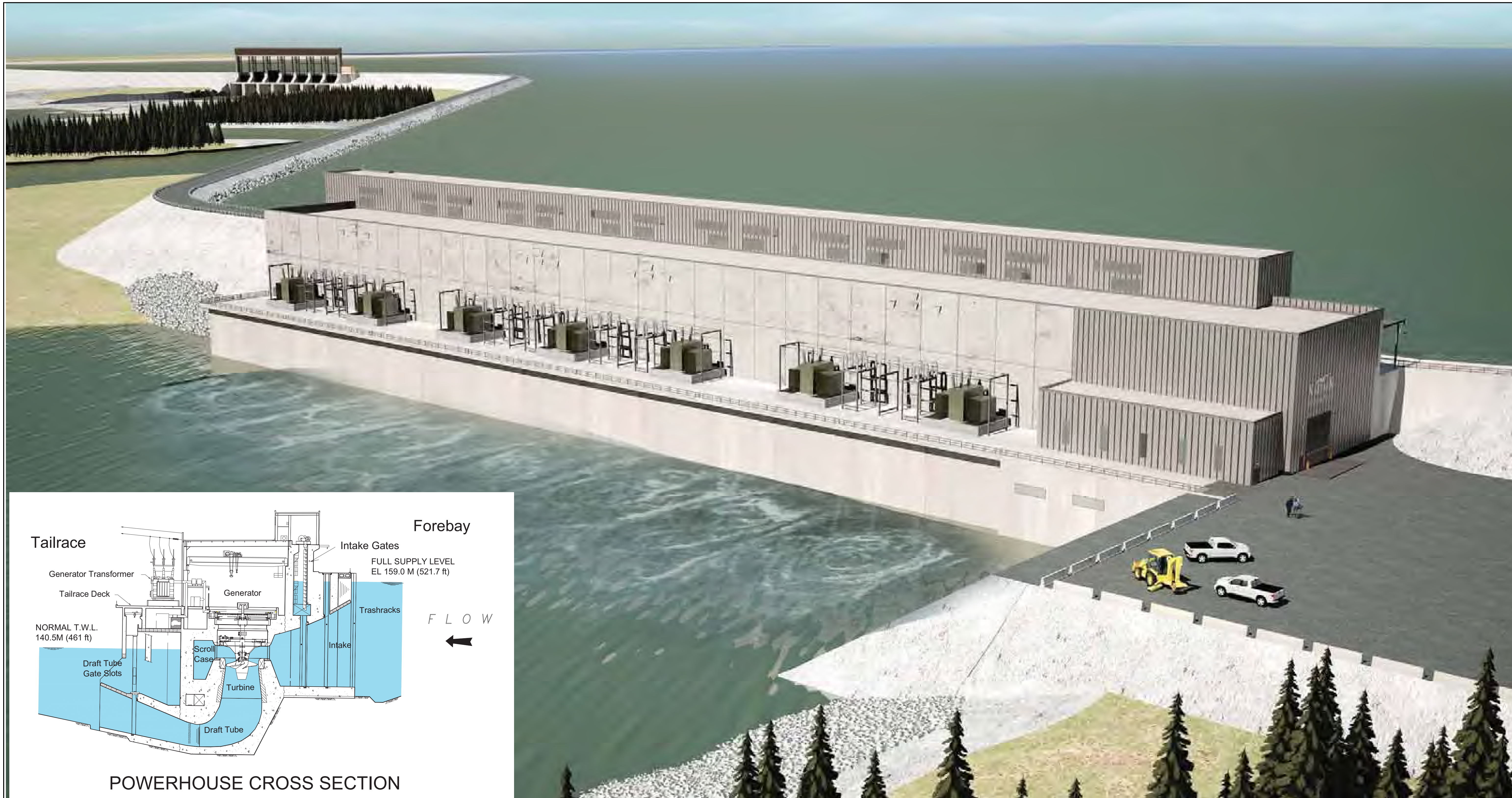
NOTES:

- Source: Split Lake Daily Outflow
- Percentile zone data Based on daily data.
- Period of record: Sept. 1977 to Dec. 2006
- Conversion: 1 foot = 0.3048 meters

