


# Keeyask Generation Project

## Environmental Impact Statement

## Responses to Requests for Additional Information from TAC & Public Reviewers, Round 1

KEEYASK
Hydropower Limited Partnership

**November 2012**

KEEYASK
Hydropower Limited Partnership

2012 11 19

Environmental Assessment & Licensing Branch
Manitoba Conservation and Water Stewardship
123 Main Street, Suite 160
Winnipeg, MB R3C 1A5

Attention: Ms. Tracey Braun

Dear Ms. ~~Braun~~: Tracey

**RE: RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION REGARDING THE KEEYASK GENERATION PROJECT**

The Keeyask Hydropower Limited Partnership submitted the Keeyask Generation Project Environmental Impact Statement on July 6, 2012. Subsequent to this submission, Manitoba Conservation and Water Stewardship invited comments from the public and Manitoba government departments, and the Canadian Environmental Assessment Agency coordinated comments from the federal review team. From these comments, and in a manner consistent with the Canada-Manitoba Agreement on Environmental Assessment Coordination, Manitoba Conservation and Water Stewardship provided the Partnership with requests for additional information on September 26, 2012 and October 5, 2012.

The Partnership is pleased to respond to these requests. Our responses are contained in the enclosed binder titled "*Responses to Requests for Additional Information from TAC and Public Reviewers, Round 1*".

Keeyask Hydropower Limited Partnership
360 Portage Avenue, PO Box 815, Stn. Main, Winnipeg, MB R3C 2P4

Should you have any questions or require additional assistance, please feel free to contact Ryan Kustra at (204) 360-4334.

Yours truly,

5900345 Manitoba Ltd.
as general partner of the
Keeyask Hydropower Limited Partnership

K.R.F. Adams, P. Eng
President

KRFA/dn
*Enclosure*

c: Mr. Dan McNaughton

# KEEYASK GENERATION PROJECT
## ENVIRONMENTAL IMPACT STATEMENT

# RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION FROM TAC AND PUBLIC REVIEWERS, ROUND 1

Prepared by

Keeyask Hydropower Limited Partnership

Winnipeg, Manitoba

November 2012

Canadian Environmental Assessment

Registry Reference Number: 11-03-64144

KEEYASK
Hydropower Limited Partnership

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| **Manitoba Conservation and Water Stewardship - Water Quality** | | | | | | | | |
| 1 | MCWS-WQ | PE SV and TE SV | Section 8.0 11.0 Section 2.0 | N/A | Physical Environment | The reservoir area is in an area of permafrost. | How might the rates of shoreline erosion change under various climatic regimes and how might these relate to observed water quality conditions under the least and greatest annual temperature predicted by global climate change models for this region? Much of the reservoir area is underlain by peat, how does the proportion of peat and wetland area compare to other reservoirs in Northern Manitoba? For example proportion of wetland area is often attributed to elevated concentrations of mercury in reservoirs. | **see MCWS-WQ-0001a and MCWS-WQ-0001b** |
| 2 | MCWS-WQ | AE SV | Section 7.2 | 7-1 | Aquatic Environment | | Of particular concern is the impact of reservoir creation on the release of mercury, and bio-magnification at higher trophic levels. The environmental assessment documents show that methyl mercury concentrations in predatory fish such as walleye and northern pike are expected to increase beyond tissue concentrations that would be considered safe for unrestricted human consumption. Fish mercury concentration increases are predicted for both Stephens Lake and the proposed Keeyask Reservoir. High mercury concentrations in fish are expected to persist for up to 35 years before eventually stabilizing near a baseline concentration. Much of the information on mercury concentrations in fish tissue with time after reservoir creation is based on case studies of existing reservoirs. It is understood that fish mercury concentrations recover at different rates. Are there any reservoirs in northern Manitoba where mercury concentrations in fish have not recovered? The proponent is asked to comment on the factors that affect recovery time and why some reservoirs may not recover as fast as others? | **see MCWS-WQ-0002** |
| 3 | MCWS-WQ | AE SV | Section 7.2 | N/A | Aquatic Environment | While having provision for Keeyask Cree Nations Members to be able to eat fish from 'off-system' unaffected lakes through the Keeyask Cree Nations' Adverse Effects Agreements Offsetting Programs will help mitigate the potential for adverse effects to human health, this will not be of benefit to mitigating the impacts on wildlife consumers of fish or the fish themselves. A number of studies have attempted to quantify the impacts of elevated mercury concentrations of behaviour and survival. In particular, maternal transfer of MeHg to fish larvae may be a source of mortality. | This raises the question if the potential mercury concentrations in the Keeyask Reservoir be high enough to contribute to mortality of larval fish such as Lake Sturgeon, Walleye of Northern Pike? Other studies have documented adverse effects on behaviour of fish and wildlife that were experimentally exposed to mercury. How will mercury concentrations in wildlife be monitored and potential impacts on behaviour of fish and wildlife documented? | **see MCWS-WQ-0003** |
| 4 | MCWS-WQ | AE SV | N/A | N/A | Aquatic Environment | While the impacts to fish and fish habitat are best referred to Manitoba Fisheries Branch, the potential creation of artificial spawning grounds implies that much is known about how fish choose spawning areas and that fish would choose these constructed spawning areas. | While we cannot directly ask fish about where they would like to spawn or direct them to a newly created habitat, some comment on the relative success and failure of artificially created spawning habitat would be appreciated from the proponent as it is understood these projects are not always successful. | **see MCWS-WQ-0004** |
| **Manitoba Wildlands** | | | | | | | | |
| 5 | MBWildlands | R-EIS Gdlines | Section 4.6.3 | 4-34 | Terrestrial Environment | Section "4.6.3 Reservoir Clearing" states: "Selected locations will not be cleared if they are deemed to provide environmentally sensitive habitat." | If these non-cleared areas of "environmentally sensitive habitat" are inside the reservoir area, will they not eventually be flooded? | **see MBWildlands-0001** |

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| 6 | MBWildlands | R-EIS Gdlines | Section 4.7.3 | 4-49A | Terrestrial Environment | "4.7.3 Vegetation and Debris Management" states: "...some shoreline areas will disintegrate after initial flooding, adding approximately 7 to 8 $km^2$ to the reservoir area in the first 30 years after it is created. | Of the total reservoir area, both initially and subsequently as the reservoir expands over decades, what percentage of flooded area will be peatlands/muskeg vs. what percentage will be forested lands, etc.? | **see MBWildlands-0002** |
| **Consumers Association of Canada** | | | | | | | | |
| 7 | CAC | R-EIS Gdlines | Section 8.0 | 8-39 | Response to EIS Guidelines | It is unclear whether these lists of "ATK observations" are exhaustive and how they were selected for inclusion in the EIS. It is also unclear whether in any circumstances technical science was displaced by "ATK observations", whether further investigation was conducted when "difference or "doubt" arose, or how "difference" and "doubt" was addressed in making the mitigation, adaptive management and monitoring recommendations. A cursory review of Chapter 8 demonstrates that ATK is addressed at p.8-39 and consists only of forward looking monitoring using ATK. No reference is made to the ATK data that has been collected to date and no reference is made to where technical science and ATK "differed". This leads the reader to believe that for the purposes of this EIS, where technical science and ATK differed, technical science was privileged and new ATK will be sought in the future for the purposes of monitoring the project. | Please provide clarification with respect to how ATK and technical science were assessed with respect to each other in making decisions related to mitigation, adaptive management and monitoring. | **see CAC-0001** |
| **Ian RJ Brown** | | | | | | | | |
| 8 | Brown | AE SV | Section 1.0 | N/A | Aquatic Environment | | Please provide additional information on compensation plans for loss of sturgeon habitat and spawning and how the success of these plans will be measured once implemented. | **see Brown-0001** |
| 9 | Brown | AE SV | Section 1.0 | N/A | Aquatic Environment | | What action will be taken by the proponent if compensation plans are not successful? | **see Brown-0002** |
| 10 | Brown | AE SV | Section 1.0 | N/A | Aquatic Environment | | Please provide addition detail regarding plans to stock Lake Sturgeon. | **see Brown-0003** |
| 11 | Brown | PD SV | Section 6.0 | N/A | Aquatic Environment | | What, in detail, considerations have Manitoba Hydro given to reducing the impacts sturgeon habitat before mitigation? In other words, if a generating station is prudent in the Gull Rapids reach of the Nelson River (needs and alternatives considered in NFAT) then what are the best ways of developing this project? For example, why must the Keeyask Project result in the complete loss of Gull Rapids? Are there alternatives to the current low head dam proposal? Turbine design? | **see Brown-0004** |
| 12 | Brown | N/A | N/A | N/A | Aquatic Environment | | What, in detail, is the management strategy for lake sturgeon in the lower Nelson river? Has this strategy undergone public review? | **see Brown-0005** |
| 13 | Brown | N/A | N/A | N/A | Aquatic Environment | | What evidence is there that artificial stocking will not harm the native populations of sturgeon in MU's 3 and 4? | **see Brown-0006** |
| **Nisichawayasihk Cree Nation** | | | | | | | | |
| 14 | NCN | N/A | N/A | N/A | Project Description | | What impact will there be on system operations from the addition of the Keeyask Generating Station when combined with the Wuskwatim Project, as part of Hydro's operation of the Integrated Power System (also referred to as "systems effects" issues? | **see NCN-0001** |

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| 15 | NCN | Ex Sum | N/A | 57 | Executive Summary | | Given experience on other recent Hydro projects, why is there no VEC listed on page 57 for disturbance of heritage sites that may not be documented as a "known archaeological site" but which may be disturbed during construction? Also, why are heritage resources only defined using the definition in provincial legislation without incorporating Aboriginal concepts of sacred heritage sites, cultural property and values although it is recognized there is a discussion of the intangible nature of heritage resources (see e.g. page 1-4)? | **see NCN-0002a and NCN-0002b** |
| 16 | NCN | SE SV | Part 3 | 1-34<br>1-35 | Socio-Economy | | What is the plan for ensuring there is Aboriginal control over any finding of Aboriginal human remains and related belongings given that page 1-34 of the Supporting Volume on Socio-Economic Environment, Resource Use and Heritage Resources indicates that provincial legislation and the HRPP will prevail if "unknown heritage resources are unearthed or exposed during construction" and page 1-35 indicates that "if the human remains are determined to be non-forensic" provincial legislation and policies will be followed? | **see NCN-0003** |
| 17 | NCN | SE SV | Part 3 | 1-33 | Socio-Economy | It is acknowledged that avoidance of heritage sites may not be possible (page 1-33). | Given this assessment, why are there no mitigation measures to reduce winter construction in the areas of potential sites, along with ground truthing in advance of heavy equipment operation that may disturb such sites, both of which may help to avoid disturbance of known and unknown heritage sites? | **see NCN-0004** |
| **Manitoba Conservation and Water Stewardship - Wildlife Branch** | | | | | | | | |
| 18 | MCWS-WB | R-EIS Gdlines | N/A | N/A | Terrestrial Environment | | Throughout the document, it indicates that the CNP (Cree Nation Partnership) will develop a moose harvest sustainability plan, and later it indicates it has been developed. Has this harvest plan been developed? It also references the responsibility of the province to regulate licensed hunter harvest levels and that moose harvest within the local study area will be recorded at access gates. Will community harvest levels throughout the regional study area be monitored through ATK monitoring and identified in the moose harvest sustainability plan? It is understood that there are sensitivities around recording community harvest levels but without a good understanding of harvest levels from all resource users, it is difficult to ensure population persistence within the northern Resource Management Areas. What exactly is meant by "ATK monitoring? | **see MCWS-WB-0001** |

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| **Manitoba Conservation and Water Stewardship - Lands Branch** | | | | | | | | |
| 19 | MCWS-LB | R-EIS Gdlines | Section 8.2.5 | 8-34 | Resource Use | | Section 8.2.5 on page 8-34 states that harvesting activities conducted by domestic resource users authorized to harvest within the Project site will be monitored at the North and South access gates. Elsewhere it states that the public will be restricted from the site, workers will be prohibited from possessing firearms on the site, hunting by workers will be prohibiting in the project site etc. The first line seems to imply that domestic hunting will be permitted in the project site. If so will this be open to all Treaty Indians, only those living near the Project area or I am misreading the line entirely? | **see MCWS-LB-0001** |
| 20 | MCWS-LB | R-EIS Gdlines | Section 8.2.5 | 8-34 | Resource Use | | This page also states that the CNP has developed moose and fish harvest sustainability plans to address the long-term sustainability of these species in the Split lake RMA in cooperation with the Split Lake Resource Management Board. Have these plans been developed? The NE region agrees that plans like this should be developed with the RMB; however are not aware of any completed plans as stated in the EIS. | **see MCWS-LB-0002** |
| 21 | MCWS-LB | SE SV | Section 1.5 | 1-85 | Terrestrial Environment | | There was no mention of how timber will be disposed of. Is the plan to utilize any of the timber (firewood or otherwise) or will it burned? Will the stumps (root systems) be left in place to slow erosion or will they be removed to reduce debris in the forebay? The EIS calculates "Project Forest Damage Appraisal and Valuation (Table 1-10) based on impacts and timber dues to be paid for timber removal within the Forest Management Unit 86, but not for timber removal outside the FMU in the non-commercial timber zone. As a major portion of this project exists outside FMU 86, Manitoba Conservation and Water Stewardship holds the option to assess Forest Damage Appraisal and Valuation on this portion of the project footprint. Bruce Holmes, NE Region Forestry Manager has raised the same concerns. | **see MCWS-LB-0003** |

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| 22 | MCWS-LB | R-EIS Gdlines | Section 8.2.5 | 8-34 | Resource Use | | The EIS focuses almost entirely on monitoring and mitigation during construction and points out that it is Conservation and Water Stewardship's responsibility to monitor harvest when the GS goes into operation and the new Highway 280 access is opened to the public. That may be true however: harvest of wildlife, particularly moose will be of greater impact when the road is opened to the public and there should still be some responsibility for the developer to provide monitoring to accurately determine what that impact is. Little mitigation and no monitoring is planned for moose (8.2.5 page 8-34). Moose is an important big game species to the KCN. To me this seems like a perfect opportunity to monitor the effects of a development like this on moose. A preconstruction survey, a survey at the conclusion of construction and a survey 5 years post construction will provide important information on effects to moose at various critical stages. I believe the EIS underestimates the impacts of harvesting by domestic and recreational harvesters once access is open to the public. Alternate Access Programs will not significantly reduce domestic harvest in the project area and the area will reach an equilibrium similar to the surrounding road accessible area in a short time. Please provide additional information regarding the monitoring of wildlife once access is open to the public. | **see MCWS-LB-0004** |
| 23 | MCWS-LB | R-EIS Gdlines | Section 6.7.3.2.1 | 6-538 | Terrestrial Environment | | The EIS refers to the Access Management Plan. (see AMP) is referenced many times such as in section 6.7.3.2.1 page 6-538 . Does the AMP exist or is still to be developed? | **see MCWS-LB-0005** |
| 24 | MCWS-LB | R-EIS Gdlines | Section 4.7.5 | 4-50 | Terrestrial Environment | | A reference to the proposed status could not be found for PR 280 east from its junction with the North Access road once the new route to Gillam is opened. Will the old 280 that runs north of Stephens Lake be decommissioned? This should be determined as it will have a significant impact on overall harvesting levels and it'd closing may offset any increased harvest created by the new access. | **see MCWS-LB-0006** |
| 25 | MCWS-LB | R-EIS Gdlines | Section 6.4.6.2.1 | 6-274 | Resource Use | | Section 6.4.6.2 - The list of Construction Effects is thorough. The EIS states that "there is no potential for an increase in fish mortality due to harvesting by Aboriginal members of the workforce. Due to restrictions within the construction site and the prohibition on bringing personal boats on the site, workers will not be able to access the areas where sturgeon will be vulnerable to harvest." Is this meant to include Aboriginal people who are not members of the work force? The EIS is not clear on whether or not road access to the Gull Lake/Keeyask area will be restricted to only members of the work force and that Aboriginal harvesters will not be allowed to access the site by road for the purpose of harvesting. | **see MCWS-LB-0007** |

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| 26 | MCWS-LB | SEE-RU-HR SV | Part 2; Section 1.8.3.2 | 1-97 | Resource Use | | Adverse Affects Agreements - The Cree Nation Partners Keeyask Environmental Evaluation describes the Offsetting Programs under the Adverse Affects Agreements. The objective of the Healthy Food Fish Program is to "provide opportunities for Members to continue to fish and to provide a supply wholesome fish to Members in order to replace fish that may no longer be safe to consume as a result of increased methyl-mercury levels caused by the Keeyask Project." Two of the lakes identified in Map 6 are allocated to an existing commercial use. Dunlop's Fly-in Lodge and Outposts is licenced to operate a 24 bed fishing lodge on Waskaiowaka Lake and a six bed outcamp on Pelletier Lake. The Supporting Volume on Socio-Economic Environment, Resource Use and Heritage Resources, Part 2 Resource Use, Section 1.8.3.2 Lodges describes this lodge and outcamp. Section 1.8.4.1 describes the potential impacts on the lodge's operations. In each case the EIS notes that "No mitigation is planned". Section 1.8.4.3 Residual Effects continues to describe the likely effects on this commercial operation and again indicates that "No mitigation is planned." Since the Healthy Fish Program is clearly identified as only being necessary because of the impacts of the project and because the resulting program is predicted to have impacts on the lodge operation, it is not reasonable to conclude that No mitigation is planned is an acceptable position for the EIS to take. The EIS does not mention whether or not the lodge owner has even been advised of the Healthy Food Program. An impact on this operation arising from the project is anticipated in the EIS. It should be comparatively simple to devise mitigation strategies that cover the range of impact that may actually occur. The proponent should be required to develop and implement measures to mitigate these impacts. Please provide additional information on mitigation as it relates to impacts on lodge operations. | **see MCWS-LB-0008** |

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| 27 | MCWS-LB | R-EIS Gdlines | Section 6.7 | N/A | Resource Use | | Fish Suitability Plan - The Evaluation also notes that TCN, with Hydro, is developing a Fish Sustainability Plan to ensure the long-term conservation of our fish population. The plan is also referenced in Section 6.7 of the Response to EIS Guidelines. While the Fish Sustainability Plan should be a valuable tool for ensuring the sustainability of fishing activities under this program, it should be noted that under 1992 Agreement between Canada, Manitoba Split Lake Cree Nation and Manitoba Hydro on the implementation of the Northern Flood Agreement the Split Lake Resource Management Board has the mandate for Resource Planning in the Split Lake Resource Management Area. The Response to EIS Guidelines states The AEAs provide for coordination with and annual reports to the Resource Management Boards with respect the management and administration of the AEA offsetting programs. The Fish Sustainability Plan should be developed and implemented through the Resource Management Board, not developed independently and then presented to them as finished product, unless the RMB decides that is the way it wants to implement its Resource Planning mandate. Please provide additional information on The Fish Suitability Plan as it relates to the mandate of the Resource Management Board | **see MCWS-LB-0009** |
| 28 | MCWS-LB | R-EIS Gdlines | N/A | N/A | Resource Use | | Should be noted that although a Draft Fish Sustainability Plan has been presented to the Split Lake Resource Management Board, it does not appear certain that this plan represents the way that fish will be harvested or the mechanism by which they will be managed. The First Nations have many options available to them on how to best implement their Offsetting Programs and it should be recognized that the means presented in the Draft Plan may not be the way that they choose to proceed. Again, the Resource Management Board should be identified as having more of a role in the development and implementation of this plan. There should be more recognition that the Offsetting Program may change over time as the First Nation adjusts it to meet the emerging needs of its people, and that the Sustainability Plan will also need to adjust to reflect the changes in the Program. | **see MCWS-LB-0010** |

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| 29 | MCWS-LB | AE SV | Section 6.0; Table 6-2 6-3 | 6-58 6-60 | Aquatic Environment | | Supporting Volume on Aquatic Environment - Section 6 Alternative Means, Design, Mitigation provides a readable summary of design considerations and the rational for the choices made. Table 6.2, Summary Table – Aquatic Environment – Alternative Means and Mitigation Measures – Upstream of Generating Station and Table 6.3 – Downstream of Generating Station, both provide an excellent summary of measures considered and adopted. The description of Potential Effects, options, considerations and recommendations is sufficiently detailed to provide confidence that effects and their mitigation options have been identified. Section 6.13.1 Aquatic Environment concludes with the statement On-going discussions with MCWS and DFO may identify modifications to the design of recommended measures or determine additional mitigation measures that will be implemented as part of the Project. The review of the proposed ongoing monitoring and the process for making decisions on the need for and suitability of the proposed and additional mitigation options should be described with attention to the structure by which Conservation and Water Stewardship will interact with CNP and Manitoba Hydro. Please provide additional detail with respect to the proposed ongoing monitoring and mitigation process as it relates to the interaction of the Province and CNP. | **see MCWS-LB-0011** |

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| **Canadian Environmental Assessment Agency** | | | | | | | | |
| 1 | CEAA | AE SV | Section 1.2.2.4 | 1-8 | Aquatic Environment | 1.2.2.4 - selection of VECs - Considering the importance of the benthic community to fish populations, should it be included as a VEC? | Please confirm. | **see CEAA-0001** |
| 2 | CEAA | AE SV | Section 4.0 | 4-21 | Aquatic Environment | Changes to trophic levels in Stephen's Lake area, aquatic macrophytes. Page 4-33 states aquatic plants and attached algae downstream of coffer dams and excavation areas may be somewhat negatively affected. Page 4-34 then states based on a low rate of deposition, downstream sedimentation is not expected to have a measurable effect on vegetation. | Please clarify the potential down stream effects to vegetation by TSS. | **see CEAA-0002** |
| 3 | CEAA | AE SV | Section 6.0 | 6-29 | Aquatic Environment | 6.4 Project Effects - In the list of potential effects it appears the following are missing: disruption of rearing and feeding habitat, and disruption of movement between Gull Lake and Stephens Lake. | Please provide a rationale why these project effects were not included in the list. Consider adding to project effects list. | **see CEAA-0003** |
| 4 | CEAA | R-EIS Gdlines | Section 7.0 | 7-30 | Terrestrial | Cumulative Effects assessment - Linear Feature Density discrepancy between Section 7.5.2.2.3 Mammals and Section 7.5.2.3.1 Habitat, Ecosystems and Plants | On page 7-30 linear feature density is not expected to change. However on page 7-32 under Intactness linear feature density will increase in the regional study area. These statements are contradictory. Please clarify. | **see CEAA-0004** |
| 5 | CEAA | Map Figure Folio | Section 4.0 | Map 4-10 | Terrestrial | Biophysical Environmental Mitigation Areas Map - A potential high quality wetland area identified on the map will be fragmented by the south access road development. The road location has the potential to impact the wetland mitigation. | Please provide a rationale for developing the wetland mitigation in an area that is also identified for the development of proposed south access road corridor. | **see CEAA-0005** |
| 6 | CEAA | R-EIS Gdlines | Section 4.6.1 | 4-33 | Project Description | Sequencing of Project Phases Figure - Figure 4-5 is not presented in the EIS document as stated (Relates to timing sequences). | Please provide or refer the reviewer to the location of the Figure in the EIS. | **see CEAA-0006** |
| 7 | CEAA | R-EIS Gdlines | Section 4.2 | 4-6 | NFAT | There is no consideration of a "No GO scenario" as required in the EIS Guidelines. | Please provide justification or refer the reviewer to the relevant section of the EIS. | **see CEAA-0007** |
| 8 | CEAA | R-EIS Gdlines | Appendix 1B | 1B-1 | Approvals | Applicable Legislation - The *Canadian Environmental Assessment Act* has applicability to the entire project as proposed. It is not clear what the "Town Centre Complex Project" is referring to. There is no mention of the Federal *Species Act Risk Act* or the Federal *Migratory Birds Convention Act* and its applicability to the project. | Please be aware of the applicable federal legislation. | **see CEAA-0008** |
| 9 | CEAA | R-EIS Gdlines | Section 4.78 | N/A | Project Description | Assessment of Accidents and Malfunctions - There is no assessment of the effects of accidents and malfunctions as required in the EIS Guidelines. There is little discussion on contingency and emergency response procedures developed in the event of an accident or malfunction. The EIS does not include a list of emergency response plans to be developed and implemented over the life of the project. | Please provide this information. | **see CEAA-0009** |
| 10 | CEAA | R-EIS Gdlines | Section 6.2.3.2.5<br>Section 6.2.3.4.8 | N/A | Physical Environment | EIS Guidelines required the proponent to provide the present mercury and methylmercury data and analysis in soil. The is very little detail provided. | Please provide this information. | **see CEAA-0010** |