KEEYASK

Date: June 12/08

HISTORICAL RIVER FLOW REGIME AT KEEYASK GS SITE FIGURE 5



POWERHOUSE CROSS SECTION

KEEYASK

Date: June 12/08

POWERHOUSE COMPLEX

FIGURE 6

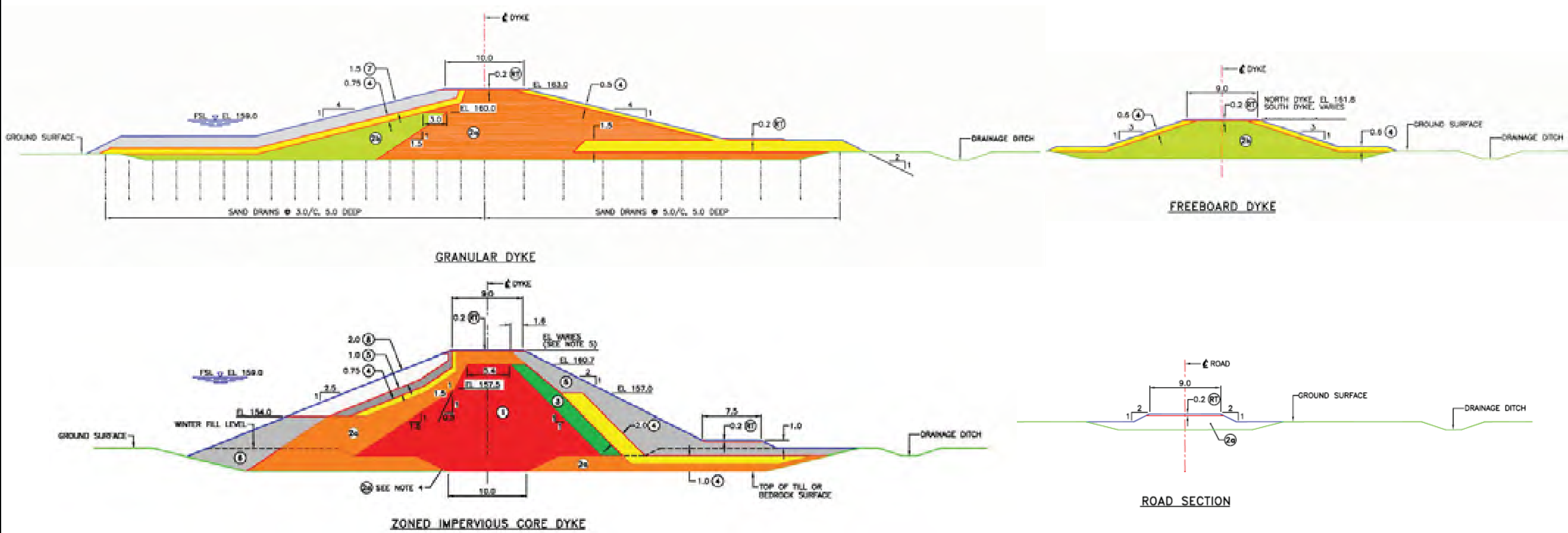
KEEYASK

Date: June 12/08

SPILLWAY

FIGURE 7

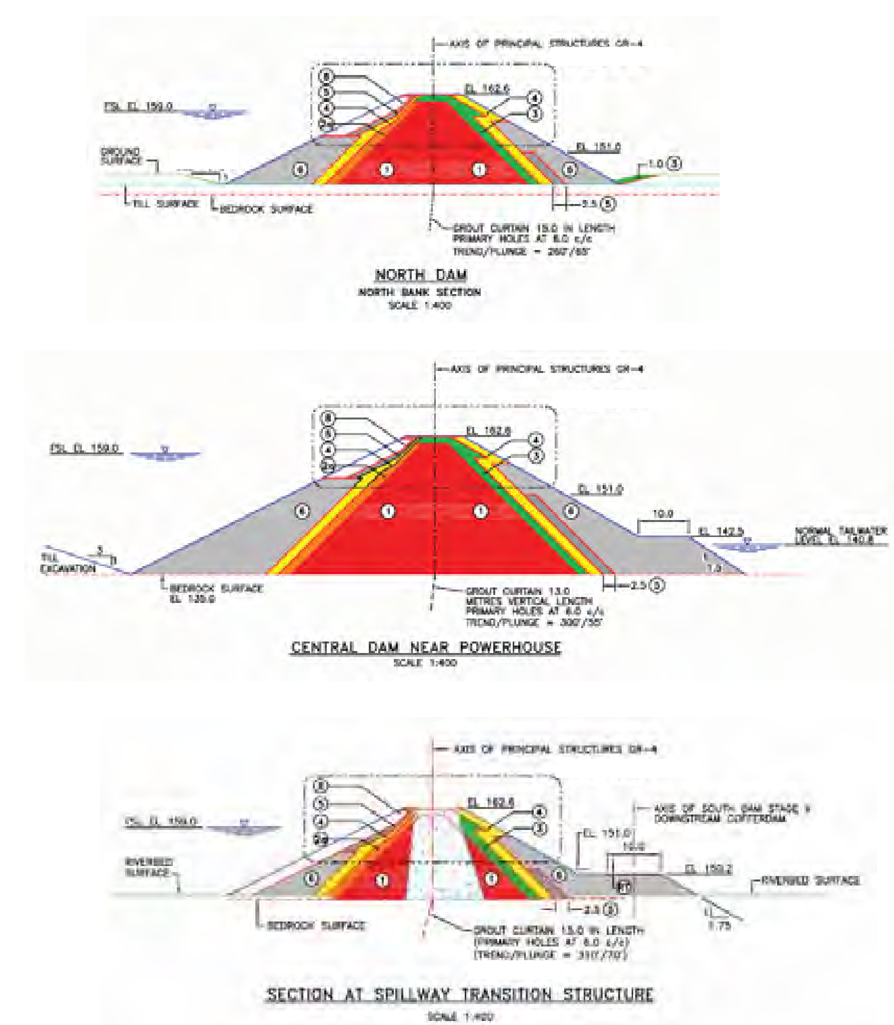
SAMPLE DYKE CROSS SECTIONS



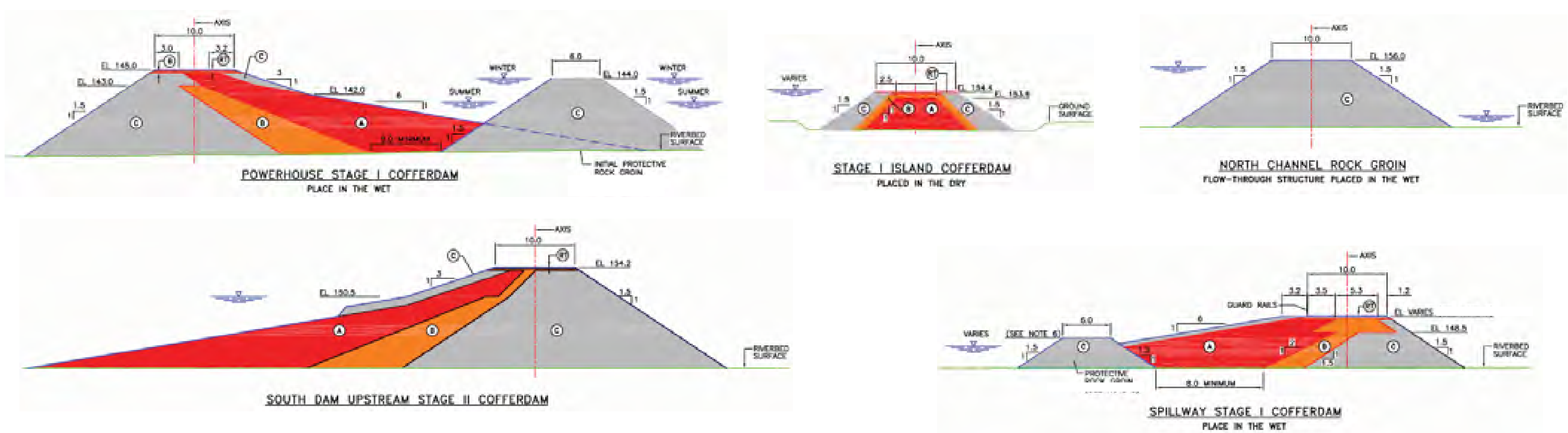
LEGEND:

- ① Ⓐ IMPERVIOUS FILL
- ②a Ⓑ PERVIOUS GRANULAR FILL
- ②b SEMI-PERVIOUS GRANULAR FILL
- ③ FILTER
- ④ TRANSITION – CRUSHED ROCK
- ⑤ RIPRAP BEDDING
- ⑥ Ⓒ ROCKFILL
- ⑦ RIPRAP (SEE NOTE 1)
- ⑧ RIPRAP
- RT ROAD TOPPING
- WATER LEVEL

SAMPLE DAM CROSS SECTIONS



SAMPLE COFFERDAM CROSS SECTIONS



KEEYASK

Date: June 12/08

DAM, DYKE, AND COFFERDAM CROSS SECTIONS FIGURE 8

ID	Name	Schedule (Year 1 – Year 10)
1	**MILESTONES (GR-4, North)**	
2		
3	Minister Announces Project	Dec 15 ◆ Minister Announces Project
4	Award Turbine Contract	Dec 15 ◆ Award Turbine Contract
5	Award Generator Contract	Jun 15 ◆ Award Generator Contract
6	Award North Access Road Contract	Dec 15 ◆ Award North Access Road Contract
7	Start North Access Road Construction	Feb 2 ◆ Start North Access Road Construction
8	Award South Access Road Contract	Oct 27 ◆ Award South Access Road Contract
9	Start South Access Road Construction	Nov 4 ◆ Start South Access Road Construction
10	Award Main Camp Contract	Dec 15 ◆ Award Main Camp Contract
11	Start Main Camp Construction	Mar 1 ◆ Start Main Camp Construction
12	Award Stage I Cofferdams Contract	Jun 14 ◆ Award Stage I Cofferdams Contract
13	Stage I Cofferdams Contractor Starts Mobilizing	Jul 14 ◆ Stage I Cofferdams Contractor Starts Mobilizing
14	Stage I Cofferdams Dewatered	Oct 3 ◆ Stage I Cofferdams Dewatered
15	Access to Centre Island Available	Nov 8 ◆ Access to Centre Island Available
16	North and South Shores Access Linked	Sep 23 ◆ North and South Shores Access Linked
17	Basic Access Road to North Shore Available	Jan 28 ◆ Basic Access Road to North Shore Available
18	Award General Civil Contract	Jun 1 ◆ Award General Civil Contract
19	General Civil Contractor - Mobilization	Jul 3 General Civil Contractor - Mobilization
20	First Concrete	Jun 2 ◆ First Concrete
21	Powerhouse Electric Overhead Travelling Crane Operational	Oct 27 ◆ Powerhouse Electric Overhead Travelling Crane Operational
22	Diversion Through Spillway	Jul 21 ◆ Diversion Through Spillway
23	First Power	Dec 21 ◆ First Power
24		
25	**INFRASTRUCTURE**	
26		
27	South Shore Infrastructure	South Shore Infrastructure
28	Site Access Road (Butnau to Site)	Nov 4 Site Access Road (Butnau to Site)
29		
30	North Shore Infrastructure	North Shore Infrastructure
31	Main Site Access Road (PR 280 to Site)	Feb 3 Main Site Access Road (PR 280 to Site)
32	Starter Camp For Infrastructure (Located by PR 280)	Jan 26 Starter Camp For Infrastructure (Located by PR 280)
33	Starter Camp For North Access Road (Located by PR280)	Jan 26 Starter Camp For North Access Road (Located by PR280)
34	Main Construction Camp - Phase I (300 Person)	Mar 1 Main Construction Camp - Phase I (300 Person)
35	Main Construction Camp - Phase II (1 200 Additional Persons)	Oct 3 Main Construction Camp - Phase II (1 200 Additional Persons)
36	Construction Power	Feb 3 Construction Power
37		
38	*Ice Boom*	Ice Boom
39	Ice Boom Construction	Jun 15 Ice Boom Construction
40		
41	**PRINCIPAL STRUCTURES**	
42		
43	River Management	River Management
44	Stage I Cofferdams Contractor Mobilization	Jul 14 Stage I Cofferdams Contractor Mobilization
45	Stage I Cofferdams	
46	Quarry Cofferdam	Sep 29 Quarry Cofferdam
47	North Channel Rock Groin	Oct 9 North Channel Rock Groin
48	North Channel Stage I Cofferdam	Oct 25 North Channel Stage I Cofferdam
49	Central Dam Stage I Cofferdam	Jul 2 Central Dam Stage I Cofferdam
50	Powerhouse Stage I Cofferdam	Jun 18 Powerhouse Stage I Cofferdam

KEEYASK

Date: June 12, 2008

Schedule: GN4_ConstrSmrySchd_D1_20070531_KJF_NR_Rev3.mpp

PRELIMINARY KEEYASK PROJECT CONSTRUCTION SCHEDULE FIGURE 9A

ID	Name	Start
51	Stage I Island Cofferdam	Jun 17
52	Spillway Stage I Cofferdam	Jun 18
53	Stage II Cofferdams	
54	Tailrace Channel Summer Level Cofferdam	Jun 16
55	Stage II Island Cofferdam	May 7
56	U/S & D/S Cofferdams for South Dam	Jul 22
57	**Removal of Powerhouse Stage I Cofferdam**	
58	- in the Dry	May 26
59	**Removal of Spillway Stage I Cofferdam**	
60	- in the Dry	May 7
61	- in the Wet	May 18
62	Removal of Tailrace Summer Level Cofferdam	Oct 11
63	Impound Forebay	Jul 3
64		
65	**Earthworks**	
66	Excavation - Unclassified	Oct 19
67	North Dam	Oct 24
68	Central Dam	May 9
69	South Dam	
70	South Dam Construction - Spillway Stage I Cofferdam	Aug 7
71	South Dam Construction - Riverbed & South Abutment	Sep 15
72	North Dyke	Jun 2
73	South Dyke	Nov 1
74	Transmission Tower Spur	Aug 18
75	Parking Lot and Access Ramp	Apr 8
76	**Spillway and Powerhouse**	
77	Excavation of Structures - Unclassified and Rock	Oct 19
78	Spillway Concrete	Jun 2
79	D/S Spillway Bridge	Jul 29
80	Spillway Rollway Concrete	Jul 4
81	Spillway Transitions and Walls Concrete	Jul 16
82	Spillway Gates	Jun 11
83	Powerhouse & Service Bay Concrete	Jun 2
84	Powerhouse Transitions and Wall Concrete	May 15
85	Intake Gates	Aug 5
86	Draft Tube Gates	Oct 26
87	Draft Tube Liner Bulkhead Domes	Aug 5
88	Superstructure Steel	Aug 20
89	Powerhouse Cranes	Sep 16
90	Turbines and Generators	Oct 28
91	Mech and Elect Installation	Jul 17
92	Decommission Construction Infrastructure	May 10
93	Unit In Service Dates	
94	First Power (Unit No. 1)	Dec 21
95	Unit No. 2	Apr 11
96	Unit No. 3	Jun 8
97	Unit No. 4	Sep 18
98	Unit No. 5	Dec 11
99	Unit No. 6	Mar 20
100	Unit No. 7	Jul 15