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| 11 | CEAA | PI SV | Section 2.2.2.3 | 2-8 | Public Involvement | The EIS refers to materials that will be submitted at a later date, either as part of a supplemental filing, (e.g. material that will be related to Round Three of the Public Involvement Program) or other information that may be collected in future (e.g. study on use of the area by the Metis, under negotiation). There is some uncertainty about the information that will be available for public review and for review by regulators before the completion of the environmental assessment. | Besides the responses to Information Requests arising from this initial review of the EIS, list all other studies, information, or reports that the proponent is planning to include as part of supplemental filing before the conclusion of the EIS review phase, and the estimated date of filing this information. | **see CEAA-0011** |
| 12 | CEAA | PI SV | Appendix 1B<br>Appendix 1C | 1B-1<br>1C-1 | Public Involvement | The tables list the events held and the comments received from groups during workshops, open houses, and meetings. Other meetings or contact with Cross Lake/Pimicikamak First Nation are not included in this listing, presumably because the information about the Keeyask project occurred in a slightly different context (CLFN/PCN - Article 9 discussions under the NFA). Although this was provided in a different context, it would be helpful to have the relevant information also included in the summary table, for the purpose of sorting and comparing. | Include the CLFN/PCN information (now currently noted in Appendix 4) and other groups in the table for sorting and comparison purposes. | **see CEAA-0012** |
| 13 | CEAA | PI SV | Appendix 1B<br>Appendix 1C | 1B-1<br>1C-1 | Public Involvement | Table 1 is sorted alphabetically by group; Table 2 is sorted alphabetically by issue. | For presentation in the document, it is recommended that a consistent format be used or state why the format was changed. For sorting electronically, please make these available on request as a non-pdf file. | **see CEAA-0013** |
| 14 | CEAA | SE SV | Part 2: Resource Use<br>Section 1.2.2 | 1-7 | Socio-Economy | CEAA requires consideration of environmental effects, including the effects of changes to the environment on the current use of lands and resources for traditional purposes by aboriginal persons. The EIS notes that the effects on domestic resource use are predicted for KCN communities only, and therefore the primary mitigation involves the effective implementation of the Adverse Effects Agreement offsetting programs (see as an example p 1-27, s. 1.2.4.1.1 Domestic Fishing Construction Phase Effects and Mitigation) which apply only to the KCN communities and members. Use in the Local Study Area by other Aboriginal groups has not been identified through the Public Involvement Program; however, the EIS also acknowledges that this information may be outstanding, in that there are ongoing discussions with the MMF and CLFN/PCN regarding how the resources are used by those communities. Further, notes from the PIP meeting with Shamattawa indicate that this community believes that their treaty rights may be impacted, implying effects to resource use. Finally, the proponent acknowledges that contact with some potentially affected Aboriginal groups has not been completed. The extent of hunting and fishing by Aboriginal groups or persons other than the KCN communities or members is not identified 'to date.' | We require further information to confirm the extent of use (or lack of use) for traditional purposes by Aboriginal persons of the resources likely to be affected by the project. If further information is collected indicating resource use by Aboriginal persons not party to the Adverse Effects Agreements, assess these effects and describe measures that will be undertaken to mitigate effects to current use of lands and resources by Aboriginal persons not party to the Adverse Effects Agreements off-setting programs. | **see CEAA-0014** |
| **Department of Fisheries and Oceans** | | | | | | | | |
| 1 | DFO | AE SV | Section 3.3.2.3.1 | 3-15 | Aquatic Environment | "Biological components of the aquatic habitat were based on the period during which field studies conducted in the area, generally between 1997 and 2006. This period included both high and low flows, and therefore would indicate interannual variability related to flows." | Detailed background reports to support statements regarding interannaul variability have not been provided in the EIS. These should be made available for review. | **see DFO-0001** |

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| 2 | DFO | AE SV | Section 3.3.1<br>Section 3.3.2 | 3-11<br>3-12 | Aquatic Environment | "No analysis of trends in aquatic habitat was conducted, since the water regime was established in 1977 and has been operated within set bounds since that time." | However, has aquatic habitat and changes in fish stocks changed since 1977, despite apparent constancy in water regime? Moreover, habitat changes were not actually assessed to support this claim. Can the existing environment be adequately portrayed if not assessed/sampled? This also does not account for natural changes in habitat with flow events outside of regulation. For example, a flow/ice event approximately 10 years ago changed the flow patterns at Gull Rapids, creating a new channel that flows northeast to Stephens Lake. Please consider the entire period of record for analyses. | **see DFO-0002** |
| 3 | DFO | AE SV | Map 3A-3 | N/A | Aquatic Environment | "Substrate composition could not be determined immediately upstream, within, or downstream of rapid sections due to safety concerns. " | Please define "immediately". Substrate composition be should be confirmed in the dewatered areas in Gull Rapids prior to any construction. Resolution should be similar to that already conducted in the vicinity of Gull Rapids. This information is crucial for proper accounting of habitat destruction in the rapids. | **see DFO-0003** |
| 4 | DFO | AE SV | Section 3.3.2.3.1 | 3-15 | Aquatic Environment | "For the purposes of predicting habitat conditions in the post-Project environment and quantifying areal changes in habitat area between the pre and post-Project environments, conditions at 95th percentile flow (pre-Project) and full supply level (FSL) in the reservoir post-Project were used. " | This analysis is incomplete. While the 95th percentile accommodates the majority of flows, changes in fish habitat at lower flows are not shown and may be more crucial. Moreover, the 95th percentile flow will be relatively uncommon. The 50th percentile would represent a more normal flow condition and changes in this habitat are not presented. Please provide the results of this analysis which includes the 5th and 50th percentile flows. | **see DFO-0004** |
| 5 | DFO | AE SV | Section 3.4.2.3.1 | N/A | Aquatic Environment | "intermittently-exposed zone"<br>Uncertain as to whether the "intermittently-exposed zone" is in the forebay, below the GS or both. There is no mention or study of the effects of water control on dewatering and re-watering areas below the GS and whether habitat losses and fish fills will occur as a result of this. | Please confirm whether the "intermittently-exposed zone" is in the forebay, below the GS or both. Please also provide an analysis of the effects of water control on dewatering and re-watering areas below the GS and whether habitat losses and fish fills will occur as a result of this. | **see DFO-0005** |
| 6 | DFO | AE SV | Secion 3.2.4.1.2 | 3-6 | Aquatic Environment | | Is the habitat classification in Section 3.2.4.1.2 related to suitability for fish habitat? Its use for Fish Community Assessments (Section 5) is challenged as the methodology is unproven and thereby likely unacceptable. The use of Habitat-based CPUE modelling was not supported by DFO, due to: 1) the high interannual and spatial variation in CPUE, often requiring several years of trend through time data, 2) only one published example of this method was provided and it this was from a marine environment and 3) very small samples sizes that do not account for variation. Can the proponent provide additional published support for this methodolody and/or provide a sensitivity analysis which confirms that changes observed in CPUE are linked to changes in habitat and not other variation (e.g. natural annual variability)? | **see DFO-0006** |

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| 7 | DFO | AE SV | Appendix 3A | N/A | Aquatic Environment | Depth Zones Section | In reviewing methods for aquatic habitat assessment in Appendix 3A, while the bathymetric surveying was very detailed, the validation of sonar data does not appear to be structured and repeated such that there is statistical confidence in the results obtained. There in no description of a comparison between the results expected and results observed and therefore the fidelity of the observations. Can the proponent present this sensitivity analysis or point the reviewer to the report which document this? Alternatively, can a study be proposed to test repeatability of bathymetric data collection (test areas beyond the survey area could be tested in the upcoming field season)? | **see DFO-0007** |
| 8 | DFO | AE SV | Section 3.4.1.1 | 3-25 | Aquatic Environment | "The main effects on habitat availability are losses due to dewatering, and disruption to available lotic habitat due to diversion." | Given that the impacts will extend for several consecutive years, impacts to fish habitat in the Nelson River and Stephens Lake can be considered as permanent and not as a temporary disruption. Please make this correction in the EIS. | **see DFO-0008** |
| 9 | DFO | AE SV | Section 3.4.1.1 | 3-25 | Aquatic Environment | "Substrate quality will also be disrupted due to erosion, transport, and deposition of bank and cofferdam materials into the downstream are primarily due to river staging in the Gull Rapids area. " | Loss in some cases is expected to be permanent, at least in part (e.g. sand lens below Gull Rapids). As such, part of this impact needs to be described in the context of permanent loss. Please make this correction in the EIS. | **see DFO-0009** |
| 10 | DFO | AE SV | Section 3.4.1.1 | 3-25 | Aquatic Environment | "New lentic habitat will be created below the south dam, but will vary in area due to inflows and construction activity, until the spillway construction is complete. " | The spillway is expected only to be operated every four years, so the "new" habitat will be of limited use. Please account for this lower productivity in this section of the EIS (habitat value and compensation). | **see DFO-0010** |
| 11 | DFO | AE SV | Section 3.4.1.2 | 3-26 | Aquatic Environment | "The total area dewatered during Stage I of construction is estimated to be 131.5 ha, inclusive of the Project infrastructure that accounts for about 30.6 ha (Table 3-6, Map 3-24)....The total area dewatered during Stage II of construction is estimated to be 123.9 ha, of which the Project infrastructure accounts for about 29.2 ha (Table 3-6, Map 3-24). Note that in Map 3-24, the infrastructure that is permanently flooded in Stage II of construction (i.e. substrate alteration), is shown within the dewatered areas for Stage I." | With reference to Table 3-6 and Map 3-24, given that areas will be dewatered and coffer dams in place for at least three years (Stage 1) and 1-3 additional years (Stage II), each of these impacts should be defined as permanent losses, not as disruptions. Much or all the area in the dewatered area will be utilized as borrow and/or river bed re-shaping (blasting) to facilitate flow to the new GS and spillway - as such current habitat function permanently destroyed. Moreover, neither the table or map (or text) account for the change in habitat use (and therefore value) from limited spawning habitat to, at best, feeding areas. Please revise estimates of habitat loss in the EIS taking into account these considerations. | **see DFO-0011** |
| 12 | DFO | AE SV | Section 3.4.1.4 | 3-28 | Aquatic Environment | "The construction of two temporary causeways will be built to access the N-5 and G-3 borrow areas.....for about seven years during the construction period. " | This would be considered a permanent loss of fish habitat. Please make this correction in the EIS. | **see DFO-0012** |
| 13 | DFO | AE SV | Section 3.4.1.6 | 3-28 | Aquatic Environment | "3.4.1.6 Loss/Alteration of Habitat at South Access Road Stream Crossings." | Any loss if habitat (riparian, stream bed, etc) will be permanent (this is not clear currently in the EIS). Also, there is no mention of sizing culverts to maintain 3Q10 fish passage for fish that contribute to an aboriginal, recreational or commercial fishery. Please make the correction on HADD in the EIS. Please provide requested information on flows and passage (3Q10) for proposed crossings. | **see DFO-0013** |

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| 14 | DFO | AE SV | Section 3.4.2.2.3 | 3-34 3-36 | Aquatic Environment | Pages 3-34 to 3-36 | Depositional areas and changes described on pages 3-34 to 3-36, but does not talk about changes to specific habitats. Please provide details on how, specifically, proposed deposition will impact fish habitats and how this will be monitored. | **see DFO-0014** |
| 15 | DFO | R-EIS Gdlines | Section 8.2.2 | 8-12 | Aquatic Environment | "A detailed monitoring plan will be provided in the Aquatic Effects Monitoring Plan" | When will this be provided? Should be in the EIS. | **see DFO-0015** |
| 16 | DFO | R-EIS Gdlines | Section 8.2.2 | 8-12 | Aquatic Environment | "This monitoring plan will be implemented during the construction phase of the Project, and will continue into the operational phase. " | Should be provided in the EIS and must be provided prior to issuance of regulatory decision. Providing input on monitoring frequency is impossible without seeing detailed monitoring plan. | **see DFO-0016** |
| 17 | DFO | AE SV | Section 6.2.3.2 | 6-4 | Aquatic Environment | "Information on movements through Gull Rapids was used to help determined whether fish passage might be required for the Keeyask Project. Lake sturgeon habitat use in the existing environment was described in part by calculating gillnet catch-per-unit-effort (CPUE) in various habitat types." | CPUE is, in general, a very limited metric for estimating population size and even more limited to describe habitat use. Description of CPUE needs to be interpreted with caution. Comparison of CPUE between years requires that sampling is standardized and/or an unbiased sample design is employed. Sampling usually needs to be conducted over several years to account for interannual bias. Variation in any metric such as CPUE needs to be reported. Please provide results of analyses of variarion in CPUE and how natural variation was accounted for. Please provide the specific reports which examine the fish community for DFO review. | **see DFO-0017** |
| 18 | DFO | AE SV | Section 6.2.4 | 6-5 | Aquatic Environment | 6.2.4 Assessment Approach "Habitat Suitability Index models were developed in consultation with Fisheries and Ocean Canada...." | While suitability indices were agreed to, the use of these in habitat modelling was not. Please make this clarification in the EIS. | **see DFO-0018** |
| 19 | DFO | AE SV | Section 6.3.1 | 6-8 | Aquatic Environment | "Over-harvesting, both historical (primarily commercial) and at the time of publishing (domestic), were the biggest problems faced by the sturgeon stocks.....Because of the time required for sturgeon to reach sexual maturity and catchable size, impacts of previous hydroelectric developments would be slow to appear in the population." | The historical loss and fragmentation of sturgeon habitats in the Lower Nelson River (e.g. spawning grounds) is not well addressed in the EIS. Impacts from, for example, from the loss of recruitment, may take decades to be realized in a long lived species such as sturgeon. Moreover, these comments do not completely agree with conclusions on impacts to and recovery potential of lake sturgeon in Designated Unit (Lake Sturgeon DU3 RPA - DFO 2010). Please address these deficiancy in the EIS by providing a more fulsom discussion of aquatic ecosystem change in the lower Nelson River. | **see DFO-0019** |
| 20 | DFO | AE SV | Table 6-6 | 6-62 | Aquatic Environment | "Four adults and 20 sub-adults were captured between Birthday and Gull Rapids during other Keeyask gillnetting studies conducted during summer and fall of 1999-2009 (Table 6-6). The sub-adult catch (number(n) = 15fish) during the summer of 2009 index gillnetting program included ten relatively small sturgeon (191-230 mm total length) believe to have hatched in spring 2008. Based on these captures and the 15 YOY captured in 2008 it appears that there was relatively high recruitment in this reach in 2008. " | These are very small sample sizes to derive any credible assumptions on any life history parameter. Floy tagging results are too generalistic to derive specific conclusions on life history patterns. Please provide the detailed reports which document sampling which was conducted, results and analyses. | **see DFO-0020** |

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| 21 | DFO | AE SV | Section 6.3.2.3.2 | 6-19 | Aquatic Environment | "It is assumed most of the spawning lake sturgeon captured in or near the (Gull) rapids moved upstream from Stephens Lake as none of the sturgeon that were tagged upstream between Birthday and Gull Rapids were recaptured in spawning condition in the Gull Rapids vicinity (see Section 6.3.2.7)." | This claim is not supported for several reasons: 1) the capture rate of sturgeon (including spawning) was very low and therefore probability of catching a sturgeon from any given area is diminished, 2) unless fish movements are tracked over time, where they originate cannot be definitive. While sturgeon may have originated from Stephens Lake, they may also have originated elsewhere in the Nelson River. Unfortunately, the data cannot provide this discrimination. Please provide detailed reports which examine lake sturgeon spawning and movement. | **see DFO-0021** |
| 22 | DFO | AE SV | Section 6.3.2.3.1 | 6-15 | Aquatic Environment | "Under the 5th, 50th, and 95th percentile flow scenarios, HSI models for lake sturgeon spawning habitat in the existing environment show that there is a WUA of between 13ha and 18ha within and at the base of Gull Rapids..... Under the 5th, 50th, and 95th percentile flow scenarios, HSI models for lake sturgeon spawning habitat in the existing environment show that there is a WUA of between 13 ha and 18 ha within and at the base of Gull Rapids. Two additional variables were added to the HSI model to account for observations made during egg deposition studies: 1) the direction of river flow, and 2) distance from the origin of white water and/or a hydraulic feature." | It is recognized that only in the spawning HSI model were additional parameters used in addition to the traditional parameters of depth, substrate and velocity. Also recognizing that in using these additional parameters in the WUA of lake sturgeon spawning habitat is greatly reduced (in most cases at 100 fold). Given the potential magnitude of these affects, please provide published examples of the use of the distance and direction parameter in other studies. | **see DFO-0022** |
| 23 | DFO | AE SV | N/A | N/A | Aquatic Environment | Lake sturgeon spawning HSI Modelling and commensurate maps | Please present WUA for all lake sturgeon spawning habitat for all presented flows using just the depth, substrate and velocity suitability curves. | **see DFO-0023** |
| 24 | DFO | AE SV | Appendix 6D | N/A | Aquatic Environment | Appendix 6D | Please present Habitat Units (HU's) for all tables in section 6D. | **see DFO-0024** |
| 25 | DFO | AE SV | Section 6.0 | N/A | Aquatic Environment | Chapter 6 | For all HSI maps, outline of existing environment (the shorelines of the Nelson River and Stephens Lake) should be shown in the post project environment maps. The additional aquatic area gained by creation of the forebay should be illustrated and given a suitability of 0, recognizing that this is terrestrial habitat that will undergo substantial change before it becomes productive aquatic habitat (EIS suggests at least 5 years). Please provide revised maps showing these changes. | **see DFO-0025** |
| 26 | DFO | AE SV | Appendix 1A | N/A | Aquatic Environment | Maps 6-48, 6-49 | Unclear as to how sand/gravel habitat will be created post project in the forebay, particularly in years 1-5. Does this include compensatory measures proposed in Appendix 1A? Please provide detailed information/model which demonstrates the creation of sand post project. | **see DFO-0026** |
| 27 | DFO | AE SV | Section 6.0 | N/A | Aquatic Environment | Chapter 6 | HSI model verification for existing environment not conducted. Can model verification be conducted prior to construction? Can verification of physical environment be conducted prior to construction. Post project verification of HSI and physical models should be conducted. | **see DFO-0027** |

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| 28 | DFO | AE SV | Section 6.3.2.3.2 | 6-19 | Aquatic Environment | "The model also suggests that there is more spawning habitat available at the base of the rapids than within them, due to the prevalence of excessively high velocities within the rapids proper." | Is this a valid conclusion at all flows? How would spawning habitat distribution change without constraining the model by distance and flow direction? | **see DFO-0028** |
| 29 | DFO | AE SV | Section 6.3.2.3.2 | 6-19 | Aquatic Environment | "Currently, lake sturgeon spawn within Gull Rapids and larvae drift downstream into lower velocity areas of the river or the western portion of Stephens Lake where an area of gravel/sand and sand has formed (Section 3). Lake sturgeon larvae have been reported to drift up to 60km downstream of the spawning site (Appendix 6A). Therefore, larvae spawned further upstream may also be drifting downstream through Gull Rapids and settling in these areas." | This statement does not reconcile with another conclusion in the EIS that movement through Gull Rapids is not required for lake sturgeon life history. Why? | **see DFO-0029** |
| 30 | DFO | AE SV | Section 6.3.2.3.2 | 6-19 | Aquatic Environment | Rearing | Did the condition of y-o-y lake sturgeon between various capture sites (Caribou Island, Stephens Lake, etc) differ? | **see DFO-0030** |
| 31 | DFO | AE SV | Section 2.5.2.2.2 | 2-54 | Aquatic Environment | Overwintering | Overwintering habitat, use and movements not well documented in the EIS. Please priovide detailed reports which examined this. If this work was not conducted as part of this EIS, please provide expected movements based on published information from similar systems. | **see DFO-0031** |
| 32 | DFO | AE SV | Section 6.3.2.7.2 | 6-27 | Aquatic Environment | Fish Movements – Importance of Movements. | Conclusions in this section that upstream or downstream movement of adult lake sturgeon are not spawning migrations do not agree with local traditional knowledge that Gull Rapids and Birthday Rapids are important spawning grounds for Stephens Lake sturgeon. Please speak to these discrepencies in the EIS or correct. | **see DFO-0032** |
| 33 | DFO | AE SV | Section 6.3.2.7.2 | 6-27 | Aquatic Environment | Fish Movements – Importance of Movements. | Acoustic and telemetry tagging clearly show movement of Lake sturgeon through Gull Rapids. However, due to the limited number of telemetry data, conclusions on habitat use and the types of migration (e.g. spawning) are not practical. Please provide detailed reports showing movement. | **see DFO-0033** |
| 34 | DFO | AE SV | Section 6.3.2.7.2 | 6-27 | Aquatic Environment | Fish Movements – Importance of Movements. | Habitat impacts as a result of the loss of migration upstream and downstream through Gull Rapids (Stage II construction) should be recognized. | **see DFO-0034** |
| 35 | DFO | AE SV | Section 6.4.1 | 6-29 | Aquatic Environment | "Disruption of spawning activity due to disturbance by construction activity and habitat loss/alteration." | Spawning habitat loss for much of Gull Rapids will be permanent. Resumption of spawning may occur in the remaining natural (and constructed) spawning habitat, but this is uncertain. Please make this correction in the EIS. | **see DFO-0035** |
| 36 | DFO | AE SV | Section 6.4.1.2.6 | 6-31 | Aquatic Environment | "The cofferdams will not affect lake sturgeon in the Nelson River upstream of Gull Rapids as those fish use habitat upstream of the rapids." | This is not a reasonable conclusion, given little long term information on documented sturgeon habitat use and movement and no evidence of distinct populations (6.3.2.5) between Stephens Lake and Clark Lake. Please provide detailed report(s) which examine the impacts of protracted inaccesibility to lake sturgeon spawning success. | **see DFO-0036** |
| 37 | DFO | AE SV | Section 6.4.2 | 6-32 | Aquatic Environment | "Increase in lake sturgeon movements upstream to Split and Clarke lakes due to velocity changes as a result of impoundment (e.g. reduction in velocity at Birthday Rapids)." | This avoidance of slack water habitat will extend too much of the forebay, not just at Birthday Rapids. The HSI curves for all sturgeon life stages are heavily influenced by velocity, a recognition that lake sturgeon select high velocity riverine environments. | **see DFO-0037** |