Date: June 12, 2008

Schedule: GN4_ConstrSmrySchd_D1_20070531_KJF_NR_Rev3.mpp

PRELIMINARY KEEYASK PROJECT CONSTRUCTION SCHEDULE FIGURE 9B

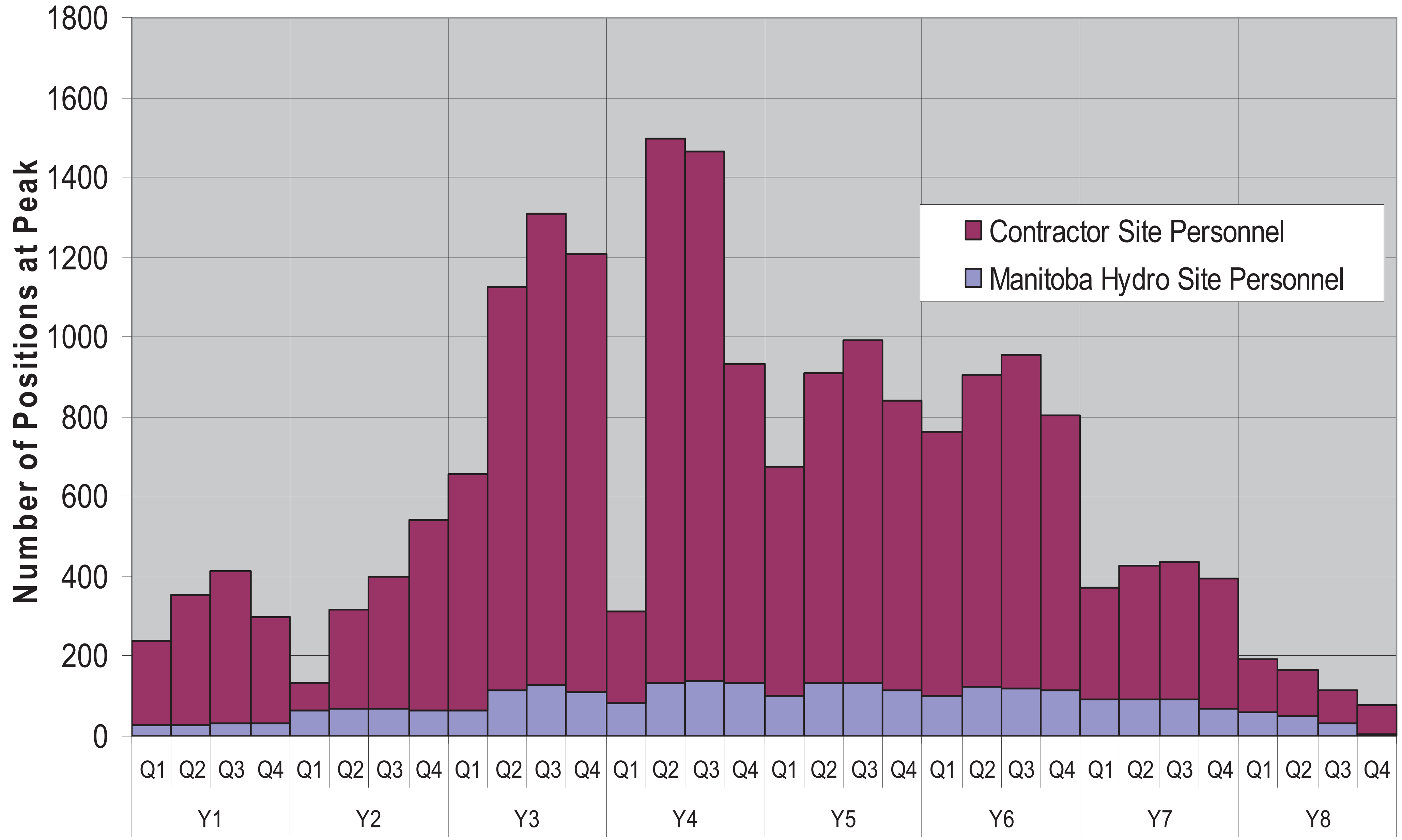
Notes:

1) The forecasts illustrated are based on Acres and Manitoba Hydro's estimates of manpower and a construction schedule based on a December, 2017 first unit in-service date.

2) The bar chart represents an estimate based on current regulations, present project plans, and experience with similar projects. Contractors will determine specific job requirements when the project is being built. Actual employment requirements will vary from the estimate presented above.

3) "Peak Site Workforce" refers to the maximum number of people on site, within the quarter specified.

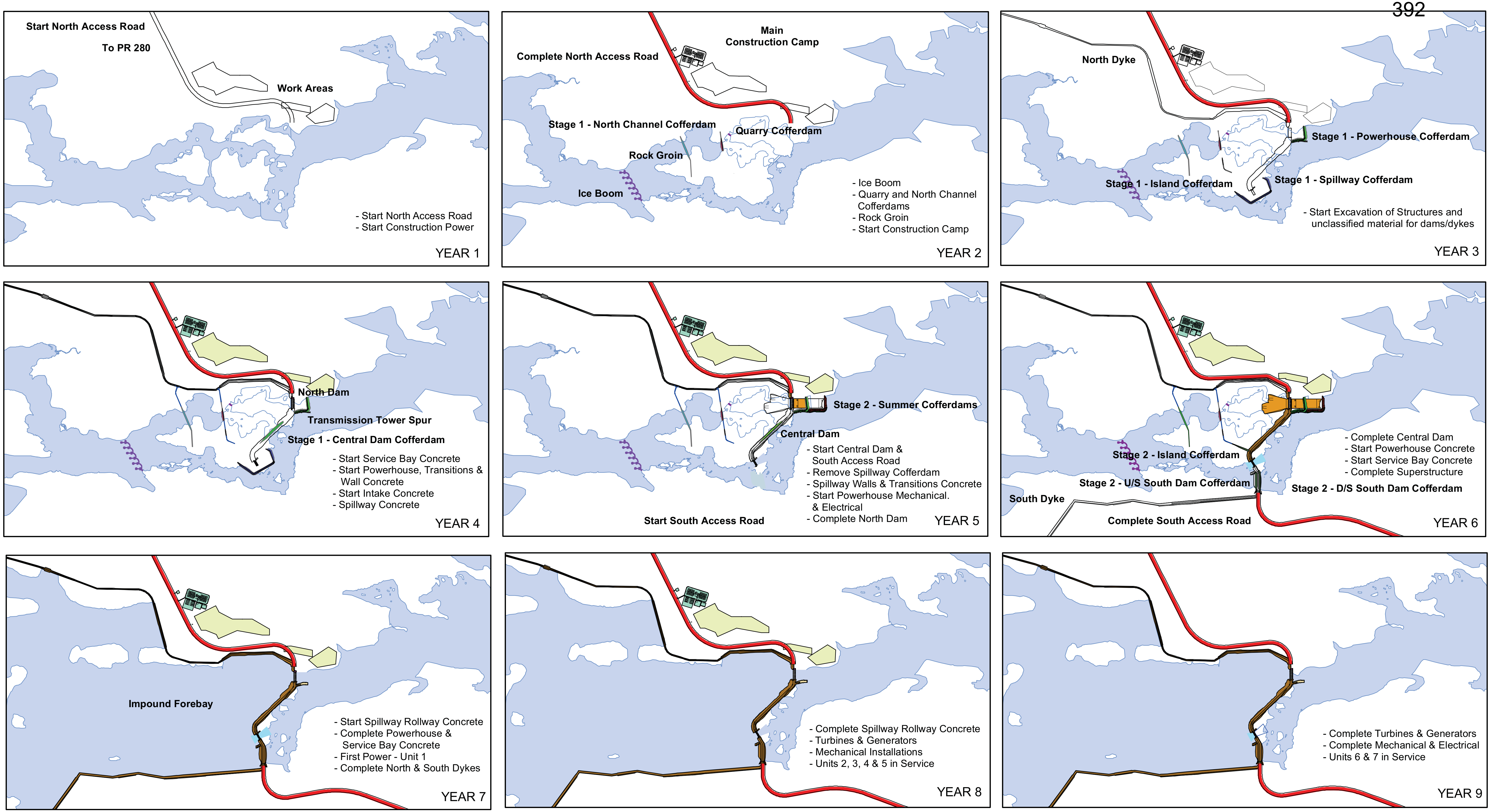
4) The bar chart illustrates contractor site personnel (including supervisory and management positions) and Manitoba Hydro site personnel. The forecasts do not include workforce for the construction of Substations and Transmission Lines.