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| 38 | DFO | AE SV | Section 6.4.2 | 6-32 | Aquatic Environment | "Habitat changes in the reservoir due to changes in water levels and flow that will result in the loss or alteration of existing habitat (riverine channels in Gull Lake....and the creation of new habitat.." | The creation of "new" habitat in the forebay should be discounted to half that of the current riverine environment. Recognizing that the forebay will not stabilize ecologically for a number of years, productiviy will be low or non-existent initially. Productivity will, however, increase with time. As a result, WUA's for all post project HSI analyses should be calculated in consideration of this change in productivity over time using a defensible methods approach. This approach would discount the value of habitat in the post project environment for the number of years required for the full productivity of the new forebay to be realized. At a minimum, this appears to be 5 years, but could be indefinite ("...downstream emigration was documented for lake sturgeon moving out of the [new] Limestone reservoir within the first five years after impoundment (NSC 2012). Over time, some lake sturgeon that move upstream may return downstream to the reservoir.") This suggests that not only will usable habitat be lost in the reservoir, but the loss of a natural population this area may occur as well. While conservation stocking is proposed to mitigate this, there is no proof that the stocked sturgeon will remain in the new forebay either. | **see DFO-0038** |
| 39 | DFO | AE SV | Section 6.4.2 | 6-32 | Aquatic Environment | "Alteration of habitat in the river channel between Gull Rapids and Stephens Lake." | Much of the habitat in this reach will be permanently destroyed with only small portions undergoing alteration. Please revise in the EIS to show permament loss. | **see DFO-0039** |
| 40 | DFO | AE SV | Section 6.4.1.2.7 | 6-31 | Aquatic Environment | 6.4.1.2.7 Net Effects of Construction with Mitigation | Given information presented in this EIS, it is highly uncertain that permanent loss of Gull Rapids as spawning, migration and rearing habitat for lake sturgeon (and several other species) can be mitigated. This is due to: 1) lack of detailed information for the proposed lake sturgeon stocking program and uncertainty regarding the acceptability of this program (see comments on stocking), 2) questionable representation of the amount and value of spawning habitat currently in and around Gull Rapids and 3) lack of understanding of the importance of maintaining migration through Gull Rapids and the avoidance of habitat fragmentation in the Nelson River. Please speak to this uncertainty in the EIS. | **see DFO-0040** |
| 41 | DFO | AE SV | Section 6.4.2.2.1 | 6-35 | Aquatic Environment | "The majority of lake sturgeon captured in these reservoirs are taken in the upper, more riverine areas. Researchers on the Winnipeg River have also found that sturgeon are most abundant in the upper reaches of the reservoirs where conditions are more characteristic of riverine conditions." | This contradicts the conclusions elsewhere in the EIS that the new forebay will create highly suitable habitat for all life stages of lake sturgeon. Please address explain and address this discrepency. | **see DFO-0041** |
| 42 | DFO | AE SV | Section 6.4.2.2.2 | 6-35 | Aquatic Environment | "The existing environment HSI model for lake sturgeon spawning habitat indicates that there is a WUA of between 9 and 12 ha from Clarke Lake to Gull Rapids." | As previously mentioned (6-15), the method of calculating spawning habitat WUA's will need to be revisited as the estimate of 9 to 12 ha is likely a substantial underestimate. | **see DFO-0042** |

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| 43 | DFO | AE SV | Section 6.4.2.2.2 | 6-37 | Aquatic Environment | "The majority of the lake sturgeon captured in the Long Spruce and Limestone reservoirs are taken in the upper end of the reservoirs where conditions are more characteristic of riverine habitat (NSC 2012). These observations suggest that, while the amount of usable foraging habitat (i.e., WUA) upstream of the Keeyask GS will be higher in the post-Project environment, not all this habitat may be selected by either sub-adult or adult fish." | This suggests that post the project environment WUA for these life stages may need to be modified using this system specific observations. Please consider these changes in the WUA tables and discuss this in the EIS. | **see DFO-0043** |
| 44 | DFO | AE SV | Section 6.4.2.3.1 | 6-40 | Aquatic Environment | "To compensate for the loss of spawning habitat, several areas will be developed to provide suitable spawning habit" | All proposed compensation works should have relevant suitability curves applied and commensurate WUA and HU's calculated. | **see DFO-0044** |
| 45 | DFO | AE SV | Section 6.4.2.3.1 | 6-41 | Aquatic Environment | "Lake sturgeon could also use habitat in the river below the spillway in years when the spillway is operating at sufficient discharges during the spawning and egg incubation period" | Please provide details on performance/success of lake sturgeon spawning habitat use and successful hatch from similar structures developed at the Grand Rapids and Limestone GS's. | **see DFO-0045** |
| 46 | DFO | AE SV | Section 6.4.2.3.1 | 6-41 | Aquatic Environment | "The capture of 3 month old (approximate) YOY sturgeon over cobble/boulder substrate along the south shore between the rapids and the lake, suggests that older YOY can survive in what is thought to be less than optimal habitat..." | Were YOY found to consistently utilize these habitats? If so, did they exhibit diminished condition or fitness? | **see DFO-0046** |
| 47 | DFO | AE SV | Section 6.4.2.3.1 | 6-41 | Aquatic Environment | "Because the number of lake sturgeon residing downstream of Gull Rapids is considerably reduced compared to historic levels, a stocking program will be implemented to avoid possible effects of a temporary reduction in rearing habitat should it occur" | Given the loss of known high quality YOY habitat north of Caribou Island (future forebay), the known YOY rearing habitat below Gull Rapids must be protected. What measures will be taken to ensure that this habitat will not change, both during construction and operation? | **see DFO-0047** |
| 48 | DFO | AE SV | Section 6.4.2.3.2 | 6-43 | Aquatic Environment | "The phased approach to fish passage.....will permit trial implementation of fish passage for lake sturgeon with minimal risk to the Stephens Lake population." | The stated risk to the Stephens Lake sturgeon population is not identified. Note, the proponent has been requested to investigate the cost/benefits of various fish passage designs, including cost, environmental cost/benefit, etc. The proponent has retained a consultant for this investigation, which has produced a preliminary report on this comparison. The detailed results of this report should be made available in the EIS for review. | **see DFO-0048** |
| 49 | DFO | AE SV | Section 6.4.2.3.2 | 6-43 | Aquatic Environment | "The phased approach to fish passage.....will permit trial implementation of fish passage for lake sturgeon with minimal risk to the Stephens Lake population." | Trap and truck was identified as the fish passage option for Keeyask, this method has traditionally been used at high head dams and information behind the rational for the selection of this option would be helpful. What criteria will be used to determine if and when trap and truck should be implemented? | **see DFO-0049** |
| 50 | DFO | AE SV | Section 6.4.2.3.2 | 6-43 | Aquatic Environment | "Sturgeon moving downstream from the Keeyask reservoir would need to pass either the spillway (when its in operation) or past the trash racks and turbines.....Although experimental studies of turbine effects have not been conducted with lake sturgeon, studies of fish movements in the Limestone reservoir have recorded downstream passage by lake sturgeon both over the spillway and past the turbines." | What is the survival of sturgeon that pass: 1) through the turbines and 2) over the spillway? How does this survival change with size? What provisions for safe downstream passage have been considered? | **see DFO-0050** |

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| 51 | DFO | AE SV | Section 6.4.2.3.2 | 6-43 | Aquatic Environment | "There is no information available on turbine mortality rates for sturgeon. " | Mortality rate for sturgeon should be based on: 1) known mortality for species of a similar size (e.g. pike) for both spillway and turbine and 2) the number of individuals passing the turbines can be calculated based on fish passage studies (e.g. Missi Falls) and a commensurate relative abundance estimates. | **see DFO-0051** |
| 52 | DFO | AE SV | Appendix 6B.1 | 6B-1 | Aquatic Environment | Appendix 6B Field Data Collection and Analysis | Gillnet and larval drift sampling described in Appendix 6B should be viewed as reconnaissance or "search" sampling. Sampling does not appear to be an index and therefore any statistics related to CPUE as an indication of population size or relative abundance should be viewed with caution. Please provide the detailed study reports. | **see DFO-0052** |
| 53 | DFO | AE SV | Appendix 6B.1 | 6B-1 | Aquatic Environment | Appendix 6B Field Data Collection and Analysis | With the exception of adult spring spawning data collection, other sampling periods are quite short. Please provide the detailed study reports. | **see DFO-0053** |
| 54 | DFO | AE SV | Appendix 6B.1 | 6B-1 | Aquatic Environment | Appendix 6B Field Data Collection and Analysis | Details on mark recapture information is lacking in terms of annual movements. Raw data used for population estimates should be made available. | **see DFO-0054** |
| 55 | DFO | PD SV | Section 3.10.2 | 3-32 | Project Description | Management Plans to be Developed | All cited management plans should be provided as part of the EIS submission. | **see DFO-0055** |
| 56 | DFO | R-EIS Gdlines | Section 4.3.3 | 4-14 | Physical Environment | Construction Mitigation - DFO notes that timing for the majority of in-stream work is scheduled between July 16 to September 15 | In 2015, construction of the spillway cofferdam is scheduled for July 16 to October 4 (extending into the Whitefish spawning period)...what additional mitigation and/or construction techniques are proposed during this sensitive period? | **see DFO-0056** |
| 57 | DFO | R-EIS Gdlines | Section 4.3.3 | 4-14 | Physical Environment | Construction Mitigation - DFO notes that timing for the majority of in-stream work is scheduled between July 16 to September 15 | Please provide detailed contingency plans for construction techniques proposed should a request to extend construction beyond proposed dates occur. DFO would appreciate the opportunity to review contingency plans in advance to ensure appropriate decisions with a timely response can be provided. | **see DFO-0057** |
| 58 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Monitoring | DFO notes that there are no monitoring plans submitted within the EIS. We look forward to reviewing the following management and monitoring plans (as proposed to be developed in chapter 8 of the EIS):<br>o Sediment Management Plan<br>o Fish Habitat Compensation Plan<br>o Waterways Management Plan<br>o Aquatic Effects Monitoring Plan<br>o Physical Environment Monitoring Plan | **see DFO-0058** |
| 59 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Monitoring | How will peat deposition be monitored? And assumptions in the EIS verified? (ex. Estimate only 1% of peat will be transported downstream) | **see DFO-0059** |

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| 60 | DFO | PE SV | Appendix 7C<br>Appendix 7D | N/A | Physical Environment | Monitoring | Please provide a detailed map of baseline sedimentation sampling sites and proposed monitoring sites? Ideally, future monitoring sites should be located near the baseline sampling sites for accurate comparisons. | **see DFO-0060** |
| 61 | DFO | PE SV | Appendix 7B | N/A | Physical Environment | Bed Load | Between 2005-2007, approximately 350 bedload samples were collected, but this yielded few measurable samples (Appendix 7B). The EIS reports an estimated an average bedload of 4 g/m/s. How reasonable is this estimate given the insufficient samples to estimate the annual bedload discharge? What method(s) will be used to monitor bedload? | **see DFO-0061** |
| 62 | DFO | PE SV | Appendix 7E | 7E-5 | Physical Environment | Bed Load | It seems that only 50th percentile flow examined – why not 5th and 95th? | **see DFO-0062** |
| 63 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Sedimentation - TSS | Is the relationship between turbidity/TSS developed using local (Gull Lake/Stephens Lake) data? Was there to be an ongoing calibration of the turbidity/TSS relationship to reduce induced error? | **see DFO-0063** |
| 64 | DFO | PE SV | Section 7.4.2.1.5 | 7-29 | Physical Environment | Sedimentation - TSS | Background TSS assumed to be 20 mg/l. EIS does not explain the rationale for using this number when the range is 5mg/l to 30mg/l. Please provide detailed rationale for choosing 20mg/l. | **see DFO-0064** |
| 65 | DFO | PE SV | Section 7.2.5.1<br>Appendix 7A.2.2 | 7-11<br>7A-25 | Physical Environment | Sedimentation - TSS | Assumption that 70% of all fine particles will remain in suspension past Kettle GS. How can they determine this? Has this been modelled? How will the model/assumptions be tested? | **see DFO-0065** |
| 66 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Sedimentation - TSS | Suggest that discrete data loggers (TSS) are better than continuous collection data loggers. Discrete loggers should be verified using point sampling to verify data loggers especially in the first year. The use of discrete data loggers for existing environment and post project post project environment. The continuous data loggers are too variable and subject to error due to bio-fouling. | **see DFO-0066** |
| 67 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Sedimentation - TSS | EIS proposes to have the first post project monitoring station 1km downstream of the construction site in the "fully mixed zone". The location of the first monitoring station downstream of Keeyask construction site is too far away to assess impacts and effectiveness of mitigation. It is recommended that a turbidity/TSS monitoring site be placed at the construction site. | **see DFO-0067** |
| 68 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Sedimentation - TSS | Can the Proponent provide an analysis showing that its monitoring will have a high degree of confidence, or the power, to detect TSS above the action threshold? | **see DFO-0068** |
| 69 | DFO | AE SV | Section 2.5.2.2.5 | 2-66 to 2-68 | Physical Environment | Sedimentation - TSS | The Proponent appears not to discuss effects of TSS specific to the individual VEC fish species. The Proponent's impact assessment appears to rely primarily on lethal TSS concentration effects. Can the Proponent provide an expanded discussion of sub-lethal or chronic impact risk assessment for anticipated TSS changes? | **see DFO-0069** |

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| 70 | DFO | PE SV | Section 4.0 | N/A | Physical Environment | Sedimentation - TSS | Existing environment sedimentation models based on low, med and high flows (2059, 3032 and 4,327 cms). Do these relate to percentile flows? Post-project sedimentation modelling simulated under 50th percentile for year 1, 5, 15 and 30 years after impoundment, and under 5th and 95th percentile flow for 1 and 5 years after impoundment. Why different flow regimes for different time periods? The post-project sedimentation environment was also simulated under the 50th and 95th percentile flows using the eroded shore mineral volumes as estimated, considering peaking mode of operation for the time frames of 1 and 5 years after impoundment. Proposed monitoring to valid models? | **see DFO-0070** |
| 71 | DFO | PE SV | Appendix 7A | N/A | Physical Environment | Peatland Erosion. | Did not look at peat downstream of the generating station, claiming that peat would not go past the GS (only 1% would get past the GS – is this reasonable?). What monitoring is proposed to confirm this? | **see DFO-0071** |
| 72 | DFO | PE SV and AE SV | Section 7.4.2.3<br>Section 3.4.2.2 | 7-35 | Physical Environment | Peatland Erosion. | Visual distribution (maps) of peatland deposition not presented in the EIS. How will peat deposition impact on known/suspected areas of fish habitat in the future forebay? | **see DFO-0072** |
| 73 | DFO | R-EIS Gdlines | Section 6.3.8 | 6-215 | Physical Environment | Deposition - EIS states deposition loads will not change post project – about 3cm/year, based on about 30cm of sediment deposited in ten years since Kettle GS was built. "Based on extensive modelling (using Stephens Lake) and field verification", the majority of mineral sediments resulting from shoreline erosion are predicted to deposit in near shore areas...after year 1, rates predicted at 0-3 cm/y. Offshore = 0-1 cm/y after year 1. The south nearshore areas in gull lake predicted to experience highest deposition rate of 4-6 cm/y for year 1 under baseloaded conditions. | Do not provide sedimentation rates based on a range of flows. No detail on sampling conducted to establish baseline other than at Kettle GS. How will the sedimentation model be tested for accuracy? What monitoring will be conducted to validate model assumptions? | **see DFO-0073** |
| 74 | DFO | PE SV | Appendix 7A.1.1.3 | 7A-6 | Physical Environment | Sedimentation | Given the variation in sedimentation rates over time and the challenges in estimating sedimentation level, does the sedimentation analysis include a sensitivity analysis to reflect possible ranges in sedimentation and the effects on fish and fish habitat both upstream and downstream? | **see DFO-0074** |
| 75 | DFO | PE SV | Section 7.4.1 | N/A | Physical Environment | The EIS notes "Placement and removal of cofferdams/groins during Stage II Diversion will occur over three years (2017, 2018, and 2019) during the open water seasons. Most of these activities are predicted to result in increases in TSS of less than 5 mg/L above background, which would be within the...CCME guidelines for the protection of aquatic life. The exceptions include placement of the South Dam Rock Fill Groin, which is predicted to result in TSS increases of up to 15 mg/L above background, with increases of greater than 5 mg/L for a period of approximately 10 days in early September 2017. An increase in TSS of 7 mg/L for a period one month is also predicted during removal of the Tailrace Summer Level Cofferdam in September/October 2019. | The Proponent predicts several instances of average TSS increases greater than the CCME guideline for longer term impacts (e.g., inputs lasting between 24 h and 30 d should not exceed 5 mg/L above background). Are there additional opportunities, both reasonable and practical, to further prevent and mitigate sediment releases such that the guidelines can be met? For example, if a given TSS exceedance is in part due to shoreline erosion, would pre-emptive shoreline stabilization be an option? | **see DFO-0075** |

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| 76 | DFO | PE SV | Appendix 7A | N/A | Physical Environment | The EIS notes "Prediction of the post-impoundment...environment upstream...was carried out by...numerical modelling...Depth-average mineral suspended sediment concentrations were estimated for average (50th percentile) flow for prediction periods of 1 year, 5 years, 15 years and 30 years after impoundment. Sediment concentrations were also predicted for low (5th percentile) and high (95th percentile flow conditions for...1 year and 5 years after...impoundment. While outside the zone of hydraulic influence, a qualitative assessment was carried out for...sedimentation...in Stephens Lake..." | Can the Proponent provide some explanation, or direct reviewers to its location, of why TSS modeling at selected flow percentiles, e.g., 50th percentile or 5th and 95th percentile, or other model settings, provide good estimates of likely effects on the aquatic environment? | **see DFO-0076** |
| 77 | DFO | AE SV | Section 2.5.2.2.5 | 2-66 to 2-68 | Physical Environment | The EIS notes "Placement and removal of cofferdams/groins during Stage II Diversion will occur over three years (2017, 2018, and 2019) during the open water seasons. Most of these activities are predicted to result in increases in TSS of less than 5 mg/L above background, which would be within the...CCME guidelines for the protection of aquatic life. The exceptions include placement of the South Dam Rock Fill Groin, which is predicted to result in TSS increases of up to 15 mg/L above background, with increases of greater than 5 mg/L for a period of approximately 10 days in early September 2017. An increase in TSS of 7 mg/L for a period one month is also predicted during removal of the Tailrace Summer Level Cofferdam in September/October 2019..." | If increases in TSS exceeding the CCME guidelines appear to be unavoidable, can the Proponent provide additional discussion and rationale (or direct reviewers to the location of that information in the EIS) for why the exceedances, in the Nelson River at Keeyask case, are not likely significant adverse environmental effects. For example, can the Proponent indicate that an exceedance of 7 mg/L TSS above background for 30 days in September/October is not likely to be in the sublethal or lethal severity of effect range for fish, fish eggs or larvae, benthic macroinvertebrates, or other aquatic organisms. In addition, can the Proponent say that the exceedance when added to the expected background range for that time of year is within the anticipated natural range of TSS in the Nelson River at the Project site, and in one case downstream to the estuary, at that time of year? | **see DFO-0077** |
| 78 | DFO | PE SV | Appendix 7E | N/A | Physical Environment | The EIS notes "data collected in the open water periods of 2005 to 2007 indicates...suspended sediment concentration generally lies within the range of 5 mg/L to 30 mg/L...from Clark Lake to Gull Rapids...sediment concentrations can vary within their normal range at a given location in a given day...variations...over a short period...can be due to many reasons, including local turbulences in the waterbody, changes in the meteorological environment, and local bank erosion processes...suspended sediment concentrations...in the open water period...2001 to 2004...show similar ranges (2 mg/L to 30 mg/L with an average of 12 mg/L)...A report prepared by Lake Winnipeg, Churchill and Nelson Rivers Study Board in 1975...documents a suspended sediment concentration range of 6 mg/L to 25 mg/L with an average of 15 mg/L based on...measurements in 1972 and 1973. Field studies...on the Burntwood and...Lower Nelson River reach also show a concentration range of 5 mg/L to30 mg/L (Acres...2004...2007b, KGS Acres 2008b...KGS Acres 2008c)...Suspended sediment concentration measurements during...winter...(January to April), of 2008 and 2009 reveal that sediment concentration variations in the winter period are larger than the open water period. A limited data set collected at monitoring locations in Gull Lake show a concentration range of 3 mg/L to 84 mg/L, with an average of 14.6 mg/L..." | The Proponent provides some ranges, point estimates, and expected durations of TSS changes. Would it be possible to provide, or direct reviewers to where this information is in the EIS, sample sizes and standard deviations for estimates? Where intervals that are not ranges, would it be possible to specify the level of confidence? E.g., are they 95% confidence intervals for a mean? | **see DFO-0078** |

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| 79 | DFO | AE SV | Section 2.5.2.2.5 | 2-65 | Physical Environment | The EIS notes, for mineral, as opposed to organic sediments:... "mineral TSS is generally predicted to decrease in the shallow and deep areas of the reservoir with the Project, most notably under high flows (95th percentile), although small increases (1–4 mg/L) are projected in some areas under some conditions (i.e., different flows and years of operation). The predicted changes in mineral TSS are also relatively similar for the peaking and base loaded modes of operation for median and high flows. In general, the predicted decreases (or occasionally increases) in mineral TSS are less than 5 mg/L under low, median, and high flows in shallow and deep areas for Years 1 and 5 of operation. The major exception would occur under high flows in reaches 7 and 8 (at the downstream end of present day Gull Lake) and most notably reach 9 (the reservoir immediately upstream of the GS) where larger decreases (up to 14 mg/L below background) are expected..." | The Proponent predicts TSS decreases. Impacts of TSS decreases appear not to be discussed. While there are no present federal guidelines e.g., in the CCME, has the Proponent considered the potential impacts of TSS decreases? | **see DFO-0079** |
| 80 | DFO | AE SV | Appendix 2A 2.5.2.2.5 4.2.4.2 | N/A | Physical Environment | The EIS says "Mineral TSS would generally remain within the chronic Manitoba PAL water quality objective and the CCME PAL guideline (a change of less than or equal to 5 mg/L relative to background, where background TSS is less than or equal to 25 mg/L). The exceptions would occur in the immediate reservoir (reach 9) and reach 8 (the area north of Caribou Island) under high flow conditions, where decreases may be larger than the Manitoba water quality objective..." | When discussing TSS decreases the Proponent refers to TSS guidelines as being for changes. In fact, the guidelines talk about increases only – not changes in general – so that they do not really apply to decreases in TSS. Can the Proponent explain in more detail its criteria for discussing changes? | **see DFO-0080** |
| 81 | DFO | AE SV | Section 2.0 | N/A | Physical Environment | Water Quality: Project Effects, Mitigation, and Monitoring...Construction Period...Total Suspended Solids, Turbidity, and Water Clarity..." p 2-44 - 2-45 "Cofferdam Dewatering... Water that is trapped or accumulates behind cofferdams will be discharged to the Nelson River. An end- of- pipe criterion of 25 mg/L will be applied such that where met, water behind cofferdams will be directly released to the Nelson River. Where this target is not met, cofferdam water will be pumped to settling ponds and discharged to the Nelson River when the end-of-pipe TSS concentration is less than 25 mg/L (PDSV, Keeyask GS EnvPP). Effects on TSS in the Nelson River are expected to be negligible in the fully mixed condition; small, localized increases in TSS may occur near these point sources..." | The Proponent refers to its proposed end-of-pipe allowed TSS of 25 mg/L for several activities. However, according to the CCME, that criteria is only acceptable for short term (e.g., 24 h) TSS increases. Can the Proponent provide additional information on the expected duration of activities for which it proposes the 25 mg/L criteria. For longer term TSS increases (e.g., inputs lasting between 24 h and 30 d), can the Proponent provide prevention measures that will meet the guideline of an increase not greater than 5 mg/L? | **see DFO-0081** |

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| 82 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | The EIS notes "An Environmental Protection Program has been developed to mitigate, manage and monitor environmental effects during the Project construction and operation phases. While descriptions of the existing environment are based on measurement and observation, descriptions of effects and mitigation designed to address adverse effects are predictions based on technical scientific studies and analysis, professional judgement and Aboriginal traditional knowledge. Monitoring will determine if these predictions are correct and if mitigation measures are working as expected. If unexpected effects are detected, the program will also define processes for determining appropriate adaptive management programs and practices. The Environmental Protection Program covers the "who, what, when, where and how" of protecting and monitoring the environment. Manitoba Hydro has a contractual responsibility for implementing the program delegated by the Partnership. The Program will consist of three types of plans...1. Environmental Protection Plans, to provide detailed, site-specific environmental protection measures to be implemented by the contractors and construction staff to minimize environmental effects from construction of the generating station and the south access road;... 2. Environmental Management Plans, focused on specific environmental issues, such as sediment management, access management, fish habitat and heritage resources; and...3. Environmental Monitoring Plans, to describe monitoring the effects of construction and operations on the biophysical, physical and socioeconomic environments using both technical science and Aboriginal traditional knowledge. Each plan includes an implementation strategy that, as required, may include contractual arrangements, training, compliance inspections and communication of results. The Keeyask Cree Nations will be directly involved in monitoring implementation by leading the Aboriginal traditional knowledge monitoring program and working side-by-side with scientists as part of the technical science-based monitoring and participating in the Partnership's Monitoring Advisory Committee. Manitoba Hydro will oversee monitoring activity to confirm that work is in accordance with the finalized, regulator approved plans..." | The Proponent refers to monitoring and Environmental Protection Plans (EnvPP) for sediment management. Are these described in detail in the EIS? While mitigation measures are described in the EIS that assist in preventing sediment deposition, DFO has been unable to find details of monitoring or action plans (management) for mitigation. If the detailed information is not shown in the EIS, can the Proponent provide that information separately from the EIS to continue the Environmental Assessment? The Environmental Protection, Environmental Management, and Environmental Monitoring plans are of significant interest to reviewers determining if there is likely to be a significant adverse effect after taking mitigation into account. | **see DFO-0082** |
| 83 | DFO | PE SV | Section 7.4.1 | 7-22 | Physical Environment | "Water Quality: Project Effects, Mitigation, and Monitoring...Construction Period...Total Suspended Solids, Turbidity, and Water Clarity..." p 2-40 ff "Cofferdam Placement and Removal...during Stage I and II Diversions have the potential to increase TSS in the Nelson River...results...presented in detail in the PE SV, section 7.4.1...Predicted increases in TSS refer to the fully mixed condition, approximately 1 km downstream of Gull Rapids..." | The Proponent notes that it has modeled TSS downstream at 1km from the construction area in the fully mixed zone. Will the Proponent be able to monitor TSS closer to the construction areas? What sort of area might be affected by construction TSS increases greater than those predicted upstream of the fully mixed zone. What are the, at source, sediment loading TSS concentrations likely to be, how extensive might they be in area, and what might their durations be? | **see DFO-0083** |
| 84 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Information does not appear to be present in the EIS but is required to determine if monitoring can adequately determine potential problems and appropriate actions taken to mitigate unexpected events. | Can the Proponent provide an analysis showing that its monitoring will have sufficient power with high confidence, to detect TSS above the action threshold (regulatory guideline)? For example, how likely is it that the Proponent can detect environmental changes that result in elevated TSS that exceed critical effect sizes such as 5 mg/L above background? Will the number of samples collected during monitoring be sufficient to correctly conclude, with a confidence of say 95% [i.e., a high confidence], that there is a difference of, say, 5 mg/L or more above background? | **see DFO-0084** |

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| 85 | DFO | AE SV | Section 2.5.2.2.5 | 2-64 | Physical Environment | The EIS, in the aquatic effects supporting document section 2 on water and sediment quality, notes: "There are few studies that have reported the acute or chronic toxicity of TSS to fish species represented in the Aquatic Environment Study Area. Lawrence and Scherer (1974) reported that the 96-hour lethal concentration (LC50) for lake whitefish (Coregonus clupeaformis) was 16,613 mg/L. McKinnon and Hnytka (1988) found relatively high increases in TSS (instantaneous maximum = 3,524 mg/L and 1-day average concentration = 524 mg/L) caused by winter pipeline construction did not have any direct effect (no downstream emigration and no mortalities) on the fish community of Hodgson Creek, NT. This study is notable as four of the fish species found in Hodgson Creek - northern pike (Esox lucius), lake chub (Couesius plumbeus), longnose sucker (Catostomus catostomus), and burbot (Lota lota) - are also found in the Aquatic Environment Study Area. As indicated in Section 5.4.2, northern pike may spawn in the nearshore areas of the Keeyask reservoir, even during the initial years of operation. Therefore, early life history stages of northern pike may be exposed to elevated concentrations of TSS for several years post-impoundment. No information on the acute or chronic toxicity of TSS to northern pike eggs or larvae could be located. Information for early life history stages of other species represented in the Aquatic Environment Study Area is also sparse and many of the available studies do not differentiate between the effects of suspended particulate materials and sediment deposition. However, the available scientific literature indicates a potential for reduced hatching success in salmonids exposed to elevated TSS concentrations on the order of two months or more, at concentrations ranging from 6.6–157 mg/L (Table 2-17). In addition, northern pike eggs would also be exposed to the combined effects of sedimentation and elevated TSS. Therefore, should northern pike spawn in the nearshore, flooded areas of the reservoir in the initial years of operation where organic TSS will be notably elevated, reduced hatching success of northern pike eggs is likely. Conversely, elevated TSS and turbidity can provide benefits to some fish species and life history stages. Reduced water clarity can reduce the risk of predation by visual predators, which in turn can enhance survival of juvenile fish (e.g., Sweka and Hartman 2003) and may favour planktivorous fish..." | The Proponent discusses effects of TSS specific to the individual VEC fish species. However, much of the Proponent's impact assessment appears to rely primarily on general and lethal TSS concentration effects. Can the Proponent provide an expanded discussion of sub-lethal or chronic impact severity of effect risk assessment for anticipated TSS changes? | **see DFO-0085** |

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| 86 | DFO | AE SV | N/A | N/A | Aquatic Environment | "Keeyask Generation Project Environmental Impact Statement Supporting Volume Aquatic Environment June 2012" (disc 2), p1A-2ff... Restricted activity timing windows...DFO...In northern Manitoba, no in-water or shoreline work is allowed during the 15 April – 30 June, 15 May – 15 July, and 1 September -15 May periods where spring, summer, and fall spawning fish respectively are present, except under site- or project-specific review and with...implementation of protective measures...Based on data from Keeyask field investigations...proposed area-specific timing windows for restricted in-water construction activities are...15 May – 15 July for spring and summer spawning fish and 15 September – 15 May for fall spawning fish...scheduling of construction activities that require working in water have been developed and modified to the extent practicable to avoid or minimize the potential for disturbance to fish in the Keeyask area during spawning, and egg an fry development periods...Adjustments to scheduling...to restrict construction and removal of structures to times of ...year when sensitive life stages of fish are least likely to be present are summarized in Table 1A-2..." A summary listing shows these are mostly for cofferdam construction and removal "To the extent possible, work in water has been scheduled to avoid interaction with fish and fish habitat during the spring and fall spawning periods...When avoidance of both spring and fall spawning periods was not possible due to critical construction sequences, avoidance of spring spawning periods was given priority over avoidance of the fall spawning period...Additional mitigation of potential disturbances to fish and fish habitat will be gained by constructing each cofferdam in a sequence that minimizes the exposure of readily-transported fines to flowing water..." | A key mitigation is timing of in-water activity to avoid impacts on VEC fish species. Can the Proponent describe its contingency plans for unavoidable changes in scheduling. E.g., if a TSS episode exceeding the CCME guidelines is relatively benign for adult whitefish migration to spawning areas, is the same episode when delayed due to schedule changes similarly benign for incubating whitefish eggs? What sort of information would be available to rapidly assess the potential risk of a schedule change? What criteria would the Proponent use to trade-off costs to the project and costs to a VEC fish species? | **see DFO-0086** |
| 87 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Previous daily TSS sediment monitoring at the Wuskwatim GS construction site had frequent problems with bio-fouling of sensors. | Can the Proponent provide additional information on its anticipated TSS monitoring showing that problems with previous monitoring, e.g., bio-fouling of sensors, has been anticipated and solved? | **see DFO-0087** |
| 88 | DFO | R-EIS Gdlines | Section 8.0 | N/A | Physical Environment | Details of the development of the turbidity/TSS relationship do not appear to be provided. DFO feels it is necessary to know details of the relationship and plans for ongoing calibration to assess whether monitoring will be adequate for effective adaptive management. | Can the Proponent provide additional information on its plans for developing a turbidity/TSS relationship, assuming that is being considered, and details of procedures for calibrating the relationship to changing conditions of sediment characteristics, variation with water depth, seasonal variation, and generally correcting for "drift" from the initial relationship? | **see DFO-0088** |
| 89 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | How will potential risks associated with Sturgeon stocking and interactions with wild stock be addressed? Loss of genetic integrity, ecologic imbalance and community structure shift? | **see DFO-0089** |
| 90 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Assuming sturgeon exhibit natal philopatry for spawning locations, significant genetic structure may be apparent even if there is considerable mixing of groups between spawning events. Will this be accounted for when choosing individual broodstock? | **see DFO-0090** |
| 91 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Has consideration for the effects of the location of the new hatchery facility on imprinting been made? | **see DFO-0091** |

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| 92 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Because the chances of capturing a ripe female from which to collect eggs is low, the use of ovaprim is suggested, yet long term effects are unknown. How will this be addressed? | **see DFO-0092** |
| 93 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Should the original population be decimated, how will the population within the Gull Reach be maintained? | **see DFO-0093** |
| 94 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | The recruitment model/unexploited scenario mimics the Wisconsin guideline. There is acknowledgement that these numbers may be too low given the guideline was developed based on rivers smaller that the Nelson. How will final numbers be derived? | **see DFO-0094** |
| 95 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Need for a protocol to accrue the maximum benefit from the stocking program. Once genetic integrity has been disrupted how can the situation be reasonably corrected? "Given uncertainties surrounding genetic mixing of stocks, the initial stocking plan will likely attempt to maintain the existing genetic structure and collect spawn from the same subpopulations as will be stocked. However given uncertainties and difficulties associated with spawn collection, a second contingency strategy may be required...spawn will be collected at sites that are genetically the most similar to proposed stocking locations." We require assurance that the genetic differences that exist pre development will persevere. Appropriate analysis will be required to address this. | **see DFO-0095** |
| 96 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Disease control in stocked fish – how will this be monitored? Should a problem be identified, how will it be rectified? | **see DFO-0096** |
| 97 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Concern over the acquisition of sufficient broodstock to avoid genetic variability. There is acknowledgement that collecting spawning individuals will be unlikely. Concern over reliance on the use of gametes from just a few individuals (EIS suggests 2 females per year) and the subsequent release of closely related offspring. Decrease in herozygosity/ genetic drift/allele loss and thereby lower genetic diversity. Please provide detailed report(s) that examined these challenges. | **see DFO-0097** |
| 98 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Given predications of accumulated sedimentation/peat accumulation and subsequent influences in water chemistry (including decreasing oxygen and increasing mercury levels) is stocking the forebay with sturgeon a rational option? | **see DFO-0098** |
| 99 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Stocking will continue as long as required to achieve and maintain the stated DFO (2010) RPA for DU3. (pg 18) Long term program expected for a generation (25 years) or in perpetuity if needed. Is the proponent prepared to stock lake sturgeon as long as required (i.e. beyond 25 years?). | **see DFO-0099** |
| 100 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Given the challenges of detecting changes in sturgeon (growth, age, etc) over the short term, how will success/failure be determined? | **see DFO-0100** |

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| 101 | DFO | AE SV | Appendix 1A, Part 2 | N/A | Aquatic Environment | Appendix 1A - Part2 | Given the challenges of detecting changes in - Phased approach to passage – have possible retrofit options been identified? - Have other forms of d/s passage been identified? | **see DFO-0101** |
| 102 | DFO | PD SV | Section 6.7 | 6-13 | Aquatic Environment | | The EIS indicates that the turbine has been designed to maximize fish survival compared to other Manitoba Hydro generating stations. Please provide a table to compare turbines of similar design and on similar systems. | **see DFO-0102** |
| 103 | DFO | PD SV | Section 6.7 | 6-13 | Aquatic Environment | | The EIS indicates 90 % survival for fish up to 500mm. Can this be further broken down into species, sex, maturity and length for the VEC fish species within the Keeyask Study area. An analysis/graphs of survival rates and injury rates should be provided. | **see DFO-0103** |
| 104 | DFO | PD SV | Section 6.7 | 6-13 | Aquatic Environment | | Several recommendations to minimize mortality that can be incorporated into hydro facilities include: using trashracks with reduced bar spacing while preventing further impingement, using temporary overlays with the existing trashracks to reduce clear spacing during migration periods, use of partial depth curtain wall over existing trash rack, installation of an inclined or skewed bar rack system upstream of the intake, barrier or stop nets set upstream in the forebay, and use of partial depth guide walls or an angled louver system upstream of the intakes coupled with a bypass system. Will the powerhouse be designed to incorporate some of these features if monitoring indicates that fish mortality is higher than predicted? Additional biological data and studies will be required post construction to better assess the requirements and potential mitigation for both potential downstream passage and protection. Also, these studies should determine the overall number of fish expected to pass through the turbines. | **see DFO-0104** |
| 105 | DFO | PD SV | Section 6.7 | 6-13 | Aquatic Environment | | Survival rates can be maximized for entrained fish if operation of the turbines is at maximum efficiency. How will Keeyask be operated to minimize mortality? | **see DFO-0105** |
| 106 | DFO | PD SV | Section 6.7 | 6-13 | Aquatic Environment | | What are acceptable mortality rates based on the fish community and population in the Keeyask study area? | **see DFO-0106** |
| 107 | DFO | PD SV | Section 6.7 | 6-13 | Aquatic Environment | | A detailed monitoring plan should be developed to assess mortality of fish passing through the station and spillway. How will this impact the fish community? | **see DFO-0107** |

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| **Environment Canada** | | | | | | | | |
| 1 | EC | PE SV | Section 5.4.1.1.6 | 5-24 | Physical Environment | This section states the following:<br>'In total, 25 granular and 16 rock samples from the Keeyask GS area were selected for laboratory testing. Samples were shipped to Maxxam Analytics in Burnaby, BC, for testing in spring 2010 (granular borrow samples, specific and bulk rock samples) and winter 2010-2011 (specific, and composite rock samples). The analysis requested for the granular materials Included soluble metals using MEND guidelines for water-extractable metals (MEND 2000). The requested analyses on the rock samples Included total sulphur, sulphate, neutralization potential and metal content using standard Maxxam methods and quality assurances and quality control procedures (Sobek et al., 1978, MEND 1991).' | EC notes that results of the rock assessment are not shown. In addition, as indicated by the Proponent, the requested analysis on the rock samples included total sulphur, sulphate, neutralization potential and metal content , but this list does not include acid potential.<br><br>EC requests that the Proponent provide the result of the static and kinetic tests. | **see EC-0001** |
| 2 | EC | PE SV | Section 5.4.1.1.6 | 5-24 | Physical Environment | In this section, the Proponent states that:<br>'With respect to the quarry rock, there are a number of different indicators for the generation of acidic drainage and therefore a weight-of-evidence approach is typically applied. Using this approach, the assessment of the Keeyask rock samples concluded that the risk of acidic drainage is low.' | EC requests that the Proponent:<br>• Clarify what the following statement implies: "assessment of the Keeyask rock samples concluded that the risk of acidic drainage is low". Since no results of the rock assessment are provided, EC is unsure if this statement implies that the rocks are non acid generating (NAG) or that the neutralizing potential/acid potential ratio (NP/AP) is greater than 3 or uncertain (between 1 and 2).<br>• Confirm that any borrow materials or quarry rocks that would be used for construction as well as road construction do not show the potential to generate acid. | **see EC-0002** |
| 3 | EC | R-EIS Guidelines | Section 4.3.1.1 | 4-7 | Aquatic Environment | This section outlines that the powerhouse unit will contain electrical and mechanical equipment, including ventilation systems, domestic and fire water systems, cranes, water and wastewater treatment systems, compressed air, and oil storage facilities. | EC would like to make the Proponent aware of the new Wastewater System Effluent Regulations that may apply to the wastewater treatment component of the powerhouse depending of the volume of influent (100 m3/d) the system is designed to treat.<br><br>EC requests that the Proponent provide estimates on proposed wastewater influent volumes (including volumes associated with combined grey water, storm water and other wastewater steams) in order to determine whether this facility would be captured under the new wastewater regulations. | **see EC-0003** |

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| 4 | EC | R-EIS Guidelines | Section 6.3.8.2 | 6-216 | Aquatic Environment | This section outlines the following:<br>'Total organic material released into the reservoir is predicted to be highest in the large bays on the north and south sides of the new reservoir... These effects are considered large in magnitude, medium in geographic extent, medium term in duration and continuous.' | There is little detail provided regarding mitigation measures which may be implemented to reduce elevated levels of organic materials in the reservoir, in this section as well as Chapter 8 (Monitoring and follow-up).<br><br>EC requests that the Proponent provide details regarding specific mitigation measures which will be considered and implemented to reduce elevated concentrations of organic materials in the surface water at each phase of the project. This may include but is not limited to an outline of various tools, techniques and materials. | **see EC-0004** |
| 5 | EC | AE SV 2 | Section 2.5.1.1.8 | 2-44 | Aquatic Environment | This section states the following:<br>'Wastewater effluent, including concrete processing wastewater, will not be directly released to a waterbody unless it has been treated to meet applicable provincial and federal effluent licences, authorizations and permits.' | EC requests that the Proponent clarify if domestic wastewater and concrete processing wastewater will be combined into the same stream. | **see EC-0005** |
| 6 | EC | AE SV 2 | Section 2.5.1.1.8 | 2-44 | Aquatic Environment | This section proceeds to outline the following:<br>'Wastewaters from concrete processing (i.e., concrete batch plant effluent) will be initially discharged to a two-cell settling pond to reduce TSS prior to discharge to the lower Nelson River and apply end-of-pipe discharge criterion of less than 25 mg/L for TSS... TSS currently ranges (on average) between 15 and 18 mg/L in the Keeyask area and discharge of the concrete batch plant effluent or aggregate wash water is predicted to cause a negligible change in TSS in the Nelson River.' | The main concern discussed regarding concrete wash water is elevated levels of TSS. Consideration should be given to the potentially deleterious effects that concrete wash water could have on the aquatic environment due to its strong alkalinity. Other contaminants associated with concrete wash water (such as chromium) will not be completely removed simply through settling ponds.<br><br>EC requests that the Proponent:<br>• Provide a detailed outline of mitigation measures to be followed for surface runoff and wastewater control<br>• Develop and provide alternative and more rigorous mitigation measures for the treatment of concrete wash water if shown to be warranted by testing of discharge quality. | **see EC-0006** |

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| 7 | EC | AE SV 2 | Section 2.0, Table 2-11 | 2-135 | Aquatic Environment | Table 2-11 outlines that water treatment plant backwash will be treated if required, such that TSS will be less then 25 mg/L prior to discharge to the receiving environment. | EC requests the Proponent provide a full characterization of discharges to ensure they are not deleterious; noting that TSS should not be the only discharge parameter to be assessed against water quality objectives. | **see EC-0007** |
| 8 | EC | R-EIS Guidelines | Section 6.3 | 6-209<br>6-211<br>6-294 | Physical Environment | Section 6.3.7.1 states that: 'Cofferdam designs, construction methodology and sequencing have been developed to minimize erosion and sediment inputs during construction. For example, fine cofferdam material exposed to erosion (waves, flow) would be covered with rock to prevent erosion. The residual construction effects associated with shoreline and erosion processes are expected to be small in magnitude, medium in geographic extent, short-term and sporadic during the construction period.' Similarly section 6.3.7.2 states that: 'Shoreline erosion will expand the reservoir by an additional 7 to 8 km² (2.7 to 3.0 mi²) during the first 30 years of operation due to mineral bank erosion and peatland disintegration... The effects of the Project on shoreline erosion are considered to be large in magnitude, medium in geographic extent, and long-term in duration.' Table 6-19 outlines mitigation measures to reduce TSS and erosion during construction and operation. Construction Mitigation includes: Measures to control sediment releases; and Management measures to maintain inputs at levels that are not harmful to aquatic life. Operation Mitigation includes: No mitigation required. | EC requests that the Proponent provide additional information on the mitigation measures to be carried out to minimize shoreline erosion, reduce soil loss and adverse impacts to water quality and the river bed during this project. | **see EC-0008** |
| 9 | EC | R-EIS Guidelines | Section 6.3 | 6-214 | Physical Environment | This section outlines the following:<br>'As noted in the Shoreline Erosion section (Section 6.3.7.1), cofferdam designs, construction methodology and sequencing have been developed to minimize the introduction of sediment into the water. For example, cofferdam removal would be done “in the dry” as much as reasonably practical to prevent sediment entering the water. ' | The uses of cofferdam designs and construction methodology (‘in the dry’) are good examples of general approaches to mitigating against shoreline erosion however there is still little detail provided on a full range of design and construction techniques and tools which could be considered throughout construction, operation and decommissioning.<br><br>EC requests that the Proponent provide more detail regarding specific mitigation measures for each phase of the project (construction, operation and also decommissioning), including but not limited to an outline of various tools, techniques and materials which will be used to reduce erosion and a detailed description of how each will indeed mitigate against erosion. | **see EC-0009** |