KEEYASK

Date: June 12/08

ESTIMATED PEAK SITE CONSTRUCTION WORKFORCE BY QUARTER FIGURE 10



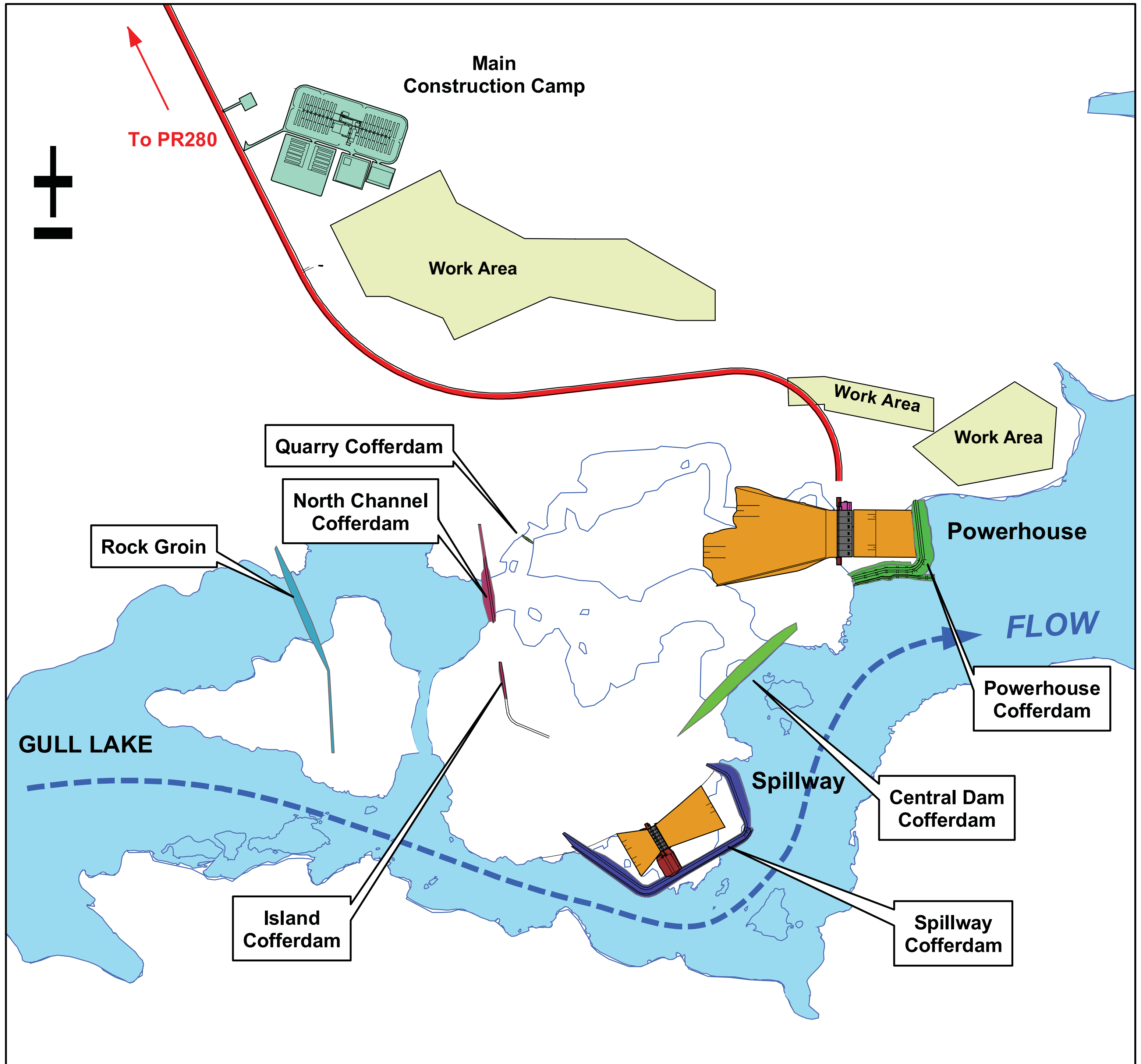
KEEYASK

1 0.5 0 1
Kilometers

Date: June 12/08

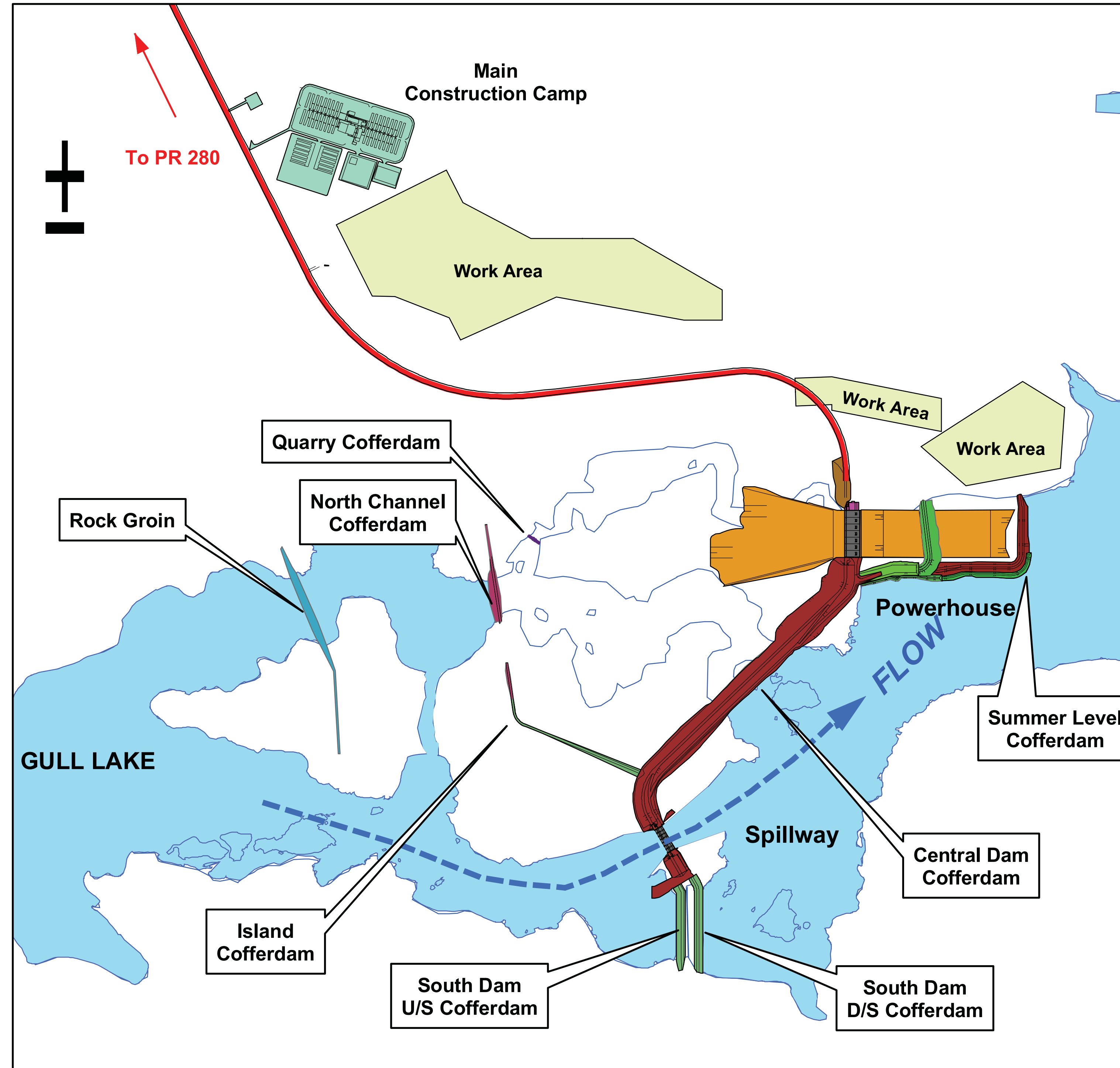
CONSTRUCTION SEQUENCE

FIGURE 11



STAGE 1 DIVERSION

YEAR 2 to YEAR 5



STAGE 2 DIVERSION

YEAR 5 to YEAR 6

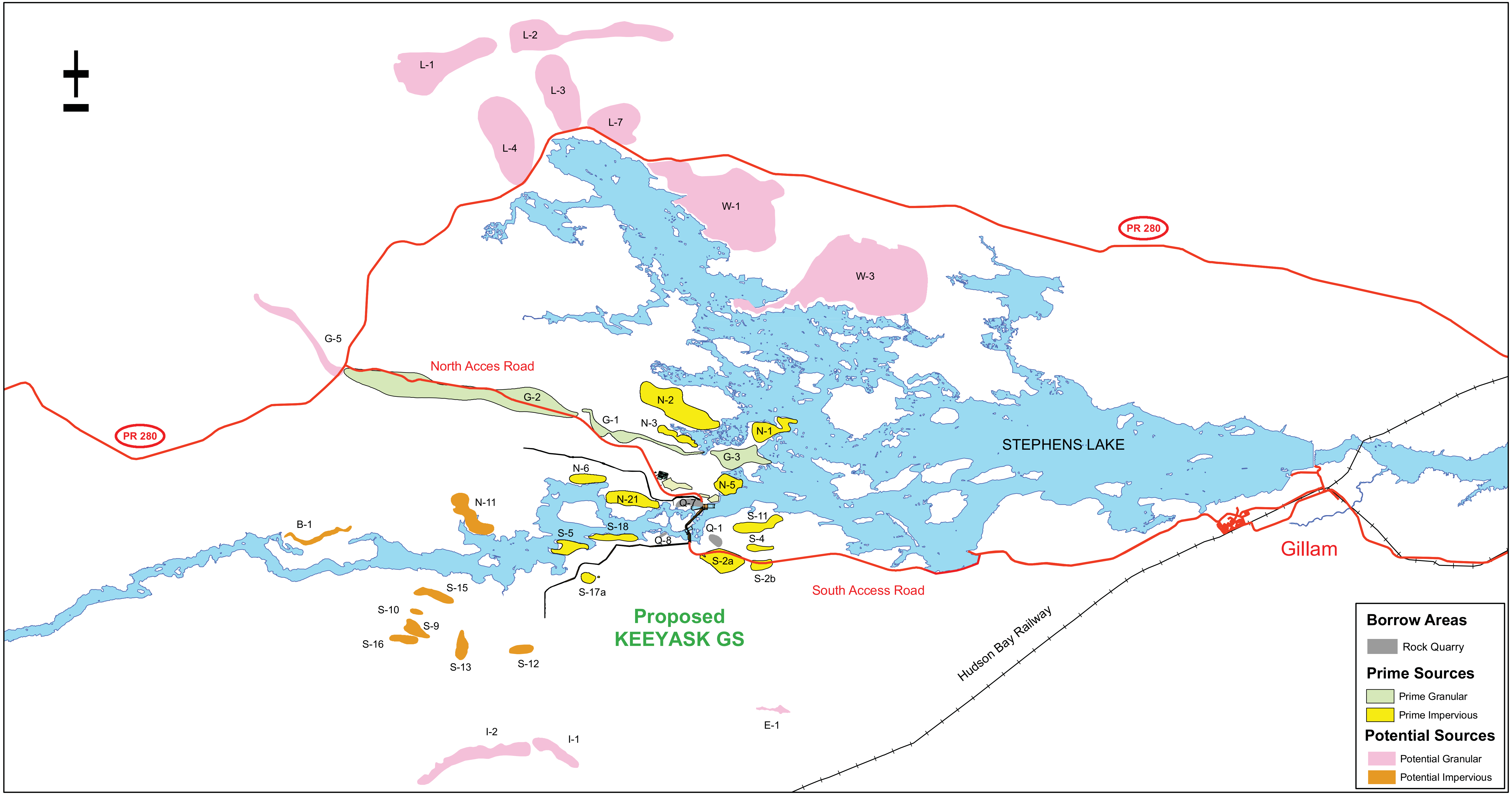
KEEYASK

0.5 0.25 0 0.5
Kilometers

Date: June 12/08