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| 10 | EC | R-EIS Guidelines | Section 6.3.8.1<br>Table 8-3 | 6-214<br>8-13 | Aquatic Environment | Section 6.3.8.1 outlines the following:<br>'A Sediment Management Plan will be in place during construction and will describe where monitoring is to be done and what actions might be taken if suspended sediment increases beyond specified thresholds... Monitoring of suspended solids and turbidity will be done at several locations upstream and downstream of the Project as part of physical environment monitoring plan (see Chapter 8). Monitoring under the Sediment Management Plan would only be in place during construction and is separate from the physical environment monitoring.'<br><br>Table 8-3 also describes the monitoring regime for managing sediment and maintaining water quality. | The information provided in chapters 6 and 8 does not specifically outline where sampling and monitoring will take place along the Nelson River and what actions might be taken if suspended sediment increases beyond specified thresholds.<br><br>EC requests that the Proponent:<br>• Provide more details in the Sediment Management Plan which includes, but is not limited to, proposed sampling locations (illustrated on a site plan, relative to proposed infrastructure), number of sampling locations, sampling and monitoring frequency, sampling parameters, type of samples to be collected, time of year sampling will take, and sampling methodology, detailed erosion and sedimentation prevention strategies, measures that will be used for reservoir preparation, best practices, and identify linkages to adaptive management, as required for a comprehensive Sampling Management Plan.<br>• Identify mitigation measure to be taken in the event of water quality exceedances. These details should be provided for each phase of the project (construction, operation and decommissioning). | **see EC-0010** |
| 11 | EC | PE SV | Section 7.4.2.3 | 7-37 | Aquatic Environment | Erosion of peatlands will result in the transportation and sedimentation of peat materials in the reservoir. The Proponent has identified peat transport zones and estimated volumes of material that would be mobilized over timelines up to 30 years. The EIS predicts some 1.3 million tones of peat within the reservoir, of which 10,000 to 13,000 tonnes are expected to travel downstream after year 1 if no peat management measures are implemented. | EC requests that the Proponent identify the peat management measures that will be undertaken; how peat inputs, behaviour and effects will be monitored over the operation of the project; and what and when adaptive management actions will be used as a contingency should effects be detected. | **see EC-0011** |
| 12 | EC | PE SV | Section 6.4.2.1.5<br>Section 7.4.2.3<br>Section 9.2.1.2 | 6-56<br>7-35<br>9-6 | Aquatic Environment - Peatlands | As peatland is flooded, floating peat mats will rise up with the rising water, and may be mobile within the reservoir. Organic sedimentation is expected to occur beyond the modeled 30 year horizon, but at reduced rates. The peat mats are predicted to sink to the bottom in some cases, and become overlain with silt. Predictions have been made respecting the effects on dissolved oxygen levels, due to decomposition of the organic material. Other changes to water quality may be associated with the addition of the peat materials. | EC requests that the Proponent:<br>• Describe the potential for further changes to the water chemistry in the reservoir, such as a drop in pH, concomitant increase in metals, increased color due to organic matter<br>• Confirm if "worst case" volumes of peat addition have been taken into account with respect to estimating mercury methylation<br>• Provide estimates of depth of lakebed to be covered | **see EC-0012** |

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| 13 | EC | PE SV | Section 7.4.6 | 7-43 | Aquatic Environment - TSS | Real time monitoring of TSS will be done using turbidity as a surrogate. This is a commonly accepted practice, as it provides immediate data for management response. However, the relationship between TSS and turbidity must be determined on a site-specific basis, and be calibrated and validated as the project proceeds. | EC requests that the Proponent revise the sediment management plan to include a section that details monitoring of turbidity and TSS, including development of the regression model, calibration with field data, and ongoing validation and QA/QC. | **see EC-0013** |
| 14 | EC | | Proponent's Presentation January 24th, Slide 15 | | Aquatic Environment | Background TSS is estimated to average 10-20 mg/L. | EC requests that the Proponent describe the dataset and method used to determine the background value of 20 mg/L. | **see EC-0014** |
| 15 | EC | R-EIS Guidelines | Table 8-3 | 8-14 | Aquatic Environment | Monitoring is described in general terms in Table 8-3. In addition, presentations made by the Proponent described proposed construction phase monitoring. In presentations on the proposed monitoring (April 11, 2012), it was proposed that there would be 3 sites for construction monitoring with thresholds set for mitigation actions to be taken. The sites include an upstream location (Site 1), downstream location (Site 2) and site near the outflow of Stephens Lake (Site 3). Turbidity will be monitored as a proxy for total suspended solids (TSS) and be compared to thresholds: increases at Site 2 of 25 mg/L above Site 1 for 1 hour would trigger investigation; increases of 200 mg/L above Site 1 would trigger mitigative action, and increases at Site 3 of 25 mg/L above Site 1 would trigger action. | Concerns with the proposed monitoring have been identified: The proposed sites allow for a considerable area of Stephens Lake to experience elevated TSS before triggering action. Monitoring Site 2 is sited well below the construction activity, and should be closer to the area of disturbance. Changes to Site 3 as proposed would mean that most or all of Stephens Lake had elevated TSS and turbidity.<br><br>EC requests that the Proponent provide further clarification of the proposed monitoring. EC requests that the Proponent develop a monitoring plan that identifies the effects associated with construction and operation of the proposed facility and planned mitigation. The plan should describe the sites to be monitored, timing, how comparisons to baseline will be drawn, identify thresholds that will trigger action, and provide details of how the field monitoring will be done, including quality assurance/quality control measures. | **see EC-0015** |
| 16 | EC | PD SV and R-EIS Gdlines | Section 2.5.1.1<br>Section 6.2.3.3.6<br>Section 8.2 | 2-37<br>6-76<br>8-9 | Aquatic Environment | The Proponent acknowledges that there will be increases in mercury associated with the reservoir impoundment, and states that there is no mitigation available. Levels are predicted to rise for a period of time before stabilizing then declining, over the order of three decades. Maximum concentrations do not appear to be provided. | EC requests that the Proponent conduct an assessment of downstream effects associated with mercury methylation including:<br>- identifying pathways for mercury throughout the food web, and incorporating lessons learned from the other hydroelectric projects;<br>- baseline mercury data collection in water, sediments and biota;<br>- revise modeling taking into account additional pathways, and particularly mercury accumulation in the benthos to predict the fate of mercury in the downstream environment; and<br>- identification of any additional mitigation or adaptive management measures. | **see EC-0016** |

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| 17 | EC | R-EIS Guidelines | Table 8-3 | Aug-12 | Aquatic Environment | The proposed monitoring includes sampling of fish for gill histology if peak sediment inputs exceed target levels. EC suggests that non-lethal techniques be investigated for use in evaluating the effects of elevated TSS on fishes; detection of effects associated with exceeding TSS thresholds may also be approached in a tiered fashion. | EC requests that the Proponent provide details on monitoring that would be done in response to threshold exceedance, and the rationale for what is proposed.<br>If levels in water approach thresholds for action, EC requests that the Proponent investigate effects on sediments and benthos should there be extended exposure to and settling out of particulate matter. DFO should be consulted on the advisability of sampling fishes. | **see EC-0017** |
| 18 | EC | R-EIS Guidelines | Section 6.5 | 6-362 | Terrestrial Environment | The Proponent has not included a discussion or impact assessment regarding these risks associated with lighting and collision; could find no reference to these in the EIS. | EC requests that the Proponent provide information regarding any design and mitigation measures that have been incorporated to minimize the adverse effects of lighting. EC also requests further information regarding the communication tower, and any other features planned for the project site that may create a specific collision hazard for migratory birds, as well as on the proponent's proposed mitigation measures to minimize the risk of collisions. | **see EC-0018** |
| 19 | EC | R-EIS Guidelines | Section 6.5.7.7.3 | 6-362 | Terrestrial Environment | In this section the Proponent has proposed the following mitigation in response to the loss of gull and tern breeding habitat: "Deployment of artificial gull and tern nesting platforms (e.g., reef rafts), breeding habitat enhancements to existing islands (e.g., predator fencing or placement of suitable surface substrate), and/or development of an artificial island, or a combination of these measures, will be implemented to off-set the loss of gull and tern nesting habitat at Gull Rapids and areas upstream." | EC requests that the Proponent provide additional information regarding each mitigation measure (i.e., for artificial nesting platforms, island enhancements, or development of artificial islands), including information regarding the design, placement, development and implementation of each measure. EC also requests that the Proponent identify the decision-making process by and situations in which they would choose to a) deploy an artificial nesting platform, b) enhance an existing island, c) develop an artificial island, or d) implement a combination of these measures. | **see EC-0019** |

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| 20 | EC | R-EIS Guidelines | Table 6-14<br>Table 6-15<br>Table 6-16 | 6-196<br>6-197<br>6-198 | Physical Environment | The emissions estimates are compared to the total Manitoba road transport emissions. Comparing all of Manitoba to the emissions generated at the Project site don't appear to match in scale. | EC requests that the Proponent provide an explanation as to why a provincial scale was used for comparison with this project. | **see EC-0020** |
| 21 | EC | PE SV | Table 3.4-2 | 3-9<br>3-11 | Physical Environment | This section states that:<br>'The maximum potential daily loading due to Keeyask road transport for each reported air contaminant is "small in comparison" to daily emission loadings derived from total emissions reported to NPRI (2009) for all road transport activities in Manitoba.'<br><br>Also, by using table 3.4-2, EC calculated that the estimated total SOx, NOx & PM emissions from the project are 13.3%, 1.6% and 1.4% respectively of the total Manitoba road transport emissions. | EC requests that the Proponent provide further clarification on the criteria being used to determine the definition of a 'small' in this context. | **see EC-0021** |

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| 22 | EC | PE SV | Section 3.4 | 3-11 | Physical Environment | This section further states that:<br>'Annual emissions associated with **dam** and facility construction are estimated to be highest for NOx at 382 tonnes per year; however, this is still less than 1% of the annual NOx loading estimate for road transport within the entire province.'<br>This is true for the number of tonnes, but both PM10 and SOx emissions have a higher percentage when compared to the 2009 emissions for MB road transport of 1.0% and 9.2% respectively. | EC requests that the Proponent provide clarification as to why they did not develop mitigation measures for SOx emissions. | **see EC-0022** |
| 23 | EC | PE SV | Section 3.4 | 3-12 | Physical Environment | This section states that:<br>'Acceptable dust-control measures will be used on the roadway, as necessary, to limit the amount of airborne dust.' | EC requests that the Proponent provide the criteria that will used to determine when the dust-control measures will be implemented and whether or not they be included in the EnvPP. | **see EC-0023** |
| 24 | EC | PE SV | Table 3.4-5 | 3-19 | Physical Environment | This table lists the magnitude of air quality impacts during construction as 'moderate', but in the preceding sections of text the magnitude is determined to be small. | There appears to be contradicting statements throughout this section on the magnitude of air quality impacts during construction of the Project.<br><br>EC requests that the Proponent provide clarification on the prediction of air quality impacts during the construction phase. | **see EC-0024** |

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| 25 | EC | PE SV | Section 3.4 | 3-20 | Physical Environment | This section states that:<br>'Project effects on noise and air quality related to construction are considered to be moderate in magnitude and medium in their spatial extent from construction sites, and therefore, confined to localized areas within the study area. Consequently, noise and air monitoring programs are not planned for the Project.' | EC requests that the Proponent revise their EIS to include temporary air monitoring programs during the construction phase of the Project. | **see EC-0025** |
| **Health Canada** | | | | | | | | |
| 1 | HC | SE SV and TE SV | Appendix 5C Section 8.3 | 5C-1 8-1 | Socio-Economy | Critical review of the HHRA:<br>The baseline mercury levels in moose and snowshoe hare were not obtained from data collected in the Keeyask region but rather from data collected outside of Manitoba. The use of off-site data increases the degree of uncertainty in the conclusions presented in the HHRA regarding human exposures to this contaminant. The HHRA recommends monitoring mercury levels in wild game so data that is representative of the impacted region is obtained. | HC supports the recommendation in the HHRA that the monitoring of wild game be undertaken. This information would serve to validate some of the assumptions used in the HHRA (e.g. off-site data for moose and snowshoe hare) and also beneficially serve as baseline data for future Keeyask HHRAs and the assessment of risk related to other hydro generation projects planned within the region (e.g. Conawapa). | **see HC-0001** |
| 2 | HC | SE SV and TE SV | Appendix 5C Section 5.4.2.3 Table 7-1 | 5C-1 5-214 7-53 | Socio-Economy | Mercury and human health – proposed mitigation measures: Based on the results of the HHRA, fish consumption recommendations were developed. HC agrees with the need for such recommendations and in general, would also concur with the recommendations themselves.<br><br>However, HC notes that with respect to recommendations of “unrestricted eating” for all fish with less than 0.2 ppm mercury, the current edition of the Guidelines for the Consumption of Recreationally Angled Fish in Manitoba (2007) recommends that women of childbearing age and children under 12 years, limit their consumption of fish with less than 0.2 ppm mercury to 8 meals per month.<br><br>The HHRA recommends that fish consumption advisories be communicated to local First Nations and communities. Also, based on fish monitoring data, additional human health risk assessments will be undertaken every 5 years after peak mercury levels have been reached to determine if consumption advisories need to be changed. | HC advises adopting Manitoba’s guidelines recommendation limiting consumption for women of childbearing age and children under 12 years with respect to fish with less than 0.2 ppm mercury to provide added protection of health for these sensitive receptors.<br><br>HC would consider this approach reasonable but would advise that if monitoring results show that mercury levels in fish are higher than the predicted maximum levels in the HHRA, prior to reaching their actual maximum levels, fish consumption advisories should be re-visited to ensure that they remain protective of human health. | **see HC-0002** |
| 3 | HC | SE SV | Section 5.3.3 | 5-104 to 5-120 | Socio-Economy | Mercury and human health: The EIS indicates that communication products to address adverse health impacts will be developed. | It should be noted that the determination and implementation of risk management strategies for country foods in the project area fall under the responsibilities of provincial and/or municipal authorities.<br><br>However, HC considers accurate communication strategies a very important tool in the reduction of risk to Aboriginal health with regards to country foods. HC would be willing to review proposed risk management approaches and communication products to provide its opinion. | **see HC-0003** |

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| 4 | HC | SE SV | Section 5.3.3.2 | 5-107 | Socio-Economy | Gull eggs and plants: The HHRA does not assess plants or gulls eggs (identified by FN as important food source of concern during the workshop held to determine what they eat).<br><br>Gull eggs and wild plants would not be expected to represent significant contributors to mercury exposure and therefore the final conclusions with respect to potential health risks are not expected to change based on this additional data. However, as local population who consume country foods have specifically identified these foods as important food sources, gull eggs and wild plants should be included in order to confirm the expectations that these foods are acceptable to consume.<br><br>This information would also beneficially serve as baseline data for future Keeyask HHRAs and in the assessment of risk related to other hydro generation projects planned within the region (e.g. Conawapa). | HC encourages the proponent to participate in the voluntary monitoring plans for gull eggs and plants to provide more comprehensive information on the potential adverse effects to these country foods. | **see HC-0004** |
| 5 | HC | SE SV | Appendix 5C, subsection 3.3 | 5C-28 | Socio-Economy | Mercury in Ducks: In the HHRA mercury levels in whitefish were used to represent mercury levels in waterbirds. The proponent shows data collected from hydroelectric project areas in Québec to support this approach. The intent is to demonstrate that according to data from the Québec projects, mercury levels in waterbirds can be estimated by the levels of mercury in fish with similar diets and similar feeding habits (TE SV-2, Section 8.0 - *Wildlife and Mercury,* Table 8-4). Waterbirds that were identified as food sources in the Keeyask region are herbivorous/benthivorous and would have similar dietary patterns to whitefish.<br><br>The HHRA recommends mitigation measures including monitoring mercury in waterfowl and waterbirds. | HC suggests that the future monitoring data should be assessed to determine whether consumption of waterbirds and waterfowl poses a health risk and implement mitigation measures if an unacceptable risk has been identified. | **see HC-0005** |
| 6 | HC | SE SV | Appendix 5C, subsection 5.1.2 | 5C-59 | Socio-Economy | Mercury concentrations in fish from AEA offset lakes: The HHRA states "...measured mercury concentrations in fish from offset lakes (specifically identified by one of the Keeyask Cree Nations) have indicated that certain fish from the various background lakes in the study area may have mercury concentrations that warrant consumption recommendations (tissue concentrations of mercury above 0.2 ug/g)."<br><br>HC notes that in Table 7L-1, data report maximum mercury levels of 0.85, 0.71, and 0.61 ppm for walleye collected from Pelletier, Recluse, and Waskaiowaka Lakes from 2004-2006. Fish from these lakes are intended to provide traditional food source as indicated in the Adverse Effects Agreement Healthy Food Fish Program, in order to replace fish that may no longer be safe to consume as a result of increased methyl-mercury levels caused by the Keeyask Project. | HC advises that the proponent monitor mercury concentration in fish from the offset lakes to mitigate potential risks to human health arising from use of off-set lakes as a country foods source as a result of the project. Communication products may be required for use of these lakes (e.g., consumption recommendations for sensitive subgroups of the population). | **see HC-0006** |

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| 7 | HC | AE SV 2 | Section 7.2.4 | 7-16 | | Project Effects, Mitigation and Monitoring: HC understands that the proponent has proposed to monitor mercury in fish tissue on an annual basis until maximum concentrations are reached, and every 3 years thereafter until concentrations are stable. HC does not have any objections to this approach; however, the EIS does not provided a clear determinant of what constitutes "maximum concentration" and "stable". Mercury levels in fish are expected to steadily increase over a number of years, reach a maximum, and decline steadily thereafter but may fluctuate slightly over the course of this time. The number of years in which a decrease in mercury levels is observed to conclude that a maximum concentration has been reached, does not appear to have been determined.<br><br>The EIS includes an outline of monitoring planned for the mercury in fish tissue. However, the detailed monitoring program that will be provided in the Aquatic Effects Monitoring Plan (AEMP) is not yet provided and is related to regulatory licensing with DFO and Manitoba Conservation. | HC advises that the proponent provide a clear determinant in the EIS of what will constitute a "maximum concentration" and "stable" condition at which point fish tissue monitoring will be reduced to a frequency of every third year.<br><br>When the AEMP is available for review, HC is able to provide advice regarding potential effects and review of additional HHRAs to ensure fish consumption advisories remain protective of human health. | **see HC-0007** |
| 8 | HC | SE SV | Section 5.3.3.1 | 5-106 | Socio-Economy | Existing / Past Health Impacts from Mercury: There are three hydroelectric generating stations planned for the Nelson River (Wuskwatim [currently under construction], Keeyask and Conawapa). This area has been impacted by past hydroelectric developments. The EIS states "Based on their experiences with previous hydroelectric development and through the Federal Ecological Monitoring Program (FEMP), the issue of mercury and human health became a primary concern for the KCNs in relation to the Keeyask Project.<br><br>HC conducted biomonitoring (blood and hair) sampling for mercury from 1976 until 1990 from local people within this region. For the most part, people from this area tested within acceptable range, but approximately 2% tested in "greater risk" range (Wheatly and Paradis, 1995)).<br><br>HC notes that many environmental assessments involving hydro projects, where mercury levels are known to increase in biota, have considered hair mercury analysis of local populations in order to determine if any potential increased dietary exposure may pose a risk.<br><br>It is important to note that the FEMP was a result of Claim 18 in 1981, under the Northern Flood Agreement (NFA), which alleged that Canada, Manitoba, and Manitoba Hydro had not met a responsibility of the NFA "to implement a long-term coordinated ecological monitoring and research program that would allow evaluation of impacts on communities" that signed the NFA and belonged to the Northern Flood Committee. Reference: Wheatly B, and Paradis S, Exposure of Canadian Aboriginal Peoples to Methylmercury. Water, Air, Soil Pol 1995; 80: 3-11. | HC suggests that the proponent consider the merit of conducting such analysis on the basis of whether it can adequately be confirmed that any increase in mercury exposure from the diet, based on empirical measurements in fish, would not have a significant impact on human health and report the results in the HHRA.<br><br>In the event where hair mercury analyses are conducted, HC is prepared to review the data and provide an opinion on the potential for adverse impacts with respect to human health. | **see HC-0008** |

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| 9 | HC | R-EIS Gdlines | Section 10-4 | 10-3 | Response to EIS Guidelines | This section states "The concept of using a precautionary approach has been an implicit foundation in the planning and design of the Project, using both technical science and aboriginal traditional knowledge (ATK)." | HC would like to inform the proponent of a biomonitoring initiative underway in Saskatchewan that may be considered to manage risk of traditional uses of land and potential impacts to human health resulting from the Project.<br><br>The Alberta and Saskatchewan governments are looking to northern Saskatchewan to determine the impact of development on the health of people living in the north. Starting in August 2011, women in northern Saskatchewan who are pregnant have been asked to participate in a health biomonitoring study. Blood routinely drawn as part of their pre-natal health care is being tested for certain chemicals, including pesticides, lead and mercury.<br><br>http://www.health.gov.sk.ca/biomonitoring-common-questions<br><br>Should biomonitoring be undertaken by the proponent, as justified by previous biomonitoring results, it would be a means of identifying whether communication products are effective i.e., if consumption guidelines are being followed, or if populations are in the range of exposure that would pose unacceptable risk. | **see HC-0009** |
| **Natural Resources Canada** | | | | | | | | |
| 1 | NRCan | R-EIS Gdlines | Section 4.3.2.1 | 4-9 | Physical Environment | The proponent plans to construct and utilize 3 landfill sites to dispose of waste. Details on the location and construction of the landfill sites are not provided. Therefore the potential effect on groundwater quality cannot be assessed. Information on the placement and construction of landfills provided in a hydrogeological context allows for the assessment of whether groundwater may become contaminated from such a facility. | Information on geographic location and depth of the landfill is requested. Discuss the type of liner to be used (natural, engineered). Discuss which hydrogeological units (and the characteristic properties of the units) are expected to be in contact with the waste. | **see NRCan-0001** |
| 2 | NRCan | R-EIS Gdlines | Section 4.6.14 | 4-39 | Physical Environment | The proponent plans to drill a potable water well for use during the construction phase of the project. Details on the location, construction and future usage of this well are not provided. | Provide details on the location, construction, and future usage of the potable well to be drilled and utilized during the project construction phase. | **see NRCan-0002** |
| 3 | NRCan | R-EIS Gdlines | Section 4.6.16 | 4-40 | Physical Environment | The proponent plans to drill a potable water well for use during the construction phase of the project. It is not clear if this well will be used beyond the construction phase or if it will be decommissioned following the construction phase. Decommissioning of wells no longer needed is required in order to protect groundwater. Abandoned wells can provide a conduit for groundwater contamination. | Clarify if the potable well to be drilled and utilized during project construction will be used beyond this phase or decommissioned. Provide details on the future decommissioning of this well. | **see NRCan-0003** |
| 4 | NRCan | R-EIS Gdlines | Section 6.2.3.2.9 | 6-48 | Physical Environment | The proponent acknowledges an inconsistent relationship between water levels in groundwater and adjacent lakes. This assessment is based on only 8 monitoring wells drilled on site. In order to better understand the relationship between groundwater and surface water, data collection from additional monitoring wells is recommended. | NRCan recommends that the proponent construct and monitor additional monitoring wells for a better understanding of the baseline groundwater-surface water relationships. | **see NRCan-0004** |

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| 5 | NRCan | R-EIS Gdlines | Section 6.2.3.2.9 | 6-50 | Physical Environment | The proponent discusses baseline groundwater quality based on reference to the literature. They also mention that on-site groundwater analyses confirm this and discuss elevated zinc concentrations. However, there is no information provided with respect to on-site sampling. It is unclear how many on-site samples were collected and what parameters they were analyzed for. The analytical results are not presented. The absence of this information makes it impossible to assess if baseline conditions of groundwater quality have been adequately determined. | Provide the location of on-site groundwater monitoring well sampling sites. Provide information on the frequency of groundwater sampling from these sites. Provide information on sampling and laboratory methodologies, including a discussion of quality assurance and quality control. Present the analytical results of all field-derived and laboratory analyses. Provide a direct comparison, by means of a table, of groundwater quality determined from on-site measurements versus groundwater quality gleaned from the literature. It is recommended the following physical and chemical parameters be tested for in groundwater: alkalinity, temperature, pH, Eh, electrical conductivity (EC), major ions, nutrients, minor and trace constituents, and metals (including methyl mercury). | **see NRCan-0005** |
| 6 | NRCan | R-EIS Gdlines | Section 6.3.9.1<br>Section 6.3.9.2<br>Map 6-54 | 6-218 to 6-219 | Physical Environment | The proponent considers the possibility of groundwater contamination as a result of accidents/spills and claims that with proposed protection measures no residual quality effects are predicted. However, they do not assess any other sources of possible contamination. These could include contamination resulting from the landfill (see NRCan comment 1) or contamination of groundwater caused by project-induced changes to the hydrogeological regime that result in potentially contaminated surface water flowing into the groundwater system. Modeled groundwater flow directions (post project) indicate that flow along the Nelson River is generally from groundwater towards the River. However, this may not be the case in the vicinity of the generator/dams. For example, groundwater on the south side of Gull Lake will decrease in velocity or flow away from the flooded zone (p. 6-219). | Discuss the possibility of flow from the Nelson River to groundwater in the vicinity of the generator/dams during the construction and operation phases of the project. Discuss the possibility of groundwater contamination from potentially contaminated surface water, including possible methyl mercury contamination. Discuss measures taken to avoid groundwater contamination in this area. | **see NRCan-0006** |
| 7 | NRCan | R-EIS Gdlines | Section 6.3.9.1 | 6-218 | Physical Environment | The proponent states that future monitoring of groundwater levels in the project vicinity is not proposed. Monitoring of groundwater levels is an important means for validating the numerical groundwater model which is used to predict project-related effects to groundwater. Given that there were only 8 on-site groundwater monitoring wells, additional monitoring wells (see NRCan comment 4) and future monitoring of those wells is recommended. | NRCan recommends that future monitoring (pre-construction, construction, and operation phases) of groundwater levels continue in order to validate model predictions. | **see NRCan-0007** |
| 8 | NRCan | PE SV | Section 8.2<br>Section 8.3 | 8-2 to 8-15 | Physical Environment | There is no mention of other possible groundwater users in this area. It is essential to know if there are any groundwater users within the defined study area, particularly those who may use the water as drinking water. Groundwater may become contaminated as a result of project activities and any existing groundwater wells may become contaminated as a result. | Clarify if there are any present or reasonably foreseeable future groundwater users in the groundwater study area (defined in Section 8.2.2). If there are, provide the location of the wells, well completion details, the existing water quality in the wells, and discuss whether the wells are used for drinking water. | **see NRCan-0008** |
| 9 | NRCan | PE SV | Section 8.2.1.3 | 8-3 to 8-4 | Physical Environment | The proponent acknowledges that potential changes to future groundwater quality resulting from the proposed project are assessed only in a qualitative manner. It is unclear why these potential changes were not assessed quantitatively, using the numerical groundwater model. | Provide justification for the absence of a quantitative assessment of changes to future groundwater quality. | **see NRCan-0009** |
| 10 | NRCan | PE SV | Section 8.2.3.3 | 8-7 | Physical Environment | The hydraulic conductivity range is given as 1x10-4m/s to 1x108 m/s. This must be a typo (should be 1x10-8), as this range is unrealistic. | Correct typo on page. | **see NRCan-0010** |

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| 11 | NRCan | PE SV | Table 8.3-1 | 8-12 | Physical Environment | No reference is provided for this table of hydraulic conductivity values. It is unclear if these values are derived from the literature or from on-site data. | Clarify the source of the hydraulic conductivity data in Table 8.3-1. | **see NRCan-0011** |
| 12 | NRCan | PE SV | Section 8.4.6 | 8-31 | Physical Environment | The number and distribution of groundwater wells is insufficient to provide a good basis for numerical modeling. Only 8 on-site groundwater monitoring wells were used. Only 3 wells are proximal to the proposed generator/dams. As this is an area where the groundwater-surface water relationship is more complex and groundwater flow reversals could occur, a greater well density is warranted. Additionally, there is only 1 well west of Caribou Island. This is a very low number of wells considering that this area represents at least half of the area to be inundated by the reservoir. | To provide greater confidence in the numerical groundwater model it is recommended that additional groundwater monitoring wells be installed to monitor water levels. It is recommended that multi-level wells be installed in some locations in order to delineate vertical groundwater flow gradients. | **see NRCan-0012** |
| 13 | NRCan | PE SV | Appendix 8A | N/A | Physical Environment | There is no mention of model verification or model validation for the numerical groundwater model. Verification is used to establish greater confidence in the model by using the set of calibrated parameter values and stresses to reproduce a second set of field data (above and beyond model calibration). Model validation is completed years after modeling is completed in order to determine if the model's prediction was accurate. This is particularly important for this project as there is considerable uncertainty in model predictions due to the lack of on-site data. | Provide details on model verification if it was conducted and plans for future model validation. | **see NRCan-0013** |
| 14 | NRCan | R-EIS Gdlines | Section 6.9.3.5, Section 6.2.3.2.5 | 6-583; 6-28 to 6-29 | Physical Environment | NRCan expert reviewed the information related to the seismic activity. Although the expert concurs that the known earthquake activity in the area is very low and that the potential for significant reservoir-triggered seismicity is also extremely low, the following sentence needs to be changed. "It is evident from the historical records since the 1600s and relatively recent seismic monitoring, which presents the distribution of magnitude 3 and greater earthquakes in Canada since 1627 (Natural Resources Canada 2008), that no major earthquakes, and hence no important earthquake generating fault movements, have occurred in Manitoba (Map 6-6)." | This sentence suggests that the earthquake reporting is complete in Manitoba for magnitude 3 and larger since 1927 based on an NRCan map that displays the known earthquakes between 1627 and 2008. This is not so. Potentially damaging earthquakes in this area of the Precambrian Shield could only be known since the late 19th century at the earliest when written reports from Manitoba started to be available. The earthquake detection in the area is about M 5 since approximately 1940 and M 5.5 and larger since about 1900 (extrapolated from Southern Saskatchewan in Basham et al., 1979). M 3 and larger could be detected only since the 1990's. Other studies may have looked at the detection completeness of this part of the Canadian Shield. Also, the proposed link between an absence of major earthquakes in recent times and no fault movements is incorrectly presented. Earthquake-induced surface ruptures could have been produced prior to earthquake reporting or detection by human beings. Pre-19th century fault movements could only be known from special geological studies, not deduced from our time-limited earthquake coverage. One must note, however, that even if the text is changed along the lines we present therein, it will not modify the conclusions of the report, i.e. that the design should use the accepted values of seismic hazard for this area of the Canadian Shield. The expert, however, would like the text to better reflect the seismological knowledge of Manitoba to minimize the risk of a false perception. | **see NRCan-0014** |
| 15 | NRCan | R-EIS Gdlines | Section 6.9.3.5, Section 6.2.3.2.5 | 6-583 6-28 | Physical Environment | Description of local seismicity does not consider completeness of earthquake catalog. | See comment 14 | **see NRCan-0015** |

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| 16 | NRCan | PE SV | Section 5.3.2.1 | 5-5 to 5-6 | Physical Environment | The nature of underlying bedrock (and overlying materials) is an important component, even in projects such as Keeyask where it provides not only the solid ground on which the Generating Station rests but also it may contain trace elements that may affect groundwater and surface water quality. | The Precambrian bedrock is described as consisting of greywacke gneisses, granite gneisses and granites. What are greywacke gneisses? Please provide a more detailed description of regional and local bedrock that includes information such as: local fracture/joint density, orientation, etc. | **see NRCan-0016** |
| 17 | NRCan | R-EIS Gdlines | Section 4.3.3.1<br>Section 4.6.3 | 4-15<br>4-34 | Reservoir Preparation | The proponent indicates that standing woody material, including dead and living trees and shrubs 1.5 m tall or taller, as well as fallen trees will be removed from the areas to be flooded. Reservoir clearing addresses boating safety issues and aesthetic issues and is also intended to reduce the production of methylmercury in the future reservoir. | The reduction of methylmercury production would be more effective if reservoir clearing included the removal of labile organic materials such as shrub foliage. Labile organic matter from flooded foliage is one of the main factors favouring the algal bloom that occurs in the first years after impoundment, and this in turn favours the methylation of mercury and its uptake in the reservoir foodweb. NRCan recommends consider whether this strategy could be applied for the Keeyask project. | **see NRCan-0017** |
| 18 | NRCan | R-EIS Gdlines | Section 6.4.7 | 6-288 to 6-291 | Mercury mitigation in aquatic environments | The proponent expects a significant increase of mercury concentrations in large piscivorous species, such as walleye and northern pike and to a lesser extent in lake whitefish. This increase is expected to peak within 3 to 5 years after flooding and to decrease gradually in the following 25 to 30 years. Peak concentrations on the order of 0.8 to 1.4 ppm (Table 6-18), well above the 0.5 ppm guideline for commercial marketing, are expected for walleye and northern pike. Given the amplitude of the mercury residual effect, monitoring of Hg concentrations in fish muscle tissue will take place until concentrations return to long-term stable levels. | The main measures proposed to mitigate the mercury issue in reservoir biota are (1) the clearing of trees and large shrubs prior to flooding and (2) the monitoring of Hg concentrations in large fish and (3) the ensuing publication of consumption advisories. In an effort to reduce as much as possible the increase of mercury concentrations, NRCan recommends that the proponent consider extending the reservoir clearing activities to areas expected to be affected by peatland disintegration (cf. section 6.3.7), one possible effect of which may be is to stretch beyond 30 years the period of strong mercury contamination in the Keeyask reservoir. This consideration should be discussed with relevant federal departments (e.g. Environment Canada) and provincial ministries. | **see NRCan-0018** |
| 19 | NRCan | AE SV | Section 7.0 | 7-1 to 7-75 | Mercury in fish | This section presents a well documented and fairly comprehensive account of the mercury issue in boreal hydroelectric reservoirs, and more specifically in the Keeyask reservoir and nearby water bodies. It presents in a single document much of the information which is otherwise scattered in various other EIS documents. | However, this document presents no information on the variability of Hg concentrations in soils (particularly in organic horizons) that will be affected by reservoir flooding, whether immediately following impoundment or much later as a result of peatland disintegration. In NRCan's view this information, and its links with vegetation cover and wildfire history, are critical in the development of strategies to reduce the remobilization of mercury and to reduce methylation rates in flooded terrain. Moreover, the EIS documents contain no information on forest fire history, as had been requested in the Guidelines (section 8.1.3). NRCan recommends that this information be included in the EIS. | **see NRCan-0019a and NRCan-0019b** |
| 20 | NRCan | PE SV | Section 7.3.1.1.2 | 7-16 | Bedload transport | Quality of conclusions from limited data | The general lack of bedload through the Local Study Area is not surprising given that the Split and Clark lakes are immediately upstream and represent sediment traps. Also, the general low rates of bank erosion, lack of alluvial bars, and the coarse character of the channel bed are all consistent with a very limited transport and supply of bedload materials. | **see NRCan-0020** |

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| 21 | NRCan | PE SV | Table 7.4-6 | 7-39 | Summary of sedimentation residual effects | Content of summary assessments of the sedimentation resulting from the project | NRCan has no issues with the summary assessments of the sedimentation effects resulting from the project. | **see NRCan-0021** |
| 22 | NRCan | PE SV | Section 7.4.6 | 7-43 | Environmental monitoring | Monitoring actual post-project effects contributes to improving the modelling of impacts from future projects | NRCan strongly encourages the monitoring of the changes in sedimentation resulting from the project. NRCan recommends that the proponent should consider undertaking a regular and detailed suspended sediment sampling program for different discharges, particularly in the first 10 years of the project, when change is most likely to be significant. | **see NRCan-0022** |
| **Transport Canada** | | | | | | | | |
| 1 | TC | PD SV | Section 2.0 | 2-24 and 2-25 | South Access Road Crossing | The south access road will cross the Butnau River with culverts | Provide details regarding the conceptual design and construction methodology of this crossing. | **see TC-0001** |

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# ACRONYMS

| Submitter Name | Full Name |
|---|---|
| Brown | Ian RJ Brown |
| CAC | Consumers Association of Canada - Manitoba Branch |
| CEAA | Canadian Environmental Assessment Agency |
| DFO | Department of Fisheries and Oceans |
| EC | Environment Canada |
| HC | Health Canada |
| MBWildlands | Manitoba Wildlands |
| MCWS | Manitoba Conservation and Water Stewardship |
| MCWS-L | Manitoba Conservation and Water Stewardship - Lands Branch |
| MCWS-WB | Manitoba Conservation and Water Stewardship - Wildlife Branch |
| MCWS-WQ | Manitoba Conservation and Water Stewardship - Water Quality |
| NCN | Nisichawayasihk Cree Nation |
| NRCan | Natural Resources Canada |
| TC | Transport Canada |

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 1.0 Introduction; p. N/A

# Brown-0001

## QUESTION:

Please provide additional information on compensation plans for loss of sturgeon habitat and spawning and how the success of these plans will be measured once implemented.

## RESPONSE:

The compensation and mitigation plans for lake sturgeon and other fish species are described in detail in Appendix 1A of the Aquatic Environment Supporting Volume.

Compensation and mitigation plans targeted for lake sturgeon include:

- Construction of a spawning shoal downstream of the Keeyask Generating Station;
- Modification of the shoreline upstream of Birthday Rapids, if post-Project monitoring indicates that this area is no longer used for spawning;
- Creation of habitat for young-of-the-year habitat in the reservoir if monitoring shows that suitable habitat is not present; and
- Implementation of a conservation stocking program with the objective of establishing/maintaining a sustainable lake sturgeon population in the Keeyask reservoir and Stephens Lake.

Other measures described in the fish community section in the EIS and Appendix 1A would protect sturgeon as well as other fish species (e.g., construction of channels to avoid stranding of fish in isolated pools after spillway operation ceases).

Post-project monitoring will provide information on the effectiveness of compensation plans and mitigation measures. A detailed aquatic effects monitoring program is being developed and will be provided to regulatory agencies in the second quarter of 2013 (also see CEAA-0011).

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 1.0 Introduction; p. N/A

# Brown-0002

## QUESTION:

What action will be taken by the proponent if compensation plans are not successful? (Note that this question is asked as follow-up to Brown-0001).

## RESPONSE:

Post-project monitoring will provide information on the effectiveness of compensation works and mitigation measures. If measures are not successful, either existing measures will be modified or alternative measures will be implemented, until the goal of sustainable lake sturgeon populations is reached. Monitoring activities will be described in a detailed aquatic effects monitoring plan that will be provided to regulatory agencies in the second quarter of 2013.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 1.0 Introduction; p. N/A

# Brown-0003

## QUESTION:

Please provide addition detail regarding plans to stock Lake Sturgeon.

## RESPONSE:

Please see the Lake Sturgeon Strategy in Aquatic Environment Supporting Volume, Appendix 1A Part 2.

## REFERENCE: Volume: Project Description; Section: 6.0 Alternative Means, Design, Mitigation; p. N/A

# Brown-0004

## QUESTION:

What, in detail, considerations have Manitoba Hydro given to reducing the impacts sturgeon habitat before mitigation? In other words, if a generating station is prudent in the Gull Rapids reach of the Nelson River (needs and alternatives considered in NFAT) then what are the best ways of developing this project? For example, why must the Keeyask Project result in the complete loss of Gull Rapids? Are there alternatives to the current low head dam proposal? Turbine design?

## RESPONSE:

A joint process has been undertaken between the Keeyask Cree Nations and Manitoba Hydro over many years to optimize the Project design, including consideration of alternative means to develop the Project that could avoid and mitigate potential environmental effects. The Project Description Supporting Volume Section 6.0, describes the Project planning process and the consideration of alternative means of developing the Project that were studied on the Nelson River between Split Lake and Stephens Lake. It includes a number of alternative Project features including the reservoir levels, arrangement of principle structures, operating parameters and turbine design. This section also describes the approach to developing major mitigation measures for the Project.

The amount of power produced at a hydroelectric generating station is dependent primarily on the river flow and the hydraulic head at the station. Hydraulic elevation head at a generating station is calculated as the difference between the water level upstream of the station (forebay level) and the water level downstream (tailrace level). Between Split Lake and Stephens Lake there is approximately 26 m of head with 11.5 m located at Gull Rapids. The most desirable way to develop this reach of river for hydroelectric generation is to utilize all of the head at Gull Rapids.

Five different general arrangements as well as multiple variations at Gull Rapids have been studied. General arrangement GR-4 was selected instead of the other alternative general arrangements because it has several economic, social and environmental advantages. These are listed in the Project Description Supporting Volume Section 6.4.

Advantages of the proposed general arrangement (GR-4) and reservoir level (159.0 m) related to mitigation of impacts to lake sturgeon include:

- During spill events (approximately 20-30% of time in the spring based on historic records), some of the existing lake sturgeon spawning habitat at the base of Gull Rapids will be preserved.
- Lake sturgeon spawning habitat in Long Rapids upstream of Birthday Rapids will not be impacted. Lake sturgeon are expected to continue to spawn at Birthday Rapids.
- Development of lake sturgeon spawning habitat downstream of the powerhouse is less challenging and more likely to be effective than other general arrangements.
- This project configuration provides opportunities to preserve and construct additional lake sturgeon spawning habitat during the operating phase should it be required.

More information is provided in the Project Description Supporting Volume Sections 6.3 and 6.4.

Section 4.5.1 in the Response to EIS Guidelines is based upon the information in the supporting volume. It, too, outlines the planning process and various alternatives that were considered.

## REFERENCE: Volume: N/A; Section: N/A; p. N/A

# Brown-0005

## QUESTION:

What, in detail, is the management strategy for lake sturgeon in the lower Nelson River? Has this strategy undergone public review?

## RESPONSE:

The final draft of the Manitoba Lake Sturgeon Management Strategy 2012, issued in April 2012 by Manitoba Conservation and Water Stewardship (MCWS) updates and builds upon the earlier 1997 strategy titled "Lake Sturgeon Management in Manitoba." The intent of this document is to "review progress towards the recovery and protection of populations in Manitoba, to set new goals and objectives based upon current knowledge, and to identify new and emerging challenges." Questions as to the public review of this document would need to be directed to MCWS.

With respect to the reach of the Nelson River from the Kelsey Generating Station to the Kettle Generating Station, which is the reach where the Keeyask Generating Station would be developed, the strategy indicates the following (p. 31):

"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 the 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 longer 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."

For mitigation measures specific to the Keeyask Generation Project, please see Section 6.4.6.2.2 of the Response to EIS Guidelines.

## REFERENCE: Volume: N/A; Section: N/A; p. N/A

# Brown-0006

## QUESTION:

What evidence is there that artificial stocking will not harm the native populations of sturgeon in MU's 3 and 4?

## RESPONSE:

Stocking of lake sturgeon in MU3 will utilize brood stock from MU3 to maintain genetic integrity and maintain any subtle genetic differences that exist between the lake sturgeon stock in this management unit and lake sturgeon stocks from other nearby management units (see DFO-0097 for more information on studies being undertaken to address genetic concerns).

Annual monitoring will be conducted to assess the abundance of stocked lake sturgeon and determine if "overstocking" is occurring. This would be evident in poor condition and growth rate of young lake sturgeon and be addressed by reducing the numbers of fish released into the river annually.

The objective of stocking lake sturgeon into MU3, combined with other measures to mitigate the effects of the Project on lake sturgeon, is to provide for sustainable sturgeon populations that will exist into the future. Stocking is a key component of the overall strategy to achieve this objective.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. 8-39

# CAC-0001

## PREAMBLE:

It is unclear whether these lists of "ATK observations" are exhaustive and how they were selected for inclusion in the EIS. It is also unclear whether in any circumstances technical science was displaced by "ATK observations", whether further investigation was conducted when "difference or "doubt" arose, or how "difference" and "doubt" was addressed in making the mitigation, adaptive management and monitoring recommendations. A cursory review of Chapter 8 demonstrates that ATK is addressed at p. 8-39 and consists only of forward looking monitoring using ATK. No reference is made to the ATK data that has been collected to date and no reference is made to where technical science and ATK "differed". This leads the reader to believe that for the purposes of this EIS, where technical science and ATK differed, technical science was privileged and new ATK will be sought in the future for the purposes of monitoring the project.

## QUESTION:

Please provide clarification with respect to how ATK and technical science were assessed with respect to each other in making decisions related to mitigation, adaptive management and monitoring.

## RESPONSE:

As set out in the EIS, decisions by the Partnership related to mitigation, adaptive management and monitoring were based on both ATK (Aboriginal traditional knowledge) and technical science. Decisions in each instance reflected the Partnership's review of the issues raised by ATK and technical science.