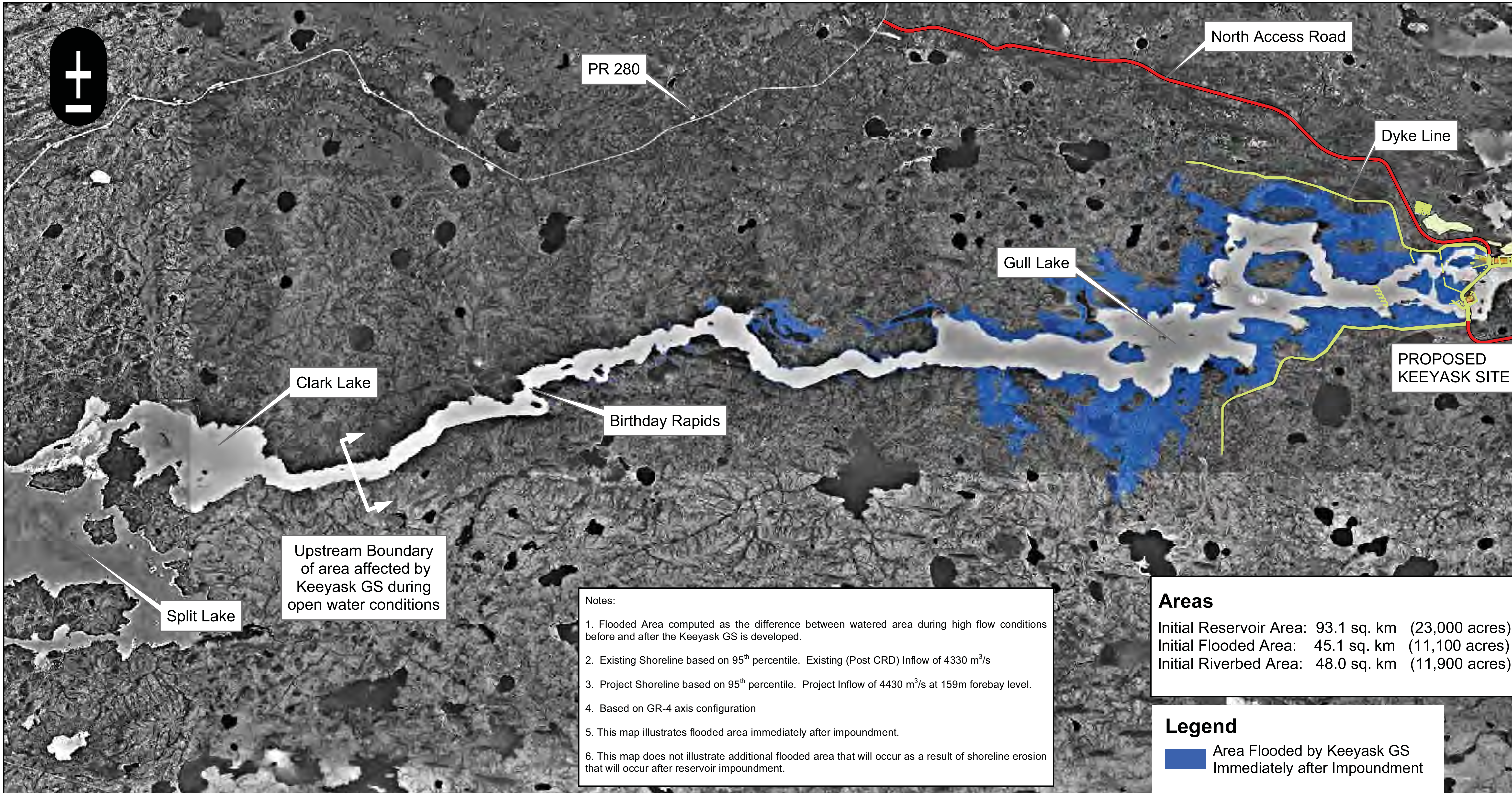
STAGE 1 AND STAGE 2 DIVERSION

FIGURE 12



Date: June 12/08

POTENTIAL MATERIAL SOURCES/ BORROW AREAS FIGURE 13



Notes:

1. Flooded Area computed as the difference between watered area during high flow conditions before and after the Keeyask GS is developed.

2. Existing Shoreline based on 95th percentile. Existing (Post CRD) Inflow of 4330 m^3/s

3. Project Shoreline based on 95th percentile. Project Inflow of 4430 m^3/s at 159m forebay level.

4. Based on GR-4 axis configuration

5. This map illustrates flooded area immediately after impoundment.

6. This map does not illustrate additional flooded area that will occur as a result of shoreline erosion that will occur after reservoir impoundment.

Areas

Initial Reservoir Area:	93.1 sq. km	(23,000 acres)
Initial Flooded Area:	45.1 sq. km	(11,100 acres)
Initial Riverbed Area:	48.0 sq. km	(11,900 acres)