The Partners agreed early on that there would be a Keeyask Cree Nations (KCNs) evaluation process as well as the government regulatory environmental assessment process for the Project. In the KCNs' process, each of the KCNs, assisted by Manitoba Hydro, evaluated the impact of the Project on their communities and Members in terms of their own worldview, values and experience with past hydroelectric development.

ATK's contributions to the Project as set out in the EIS are reviewed below.

ATK contributed both to planning the Project and, along with technical science, to conducting the environmental assessment.

Since the early 1990s, a joint process was undertaken that involved Manitoba Hydro and Tataskweyak Cree Nation, and over the past decade also War Lake First Nation, York Factory First Nation and Fox Lake Cree Nation. During the planning and design phase, many potential effects were either avoided or minimized based on decisions related to reservoir size, level and operating range, site selection, general arrangement of principal structures, and turbine design.

In addition, the KCNs drew on their ATK in identifying effects of the Project on their communities and this helped shape the mitigating programs and measures that they negotiated in their individual adverse effects agreements (AEAs). These agreements, along with the Joint Keeyask Development Agreement (JKDA), were subject to independent ratification votes of each KCN and govern the way that the Project will be implemented.

Both technical science and ATK contributed to the environmental assessment of the Project. Section 5.3.2.1 of the Response to EIS Guidelines provides the following description of the role of ATK in the environmental assessment:

- ATK is a cumulative body of knowledge, practice and belief about relationships among living beings that is handed down by Elders to each generation and is a way of life continuously adapted and added to by each generation (as taken from Berkes 2008). ATK is broad and holistic and also includes more specific knowledge. All of the KCNs' ATK is grounded in the Cree worldview. Each of TCN, WLFN, YFFN and FLCN took its own approach to applying their ATK to their respective evaluations of the Project; therefore, different sources of ATK were brought into the process.
- ATK played a role in the scoping and conduct of the environmental assessment. A major ATK workshop was held by the partners in June 2008; from there, they established ATK principles to guide how ATK would be brought into the process (see Chapter 2, Appendix 2A). ATK helped to identify issues, effects, mitigation and monitoring. The KCNs brought their ATK to the processes, which guided the environmental assessment (*e.g.,* through the Partners Regulatory and Licensing Committee, EIS Coordination Team, bilateral environmental studies working groups, and multilateral working groups dealing with the aquatic environment, mammals and mercury and human health). In addition, extensive community-based consultation was undertaken by each of the KCNs with its Members. Finally, the KCNs will play a role in monitoring and follow-up plans (including ATK) through mechanisms established through the governance structures of the JKDA.

Where technical science and ATK came to different conclusions about effects of the Project, this was indicated in Chapter 6, Environmental Effects Assessment in Sections 6.3 through 6.8. Monitoring was identified as a key mechanism to address uncertainty raised by these differences and to determine the accuracy of predictions. Chapter 8 sets

out the monitoring commitments for each component of the environment. In addition, Section 8.2.7 describes the process which is underway by the KCNs to develop ATK monitoring plans to be implemented by the KCNs. Both the KCNs and Manitoba Hydro will be represented on the Monitoring Advisory Committee set out under the JKDA. Results of technical science monitoring and ATK monitoring will be considered by this group.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 1.2.2.4 Selection of Valued Environmental Components p. 1-8

# CEAA-0001

## PREAMBLE:

1.2.2.4 - selection of VECs - Considering the importance of the benthic community to fish populations, should it be included as a VEC?

## QUESTION:

Please confirm.

## RESPONSE:

The selection of VECs considered the following criteria (Table 1-1 in the Aquatic Environment Supporting Volume):

- likely to be affected by the Project;
- amenable to scientific study;
- provide useful information about the effects of the Project to the aquatic environment (i.e., indicator);
- important to the ecosystem;
- Important to local stakeholders; and
- regulatory requirement (i.e., protected under legislation).

The list of VECs was provided to the Project Administration Team, the Technical Advisory Committee and two other organizations prior to the completion of the EIS. No changes were suggested.

Benthic invertebrates met the first four criteria, but were not directly important to local stakeholders or specifically addressed in legislation and, therefore, were not selected as a VEC. However, it should be noted that effects of the Project on the benthic invertebrate community were predicted and assessed using comparable methodology to the five VECs highlighted in Section 1.2.2.4, with the exception of assessing the regulatory significance of effects. Effects of changes to the benthic invertebrate community on fish species were assessed for each of the VEC fish species. The benthic invertebrate community will be monitored during both the construction and operation phase as described in the Aquatic Effects Monitoring Plan, to be provided in the second quarter of 2013.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 4.0 Lower Trophic Levels; p. 4-21

# CEAA-0002

## PREAMBLE:

Changes to trophic levels in Stephen's Lake area, aquatic macrophytes. Page 4-33 states aquatic plants and attached algae downstream of coffer dams and excavation areas may be somewhat negatively affected. Page 4-34 then states based on a low rate of deposition, downstream sedimentation is not expected to have a measurable effect on vegetation.

## QUESTION:

Please clarify the potential downstream effects to vegetation by TSS.

## RESPONSE:

### As per p. 4-33 and 4-34 of the Aquatic Environment Supporting Volume:

It is predicted that approximately 30% of the additional sediment resulting from shore erosion during Stage I and II Diversions will be deposited in Stephens Lake before it reaches the Kettle Generating Station (Section 2.5.1.1.3); most of the deposition is expected to occur near the entrance of Stephens Lake, downstream of Gull Rapids (Section 3.4.1.5). This additional sedimentation could negatively influence any aquatic macrophytes (vascular and non-vascular) in the affected area depending on the size of sediment particles, the spatial extent (e.g., greater negative potential if an entire plant bed is affected) and depth (e.g., greater negative potential if depth of sediments exceeds 5 cm) of deposited sediments, the rate of deposition, and if deposited sediments are stable or transient (e.g., washed away with the next higher flow event). Cumulative sediment input from all construction sources, over a four-year period for instream work, is expected to result in a depth of deposited sediments less than 0.6 cm (very low rate of deposition) through the south arm of Stephens Lake. Deposited material will likely be a combination of silt, sand, and coarser material, and is unlikely to be remobilized during the generating station operating period. The sensitivity of aquatic plants to sedimentation is species specific and some are more tolerant as they are able to respond by adjusting their rooting levels if sedimentation is not sufficiently rapid or of sufficient depth to bury plant stands. However, based on the low rate of deposition and resultant minimal depth of deposited sediments over the four years of instream work, downstream sedimentation is not expected to have a measurable effect on aquatic macrophyte beds during the construction period.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.0 Lake Sturgeon; p. 6-29**

# CEAA-0003

## PREAMBLE:

6.4 Project Effects - In the list of potential effects it appears the following are missing: disruption of rearing and feeding habitat, and disruption of movement between Gull Lake and Stephens Lake.

## QUESTION:

Please provide a rationale why these project effects were not included in the list. Consider adding to project effects list.

## RESPONSE:

**As noted in the introduction to the assessment of construction effects to lake sturgeon (Section 6.4.1 of the Aquatic Environment Supporting Volume), "Effects that begin during construction but are a permanent feature of operation (e.g., flooding of terrestrial area), are considered under the operation period (Section 6.4.2)." Changes to habitat during construction were only considered to the extent that a reduction in available habitat during the construction period could affect the population.**

Disruption of feeding and rearing habitats for lake sturgeon was not included in the list of construction effects because:

- there will be sufficient foraging habitat in the reach between the Keeyask Generating Station and Gull Rapids, thus the loss of foraging habitat in Gull Rapids during construction is expected to have a minimal effect to lake sturgeon; and
- the estimated amount of sediment deposition in Stephens Lake is too low to cause significant disruption to lake sturgeon rearing or feeding habitat.

The movement of lake sturgeon through Gull Rapids during construction will be disrupted, in particular during Stage 2 of construction when all flow is passed through the spillway. Disruption of movement between Gull Lake and Stephens Lake was discussed extensively under operation and was included in the list provided in Section 6.4.2.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 7.0 Cumulative Effects Assessment; p. 7-30

# CEAA-0004

## PREAMBLE:

Cumulative Effects assessment - Linear Feature Density discrepancy between Section 7.5.2.2.3 Mammals and Section 7.5.2.3.1 Habitat, Ecosystems and Plants

## QUESTION:

On page 7-30 linear feature density is not expected to change. However on page 7-32 under Intactness linear feature density will increase in the regional study area. These statements are contradictory. Please clarify.

## RESPONSE:

The two referenced sentences address two separate assessments.

The apparent contradiction occurs because the two sentences being referred to in the quote are from different sections of Chapter 7 in the EIS:

- The first sentence at p.7-30 under Mammals (Caribou) appears in Section 7.5.2.2.3 (Summary Of Cumulative Effects Of The Project With Past And Current Projects/Activities), and states that there will be a negligible change as a result of the Project." The overall assessment of Intactness in Section 7.5.2.2. p. 7-28 notes a slight reduction in total linear feature density (positive effect) due to the Project as a result of existing cutlines being replaced by Project features.
- The second sentence at p. 7-32 under Habitat, Ecosystems and Plants (Intactness) appears in Section 7.5.2.3.1 (Cumulative Effects of the Project Including Future Projects/Activities) and correctly states that linear density will increase in the regional study area (due to additional linear features contributed by Bipole III and the Keeyask Transmission Project). These increases will overlap with effects of the Project (which, as noted above, are positive), but will not be due to the Project.

## REFERENCE: Volume: Map & Figure Folio; Section: 4.0 Project Description; p. Map 4-10

# CEAA-0005

## PREAMBLE:

Biophysical Environmental Mitigation Areas Map - A potential high quality wetland area identified on the map will be fragmented by the south access road development. The road location has the potential to impact the wetland mitigation.

## QUESTION:

Please provide a rationale for developing the wetland mitigation in an area that is also identified for the development of proposed south access road corridor.

## RESPONSE:

Wetland mitigation is being developed adjacent to the proposed south access road for several reasons.

Firstly, this area is currently comprised of veneer bog, blanket bog and riparian peatlands. Enhancing this area to off-system marsh would create negligible increases to adverse environmental effects. This is because off-system marsh is replacing the regionally widespread and relatively abundant wetland types currently found in the area and the effects assessment has already treated portions of this area as being indirectly affected by the Project. In addition, locating wetland mitigation adjacent to a road allows the Partnership to avoid further effects to the terrestrial environment that would arise from having to clear access trails for equipment.

Secondly, locating mitigation in this particular area provides the only opportunity to provide the adequate water flows and water level control required for a potential wetland mitigation area without increasing terrestrial environment effects (a discharge control structure built into the south dyke would supply water to the upstream lake in the map). The presence of adequate water levels throughout a wetland area which can be varied are a prerequisite to developing and maintaining off-system marsh.

Finally, locating a road through the area is not expected to inhibit the ability to convert the area into off-system marsh. In contrast, the road effectively makes use of an elevation drop to constrict flow and create a pond. The road culverts may also provide an opportunity to regulate water levels, which is a prerequisite to developing and maintaining off-system marsh.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.6.1 Construction Schedule; p. 4-33

# CEAA-0006

## PREAMBLE:

Sequencing of Project Phases Figure - Figure 4-5 is not presented in the EIS document as stated (Relates to timing sequences).

## QUESTION:

Please provide or refer the reviewer to the location of the Figure in the EIS.

## RESPONSE:

If using a hard copy, Figure 4-5 is provided in the Response to EIS Guidelines Map and Figure Folio Binder. Figures are located after the maps in the 4.0 Project Description Section.

If using a digital copy, Figure 4-5 is provided at the end of Response to EIS Guidelines Section. References to figures in the table of contents or in the text are hyperlinked directly to the figure.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.2 Need For and Alternatives To; p. 4-6

# CEAA-0007

## QUESTION:

There is no consideration of a "No GO scenario" as required in the EIS Guidelines.

Please provide justification or refer the reviewer to the relevant section of the EIS.

## RESPONSE:

The EIS does consider a “No Go” scenario as per the EIS guidelines but it does so implicitly. A more explicit consideration is provided here.

The guidelines state:

“The proponent will:

- clearly describe its objectives in undertaking the Project;
- identify, from the perspective of the proponent, alternatives to the Project that were considered, including ‘the No Go’ scenario;
- develop criteria to identify the major environmental, economic, social and technical costs and benefits of the alternatives; and
- identify the preferred alternatives based on the relative consideration of the environmental, economic, social and technical costs and benefits.”

The proponent is Keeyask Hydropower Limited Partnership (KHLP). The Partnership was created as per the Joint Keeyask Development Agreement (JKDA). The JKDA by necessity is specific to the Keeyask Project. The Keeyask Project and the partnership have specific relevance to each of the partners which cannot be simply applied to any other project.

The JKDA does make not provisions for any other projects. From the perspective of the proponent the only alternative to proceeding with Keeyask is to not proceed with Keeyask. The “null” project is the only alternative for KHLP. As stated in the EIS: “The Partnership, as proponent, has no alternative available to develop other than Keeyask“. There is no alternative electricity supply project that KHLP could develop. In the No Go Alternative, Keeyask development arrangements and contracts would be cancelled and the KHLP would cease to exist.

The Keeyask Cree Nations, per se, are not the proponent. If Keeyask does not proceed, the benefits and costs accruing to the Keeyask Cree Nations from Keeyask would not occur. These costs and benefits have been dealt with in the Keeyask EIS.

Manitoba Hydro, per se, is not the proponent. If Keeyask does not proceed, Manitoba Hydro's export contracts reliant on Keeyask would be cancelled. While there could be a no go for Keeyask, there is no such no go option from a supply perspective. Manitoba Hydro must do something to supply domestic load growth in the province and to address retirements of existing thermal generation supply. Manitoba Hydro would pursue other potential sources of supply to meet domestic load growth and possibly to provide for the possibility of negotiating new export contracts. Increasing imports in major quantities would require additional import capability and that cannot be assured. In addition the energy will be primarily coal or natural gas based. Coal generation is restricted in Manitoba due to provincial legislation. Gas is environmentally undesirable. Wind while an important resource is not dependable over the winter peak and thus does not meet the capacity requirement in the planning criteria. Demand Side Management is already planned to continue expanding. The consideration of alternative plans involving other resource options will be dealt with comprehensively in a provincial public review process (the provincial Need For and Alternatives To process) as has been committed by the province.

## REFERENCE: Volume: Response to EIS Guidelines; Section: Appendix 1B Keeyask Generation Project Regulatory Licences; p. 1B-1

# CEAA-0008

## PREAMBLE:

Applicable Legislation - The *Canadian Environmental Assessment Act* has applicability to the entire project as proposed. It is not clear what the "Town Centre Complex Project" is referring to. There is no mention of the Federal *Species Act Risk Act* or the Federal *Migratory Birds Convention Act* and its applicability to the project.

## QUESTION:

Please be aware of the applicable federal legislation.

## RESPONSE:

The "Town Centre Complex Project" is an incorrect reference; it should have been “Keeyask Generation Project”.

An updated Appendix 1B list has been developed and now includes reference to the Federal *Species at Risk Act* and the Federal *Migratory Birds Convention Act*. See table below.

**Keeyask Generation Project Environmental Legislation**

| Applicable Legislation | Activities |
|---|---|
| **FEDERAL** | |
| ***Canadian Environmental Assessment Act* (CEAA)**<br>Comprehensive Study List Regulations (SOR/94-638)<br>Law List Regulations (SOR/94-636)<br>Inclusion List Regulations (SOR/94-637)<br>Federal Authorities *Regulations* (SOR/96-280)<br>*Exclusion List Regulations, 2007* (SOR/2007-108)<br>*Establishing Timelines for Comprehensive Studies Regulations* (SOR/2011-139)<br>*Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements* (SOR/97-181) | Project |
| ***Fisheries Act*** | All in-water works that may cause |

**Keeyask Generation Project Environmental Legislation**

| Applicable Legislation | Activities |
|---|---|
| | a harmful alteration, disruption, or destruction (HADD) of fish habitat or for killing fish by means other than fishing (GS, cofferdams, dykes, causeways, culverts, boat/barge launches, groins, quarry development affecting fish habitat, etc. Also blasting. |
| ***Migratory Birds Convention Act***<br>(Except as authorized by Regulation, no person shall without lawful excuse be in possession of a migratory bird or nest.<br>No person shall deposit a substance or permit a substance to be deposited in any place frequented by migratory birds if the substance is harmful to migratory birds.) | Project |
| ***Navigable Waters Protection Act* (NWPA)**<br>*Navigable Waters Bridges Regulations* (**C.R.C., c. 1231)**<br>*Navigable Waters Works Regulations* (**C.R.C., c. 1232)** | All works placed in, on, over, under through or across navigable waters, including GS, cofferdams, dykes, causeways, culverts, boat/barge launches, groins, fish habitat compensation works, ice booms, etc. |
| ***Species at Risk Act* (SARA)**<br>Lists provisions for federal species at risk | Project |
| ***Transportation of Dangerous Goods Act. 1992***<br>*Transportation of Dangerous Goods Regulation* (SOR/2001-286) | Transportation of dangerous goods. |
| **PROVINCIAL** | |
| ***The Endangered Species Act***<br>*Threatened, Endangered and Extirpated Species Regulation* (25/98) | Project |
| ***The Environment Act***<br>*Classes of Development Regulation* (164/88)<br>*Onsite Wastewater Management Systems Regulation* (83/2003) | Project |

**Keeyask Generation Project Environmental Legislation**

| Applicable Legislation | Activities |
|---|---|
| *Waste Disposal Grounds Regulation* (150/91)<br>*Water and Wastewater Facility Operators Regulation* (77/2003) | |
| *Crown Lands Act*<br>Work permit | Generation Station site and borrow areas for work on Crown Lands |
| *Dangerous Goods Handling and Transportation Act*<br>(Permit for tanks) | Petroleum storage |
| *Fires Prevention and Emergency Response Act*<br>(Occupancy permit for Road Camp) | South access road camp |
| *Forest Act*<br>Permit to cut timber on Crown Lands | Project-related clearing |
| *Fisheries Act*<br>Permit to handle fish | Project (fish salvage)/Monitoring |
| *Ground Water and Well Act*<br>Provisions for properly sealing wells | Groundwater well decommissioning |
| *The Heritage Resources Act* Heritage resources permit if heritage resources found | Project |
| *Highways Protection Act*<br>Permit to connect to highway | South Access Road construction |
| *Mines and Minerals Act*<br>Quarry Lease<br>Casual Quarry Permit | Quarry use |
| *Public Health Act*<br>Food handling Permit | All food handling establishments in camps |
| *Sustainable Development Act* Compliance with principles and guidelines through which sustainable development will be implemented | Project |
| *Waste Reduction and Prevention Act*<br>Compliance with to reduce and prevent the production and disposal of waste | Project |
| *Water Protection Act*<br>Compliance with guidelines for the protection and management of the province's water quality | Project |
| *The Water Rights Act* | Concrete production and other |

**Keeyask Generation Project Environmental Legislation**

| Applicable Legislation | Activities |
|---|---|
| Water Rights Licence | water withdrawal |
| *Water Power Act*<br>Water Power Licence<br>Provides for the sustainable allocation of the province's water power resources | Project |
| *Wildfires Act*<br>Work Permit and Burn Permit | Clearing, burning |
| *The Wildlife Act*<br>Compliance with provisions related to wildlife management | Project |

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.78 Safety, Security and Emergency Response; Page No.: N/A

# CEAA-0009

## PREAMBLE:

Assessment of Accidents and Malfunctions - There is no assessment of the effects of accidents and malfunctions as required in the EIS Guidelines. There is little discussion on contingency and emergency response procedures developed in the event of an accident or malfunction. The EIS does not include a list of emergency response plans to be developed and implemented over the life of the project.

## QUESTION:

Please provide this information.

## RESPONSE:

Accidents and malfunctions are risks for any large, lengthy construction project and during the design and planning for the Keeyask Generation Project considerable effort was made in identifying those risks and developing methods to address them. Plans focused on methods to deal with specific types of accidents and malfunctions should they occur, ranging from spill response plans to deal with accidental fuel spills, to Manitoba Hydro's Dam Safety Program (see Project Description Supporting Volume Section 4.6.3.3), which aims to minimize the risk of a dam failure as well as putting measures in place to respond to such an extremely unlikely event should it occur. Most plans were advanced fairly early on in the assessment process and made available to each discipline lead as key references to demonstrate the measures to reduce the likelihood of potential effects to each VEC.

Section 4.7.8 of the Response to EIS Guidelines provides a high level summary of the framework that will be in place to prevent and respond to accidents and malfunctions. The Project Description Supporting Volume Section 3.12 discusses safety, security and emergency response during the construction phase. Section 4.6 of the Project Description Supporting Volume provides additional details for the framework for the operations phase, including the Hazard Risk Assessment (HRA), Environmental Management System (EMS), Safety Management System (SMS) and Dam Safety Program (DSP). These systems include numerous detailed plans aimed at preventing and avoiding a variety of potential accidents and malfunctions. These plans and procedures and associated details for this framework are normally developed during the last few years of construction of the particular project. While it is not possible to provide the plans and procedures for the Keeyask Project at this time, it would be possible to provide sample plans for other Manitoba Hydro generating stations. This would

demonstrate that the HRA, EMS, SMS and DSP put numerous detailed plans and procedures in place to prevent and respond to a wide range of accidents and malfunctions. The framework for response plans involves the following four elements:

1. Environmental Management System Procedures & Plans, including:
    - Waste water treatment and monitoring;
    - Storage and handling of petroleum products;
    - Testing and inspection of oil-filled equipment (e.g., transformers);
    - Testing and inspection of Sodium Hexafluoride (SF6) filled equipment (e.g., breakers); and
    - Maintenance of vehicles and mobile equipment.
2. Safety Management System Procedures & Plans, including:
    - Workplace hazardous material information system;
    - Asbestos containing material;
    - Releases – Response and Prevention;
    - Transportation of dangerous goods; and
    - Storage, use, and disposal of hazardous materials.
3. Emergency Response, including:
    - Hazard Risk Assessment ;
    - Hazardous Materials Management Handbook;
    - Chemical Storage (Publication);
    - Keeyask Emergency Response Crew (ERC) (to be established in transition to operation);
    - SMS Section 3.4: Releases – Response & Prevention, involving:
        - Keeyask Spill Response Plan (SRP);
        - Annual SRP activation;
        - Quarterly spill response equipment inspections;
        - Standardized environmental accident reporting;
        - Annual assessment of releases;
        - Emergency Response Crew training;
        - Spill awareness training for general staff;
        - Annual inspection of high risk containment and mitigation systems; and
    - Root cause analysis and incident investigation.
4. Dam Safety Program – a detailed description provided in subsequent section of this response.

The Partnership notes that the types of accidents and malfunctions that could potentially occur at a generating station involve a very broad range in type and magnitude. For example malfunctions could include spills, releases, forest fires and a

dam failure. The following sections present a series of potential accident and malfunction scenarios, the measures in place to avoid or reduce the risk of occurrence and the response plans.