Legend

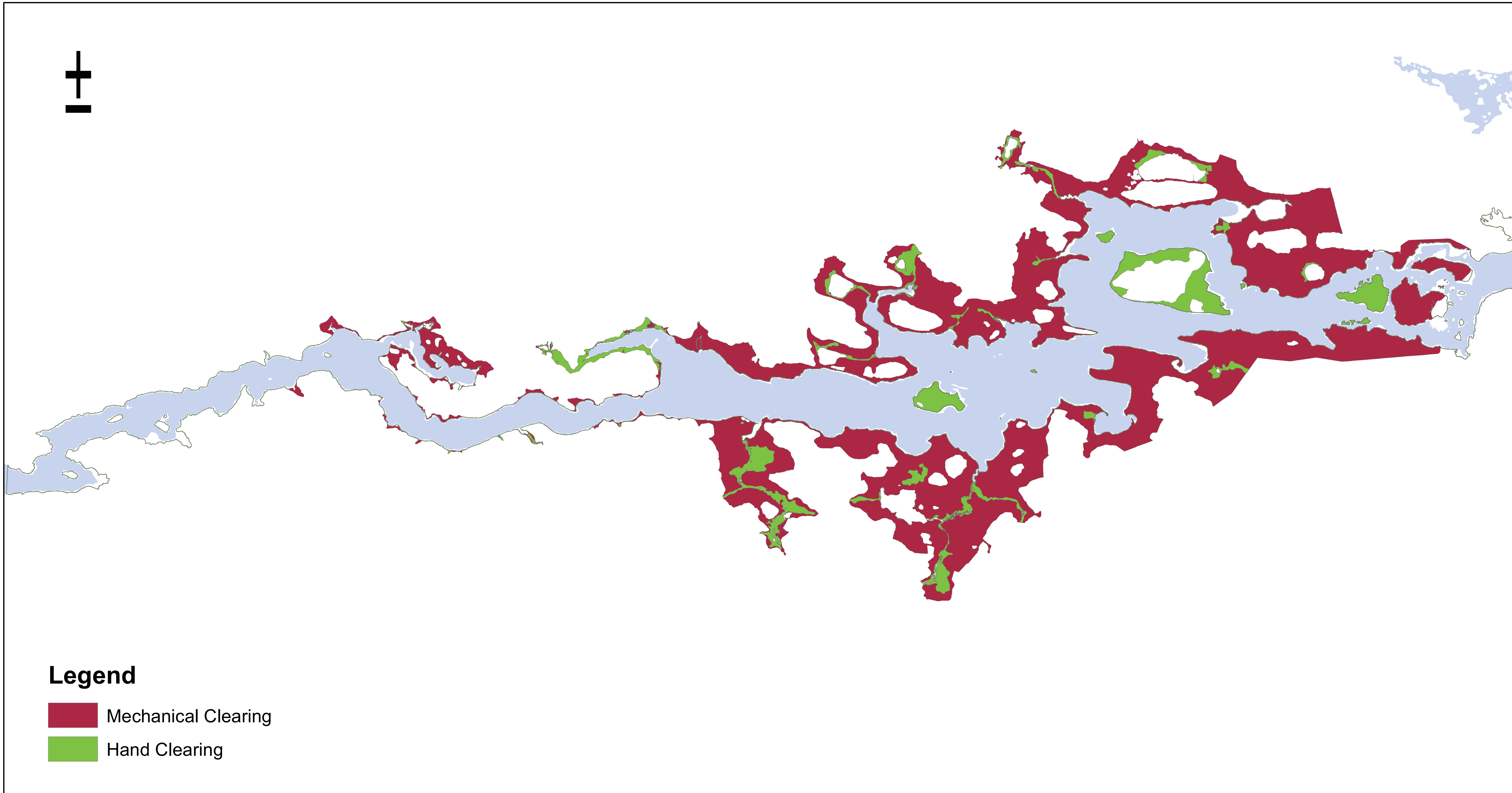
Area Flooded by Keeyask GS Immediately after Impoundment

KEEYASK

2 1 0 2
Kilometers

Date: June 12/08

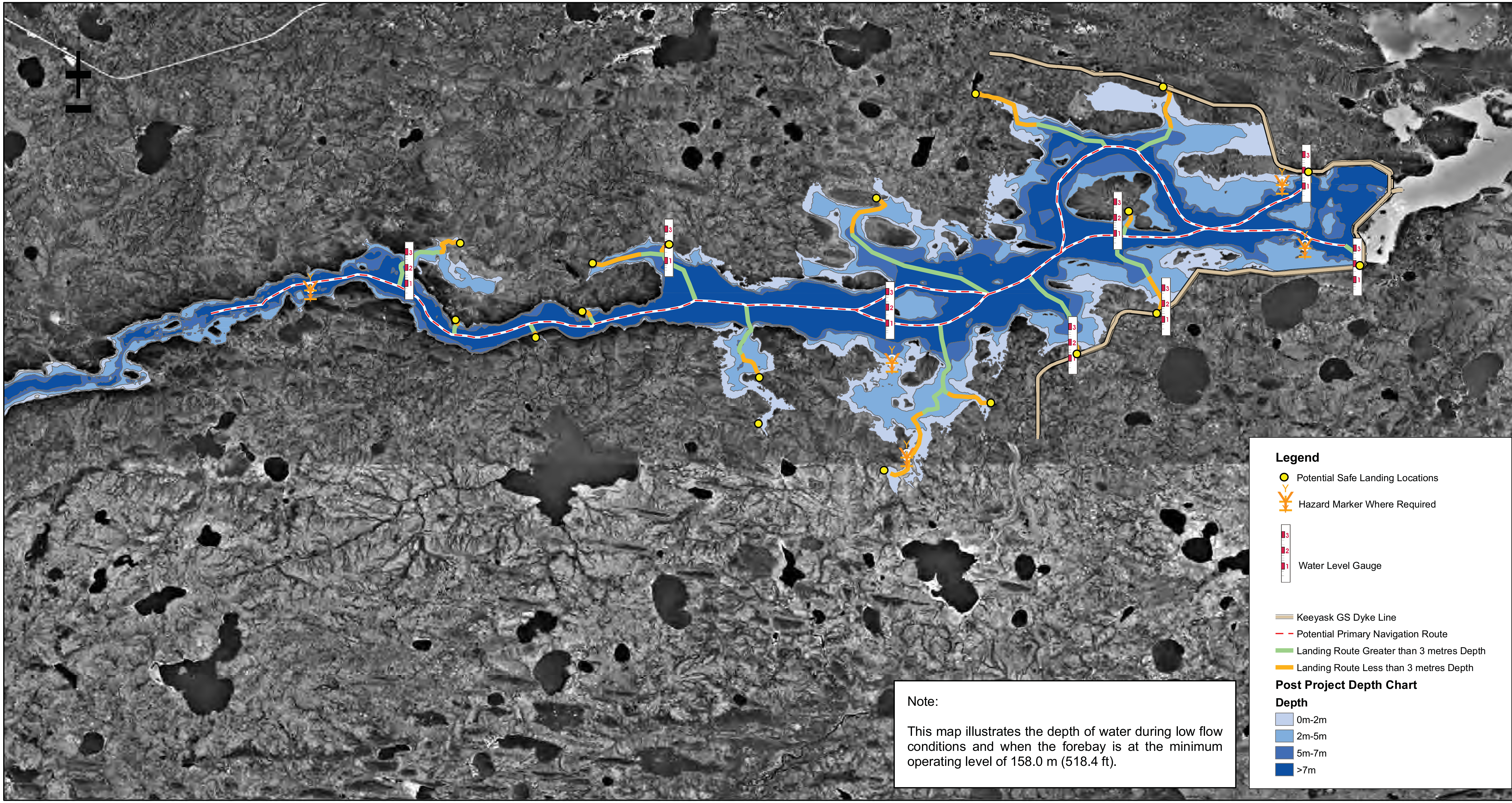
AREA FLOODED BY KEEYASK GS FIGURE 14



KEEYASK

Date: June 12/08

RESERVOIR CLEARING PLAN
AREAS TO BE CLEARED PRIOR TO FLOODING
FIGURE 15



KEEYASK

Date: June 12/08

PRELIMINARY DEPTH CHART, TRAVEL ROUTES AND SAFE LANDING LOCATIONS
FIGURE 16