## Dam Failure

Engineering studies determined that in the extremely unlikely event of a dam breach at Keeyask, the economic consequences would be extreme because it could potentially result in the cascading failure of one or more earth embankments at each of the downstream generating stations (Kettle, Long Spruce, Limestone). As a worst case scenario, the majority of Manitoba Hydro's generation system could be lost and there would be substantial environmental impacts along the lower Nelson River.

### *Type of Accident*

A dam failure is an uncontrolled release of the water from the reservoir, also known as a dam breach. There are a number of modes by which a dam can fail, including overtopping, internal erosion or piping, mass movement or sliding, erosion, overturning or liquefaction. Conditions that could lead to a failure include:

- extreme floods that exceed the discharge capacity of the powerhouse and spillway
- extreme wind
- flooding due to a failure of another dam upstream
- blockage of the powerhouse and spillway
- damaged flow control equipment or incorrect operation of powerhouse or spillway
- settlement of the crest of a dam
- earthquakes
- piping (flow and internal erosion through or under the dam);
- applied loads such as reservoir surcharge and ice forces; and
- defects in design or construction

### *Countermeasures/Prevention/Response*

Manitoba Hydro has a comprehensive Dam Safety Program with specialized staff dedicated to administering the program. Manitoba Hydro's Dam Safety Program is in place so that dams, including those associated with the Project, are constructed, operated and maintained in a safe manner. The program also includes preparedness plans for the unlikely event of a dam failure. The program is based on the Canadian Dam Association (CDA) Dam Safety Guidelines (2007). The system and program has the following elements:

1. **Design** – Design and construction of new structures to meet or exceed the CDA guidelines. Keeyask is being designed to safely pass the probable maximum flood (PMF). The PMF is the flood that would result from the most severe hydrologic and meteorological conditions that could reasonably occur in the Nelson River

Watershed at this location. It is based on analyses of local historic precipitation, snowmelt and other factors producing maximum flows. Statistically, this flood represents an extremely remote event, less than a 1:10,000-year frequency. The estimated PMF for this Project is more than double the flow experienced during the summer of 2005, which is the highest recorded daily average on record.

2. **Emergency Preparedness Plan (EPP)** – A Dam Safety Emergency Preparedness Plan will be prepared specifically for the very unlikely event of a dam failure. The EPP describes the potential hazards under various dam breach scenarios, outlines the response in terms of emergency assessment, activation, preventative actions, notifications and EOC activation, and includes essential information on the inundation (mapping), site access, key contacts, communication and warning systems, resources, equipment and services. This plan will be prepared, implemented, tested and maintained for Keeyask. The plan includes information for emergency responders and local civil authorities about such things as the emergency response structure, emergency classification, notification procedures, and the potential inundation due to an extreme flood or a dam breach. Manitoba Hydro will distribute copies of the emergency preparedness plans to appropriate emergency responders and stakeholders as well as offer presentations to local emergency response agencies and local civil authorities about these plans prior to reservoir impoundment.

3. **Dam Safety Training, Exercises and Simulations** - Existing Manitoba Hydro dam safety policy includes requirements for plant staff and internal specialists to have appropriate training to carry out inspections, recognize potential emergency conditions, and be prepared to respond to a dam safety emergency. This is achieved with classroom training as well as simulation exercises.

4. **Condition Assessments** – Ongoing condition assessment of structures, which includes inspection, instrumentation and analysis in order to detect and address any developing problems early.

5. **Maintenance Programs** – Output from the condition assessments as well as regularly scheduled maintenance aims to keep all components of the generating station in good working condition to minimize the risk of dam failure.

6. **Formal Dam Safety Reviews** - Reviews of dam safety will be conducted periodically at regular intervals by independent external engineers with appropriate expertise.

7. **Dam Safety Reference Manual (DSRM) -** The DSRM, also referred to within the industry as Operations, Maintenance & Surveillance Manuals, contain suitable and sufficient information or references to allow the dam to be operated in a safe manner, maintained in a safe condition and adequately monitored to detect early

signs of distress. The DSRM complements (and is not a substitute for) the Station Operation and Maintenance Manual. Qualified personnel will be used for operation, maintenance and surveillance of the dams. The DSRM is reviewed by the facility staff and updated at appropriate intervals.

8. **Dam Safety Report -** An annual Dam Safety Report summarizing the dam safety activities performed during that year is prepared for the operation period. The report will update the status of the Dam Safety activities as well as identify any significant changes in the condition of the dams.

## Waste Management

As described in the Response to the EIS Guidelines, various wastes will be generated from the project site, include solid waste and wastewater. All waste will be contained, treated and or/disposed of according to applicable regulations.

### *Type of Accident*

Accidents that could occur include spilling sewage on the ground from wastewater hauling as a result of a vehicular accident or a valve being left open unintentionally at the back of the truck. Sewage in holding tanks could potentially overflow if not checked. Each of these would cause a sewage spill on the ground, which could contaminate soil/vegetation. Also, a malfunction of the wastewater treatment plant could result in untreated sewage entering the Nelson River which may impair water quality.

### *Countermeasures/Prevention/Response*

Schedule B of Manitoba *The Environment Act* Licence No. 2952 lists the terms and conditions that must be followed with respect to wastewater/storage treatment during construction, as well as the steps to be taken in the case of an accident or malfunction of the wastewater treatment plant. The relevant clauses in the licence will be adhered to, which will minimize the potential of impairing water quality. Environmental protection measures will be included in the Generation Station Construction Environmental Protection Plan related to proper handling and maintenance of wastewater holding tanks. Should wastewater be unintentionally spilled on the ground, the contaminated soil/vegetation will be removed and disposed of at a permitted or licensed waste disposal ground.

## Spill of Hazardous Material

### *Type of Accident*

Petroleum hydrocarbons include diesel and hydraulic fuel, as well as oils and lubricants for vehicles and equipment. Hazardous substances include any material that, when released, could contaminate biotic and abiotic environmental conditions and/or prove to be toxic to wildlife or humans. These may include substances such as solvents, isopropanol, methanol, acetone, etc.

Petroleum hydrocarbons and other hazardous substances are required for activities during both the construction and operation phases of the proposed work. Accidents and malfunctions could occur either during transportation of these products to and from the site, during fuelling or general use of vehicles and equipment, or during storage and use of hazardous products.

There is a moderate to high potential for a malfunction or accident to occur resulting in a spill or release during the construction phase of the Project, based on the number of activities that would be occurring simultaneously. However, this potential will be low to moderate during typical operation of the facility. Impacts to surface water from hazardous substances have the potential to be more severe than terrestrial impacts. Regardless, the magnitude of a potential spill will depend on the material, concentration, quantity, and proximity to sensitive environmental conditions. The likelihood of a non-reversible impact from an accidental spill or release is very low, particularly if clean-up and restoration procedures for mitigating spills are adhered to. The following paragraphs provide further details related to the assessment of spills on various aspects of the biophysical environment:

- **Terrestrial Habitat** – For the assessment of wildlife, Terrestrial Environment Supporting Volume Section 7.4 states that accidental events such as spills and human-caused fire could affect areas of varying sizes, thus different numbers of individuals of particular species. Such events are most likely to occur during the construction phase. Accidents and malfunctions are also addressed in Sections 7.4.1.1.2, 7.4.2.1.2, 7.4.3.1.2, 7.4.4.1.2, 7.4.6.2, 7.4.6.3, and 7.4.7.1.1. Accidental spills would affect site-specific areas for a short period. Given the low probability of occurrence, the regulation requirements for storing, handling, and transporting fuels, oils, and other hazardous materials under *The Dangerous Goods Handling and Transportation Act*, there would likely be a minimal effect on mammals.
- **Birds -** For the assessment of birds, Section 6.5.7 of the Response to EIS Guidelines states that accidental events that may occur during Project development, such as spills or fires, may affect the local bird populations and their habitats; however, the risk of these events occurring is small and will be adequately addressed through the implementation of measures to be outlined in the Construction Environmental Protection Plans.
- **Aquatic Environment -** For the assessment of the aquatic environment, the Aquatic Environment Supporting Volume Section 2.5.1.6.5 notes the presence and levels of hydrocarbons in the local surface water environment could potentially be affected by accidental spills or releases of substances containing hydrocarbons (e.g., fossil fuels) or other contaminants. The release of significant quantities of hazardous substances to the aquatic environment as a result of accidental spills and releases is considered unlikely due to the development and implementation of good management practices.

### *Countermeasures/Prevention/Response*

Mitigation to reduce or prevent the impacts from a release of petroleum hydrocarbons or other hazardous substances includes:

- Preparation of an emergency (spill) response plan and appropriate spill clean-up equipment for each hazardous material;
- Personnel will receive training in spill response;
- If a spill should occur that is of reportable quantity, the contractor would be responsible to provide notification through the emergency response line at (204) 944-4888, which is monitored by Manitoba Conservation and Water Stewardship;
- If a spill should occur, appropriate clean up would be determined according to the quantity of category of contaminant. Larger spills would be assessed and delineated following Phase III Environmental Site Assessment standards and a remediation program would be developed;
- Handling and storage of all fuel or hazardous materials on site will be in accordance with the Generation Station Construction Environmental Protection Plan and all federal and provincial standards and protocols;
- Restricting construction to areas greater than 30 m from open water unless explicitly required for the work to occur;
- Refuelling and equipment maintenance activities will occur at least 100 m away from a water body, or conducted in a manner to prevent the release of deleterious substances to a water body; and
- All equipment and vehicles are to be maintained and regularly monitored for leaks; and
- Sections 6.5.3 1.1 and 6.5.3.1.3 of the EIS state that the Environmental Protection Plans will also include measures to minimize the risk that accidental fires and spills will affect vegetation, terrestrial habitat and ecosystem diversity.

## Accidental Fires

Prevention of all types of fires will be important during construction of the Project. The assessment of the risk of fires mainly deals with vegetation effects, which relates to habitat effects for terrestrial VECs. The assessment of effects of fire is discussed in Sections 6.5.3.1.1. 6.5.3.1.3, 6.5.3.2.1, 6.5.3.2.3, 6.5.3.3.1, 6.5.3.3.3 and 6.5.4.2.1 of the Response to EIS Guidelines.

### *Type of Accident*

Accidental fires include forest fires caused by equipment (particularly associated with clearing/grubbing and road construction), explosive/rock cutting, welding materials, environmental causes (lightning), or anthropogenic causes (cigarettes, arson, or uncontrolled camp fires). Many activities create heat, flame and sparks, all of which can, if uncontrolled, result in a wildfire. Possible sources include vehicle collisions, vegetation clearing throughout the construction site and in the reservoir, burning cleared debris,

electrical/equipment malfunction or due to human error. A peat fire could be initiated when burning debris or by an accidental fire. Wildfires or peat fires that occur naturally due to a lightning strike could become larger or more severe due to Project features such as debris piles.

Weather, terrain, fuel loads, fuel moisture, time of year and the nature of the response effort will determine the extent, duration and severity of a fire. The risk of fire increases during periods of hot dry weather which can occur throughout the summer months.

If a fire was to occur, the size of the fire would determine the magnitude and duration of the impacts. A wildfire or peat fire will release gases, particulates and other matter into the atmosphere, and may create long term terrestrial habitat loss and/or alteration under some conditions. A large fire could also impact wildlife and other biophysical and social/economic factors. The frequency of fires occurring throughout the year would be low; particularly if proper procedures for monitoring and mitigating fires are adhered to.

### *Countermeasures/Prevention/Response*

A number of fire prevention and suppression measures will be followed to avoid or respond to wild fires. Measures applicable to personnel or activities will be incorporated into the Project Environmental Protection Plans, the project-specific emergency response plan developed by the contractor, and the Joint Keeyask Development Agreement Schedule 11-1: Reservoir Clearing Plan.

A variety of measures to minimize the risk that a wildfire or peat fire will occur include, but are not limited to:

- Flammable waste will be disposed of on a regular basis.
- Cleared material that is piled during reservoir clearing will be burned in the winter in locations selected to minimize the risk of peat fires.
- Measures to minimize the risk that people using the area will accidentally start a fire include restricting public access to the Project at PR 280 and the Butnau Dam during construction.
- Project-related cut lines and trails will be blocked and revegetated where they intersect the Project Footprint (does not include existing resource-use trails as described in the Construction Access Management Plan).
- The camp and work area buildings will contain fire detection sensors, which will be continuously monitored by the site security forces.
- Every off-road vehicle, including ATVs and 4-wheel drive trucks used for off-roading purposes, will be equipped with a working spark arrester that will be in operation while the engine is running to prevent the possibility of a fire hazard to the terrain.
- Littering of solid waste tobacco products will be prohibited.

Measures to minimize the potential for forest fires to become large may include the following:

- A rapid response will be facilitated by fire awareness and prevention training for personnel.
- Supplying and maintaining adequate fire suppression equipment and having fire truck on site.
- All personnel will be continuously responsible for reporting suspected or actual fires
- All uncontrolled fires will be reported immediately to the appropriate Manitoba Conservation and Water Stewardship representative.
- Personnel will be trained in the use of fire suppression equipment and will be available to respond immediately to an emergency.
- In the event of a wildfire or peat fire, steps will be taken as quickly as possible to contain or extinguish the fire to the extent practical and safe.
- Storage tanks will provide storage capacity requirements to meet fire-protection requirements stipulated by the National Fire Protection Association 851.
- Project-related cut lines and trails within 100 m of the Project Footprint will be revegetated for a number of reasons including minimizing the potential for accidental fires (Terrestrial Environment Supporting Volume Section 6.5.3).

Although the Project is not expected to create large accidental fires or to alter fire behaviour, a single large and/or severe fire could substantially alter habitat composition over the long-term, which could affect many of the terrestrial environment predictions. Therefore, the occurrence and nature of Project-related fire regime effects will be monitored.

## Wildlife Mortality Due to Vehicular Accidents

### *Type of Accident*

As described in the Terrestrial Environment Supporting Volume Sections 6.4 and 7.4.6.3, vehicle-wildlife collisions will likely increase due to increased traffic on the north and south access roads during the construction and operation phases of the project. Collisions with vehicles on the access roads could result in increased moose and caribou mortality. Collisions with moose are most likely to occur during the periods of peak moose activity at dusk, night, and dawn.

### *Countermeasures/Prevention/Response*

Measures to minimize the potential for wildlife-vehicle collisions include the following:

- Warning signs will be placed in areas along the access roads near caribou travel corridors and high-quality habitats to reduce the potential of wildlife-vehicle collisions.

- Roadside ditches will be rehabilitated where practical with native plants with low quality food value for caribou and moose, to minimize attraction and the risk of collisions and harvest opportunities.
- Information about wildlife awareness will be provided for workers to reduce the risk of wildlife-vehicle collisions.
- To minimize the potential of vehicle collisions with colonial water birds and raptors, traffic signage will be installed indicating reduced vehicle speed over the generating station and at other potentially sensitive water body crossing sites where practicable.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.2.3.2.5 Physiography and 6.2.3.4.8 Mercury in Wildlife; p. N/A

# CEAA-0010

## PREAMBLE:

EIS Guidelines required the proponent to provide the present mercury and methylmercury data and analysis in soil. There is very little detail provided.

## QUESTION:

Please provide this information.

## RESPONSE:

Total mercury was analysed in conjunction with a suite of metal and nutrient analyses conducted for soil samples in the flooded area. The report with the data and analyses, which is in preparation, is listed in Appendix 6A of the Response to EIS Guidelines as "ECOSTEM Ltd. Terrestrial habitat and ecosystems in the Lower Nelson River Region."

The total mercury data were used in support of the assessment of effects to water quality due to releases of metals from flooded soils. Methylmercury data were not collected as the model used to predict methylmercury levels in fish is not reliant on methylmercury levels in soil. As discussed in NRCan-0018, methylmercury levels in soils do not necessarily translate into increased bioaccumulation in fish. Given that collection of methylmercury data requires maintaining cold samples, which is difficult in remote field camps, this parameter was not measured.

**REFERENCE: Volume: Public Involvement Supporting Volume; Section: 2.2.2.3 Round Three of the Public Involvement Program; p. 2-8**

# CEAA-0011

## PREAMBLE:

The EIS refers to materials that will be submitted at a later date, either as part of a supplemental filing, (e.g. material that will be related to Round Three of the Public Involvement Program) or other information that may be collected in future (e.g. study on use of the area by the Métis, under negotiation). There is some uncertainty about the information that will be available for public review and for review by regulators before the completion of the environmental assessment.

## QUESTION:

Besides the responses to Information Requests arising from this initial review of the EIS, list all other studies, information, or reports that the proponent is planning to include as part of supplemental filing before the conclusion of the EIS review phase, and the estimated date of filing this information.

## RESPONSE:

The Partnership will be filing the following documents as part of the EIS:

- An updated traffic analysis, in the first quarter of 2013;
- The Final Human Health Risk Assessment, in the first quarter of 2013;
- A report from a Domestic Plant Workshop, in the first quarter of 2013; and
- A report from the third, final round of the Public Involvement Program (the program is currently scheduled for February and March 2013, and the report will be filed in the second quarter of 2013).

The Partnership is currently developing environmental management plans and environmental monitoring plans. These will be required either prior to the issuance of regulatory authorizations or as a condition of the authorizations. The Scoping Document submitted by the Partnership in December 2011 and the Guidelines issued by the Canadian Environmental Assessment Agency in March 2012 required a description of these plans in the EIS, which was done in Chapter 8 of the Response to the EIS Guidelines. However, while the detailed plans are not a requirement for the EIS, the Partnership intends to provide regulators with the following in the first quarter of 2013:

- Preliminary South Access Road Construction Environmental Protection Plan;
- Preliminary Generation Station Construction Environmental Protection Plan;

- Preliminary Heritage Resources Protection Plan;
- Preliminary Construction Access Management Plan;
- Preliminary In-stream Construction Sediment Management Plan; and
- Preliminary Fish Habitat Compensation Plan.

The Partnership intends to provide regulators with the following in the second quarter of 2013:

- Preliminary Aquatic Effects Monitoring Plan;
- Preliminary Physical Environment Monitoring Plan;
- Preliminary Terrestrial Environment Monitoring Plan;
- Preliminary Socio-Economic Monitoring Plan; and
- Preliminary Resource Use Monitoring Plan.

## REFERENCE: Volume: Public Involvement Supporting Volume; Section: Appendix 1B and 1C; p. 1B-1 and 1C-1

# CEAA-0012

## PREAMBLE:

The tables list the events held and the comments received from groups during workshops, open houses, and meetings. Other meetings or contact with Cross Lake/Pimicikamak First Nation are not included in this listing, presumably because the information about the Keeyask project occurred in a slightly different context (CLFN/PCN - Article 9 discussions under the Northern Flood Agreement). Although this was provided in a different context, it would be helpful to have the relevant information also included in the summary table, for the purpose of sorting and comparing.

## QUESTION:

Include the CLFN/PCN information (now currently noted in Appendix 4) and other groups in the table for sorting and comparison purposes.

## RESPONSE:

Discussions about the Keeyask Generation Project with Cross Lake First Nation (Pimicikamak Cree Nation) occurred under the Northern Flood Agreement Article 9 process. A summary of these discussions are set out in the summary provided in Appendix 4A of the Public Involvement Supporting Volume. As requested, the relevant information has been placed in the table shown below in the same format as Tables 1C-1 (Round One) and 1C-2 (Round Two) but has not been attributed to a particular round of the Public Involvement Plan (PIP) because the Article 9 meetings were held separately from these processes.

## Issues Concordance for Some Issues Raised by CLFN (PCN) During the NFA Article 9 Process

| Issue | Description | Response Provided | Stakeholder/Source |
|---|---|---|---|
| Environmental Assessment | A request to review a list of study reports | Manitoba Hydro considered the First Nation's request and provided a list of study reports, including the Keeyask annotated reference to field studies, environmental study reports and technical memoranda. | CLFN (PCN) |
| Environmental Assessment | A request to review component studies in draft form prior to integration into the EIS | Manitoba Hydro considered the First Nation's request and provided Dr. Lutterman access to studies located on the Stantec FTP site, but otherwise concluded it was not prepared to share the EIS while it is still in draft form. | CLFN (PCN) |
| Environmental Assessment | A request for a list of VECs | A list of VECs was provided. | CLFN (PCN) |
| Environmental Assessment | A concern that the scoping document is too generic and does not include the full list of VECs to be used | Manitoba Hydro considered the First Nation's concerns and determined that the scoping document contained a reasonable level of detail and conformed with the standards in place. | CLFN (PCN) |
| Environmental Assessment | A request that Manitoba Hydro fund a 2-year land use and occupancy study (to be conducted by Tobias and Associates). The First Nation is currently developing a | | CLFN (PCN) |

| Issue | Description | Response Provided | Stakeholder/Source |
|---|---|---|---|
| | proposal for Manitoba Hydro's consideration. | | |
| Environmental Assessment | A concern that any effects of the Project be considered cumulatively with the Lake Winnipeg Regulation and Churchill River Diversion. | | CLFN (PCN) |
| Environmental Assessment | A concern that the study area is not broad enough and the whole of the First Nation's traditional territory should be considered | Manitoba Hydro's position is that the study areas that were developed for the environmental assessment effectively capture the effects of the Project on the environment. | CLFN (PCN) |

A meeting held with the Manitoba Métis Federation (MMF) during Round One of the PIP is reported in Table 1C-1 of the Public Involvement Supporting Volume. After that point, the MMF requested a process separate from the PIP. Those discussions focused on establishing an agreement to undertake a research study. This is reported at Appendix 5 of the Public Involvement Supporting Volume. A table consolidating issues raised through this process similar to that provided above for CLFN (PCN) is not applicable.

Nisichawayasihk Cree Nation also requested a process separate from the PIP. That process has yet to be defined.

## REFERENCE: Volume: Public Involvement Supporting Volume; Section: Appendix 1B and 1C; p. 1B-1 and 1C-1

# CEAA-0013

## QUESTION:

Table 1 is sorted alphabetically by group; Table 2 is sorted alphabetically by issue.

For presentation in the document, it is recommended that a consistent format be used or state why the format was changed. For sorting electronically, please make these available on request as a non-pdf file.

## RESPONSE:

Electronic version will be sent to Canadian Environmental Assessment Agency.

## REFERENCE: Volume: Socio-Economic Environment, Resource Use and Heritage Resources Supporting Volume, Part 2 Resource Use, Section1.2.2 Approach and Methodology; p.1-7

# CEAA-0014

## PREAMBLE:

CEAA requires consideration of environmental effects, including the effects of changes to the environment on the current use of lands and resources for traditional purposes by aboriginal persons. The EIS notes that the effects on domestic resource use are predicted for KCN communities only, and therefore the primary mitigation involves the effective implementation of the Adverse Effects Agreement offsetting programs (see as an example p 1-27, s. 1.2.4.1.1 Domestic Fishing Construction Phase Effects and Mitigation) which apply only to the KCN communities and members. Use in the Local Study Area by other Aboriginal groups has not been identified through the Public Involvement Program; however, the EIS also acknowledges that this information may be outstanding, in that there are ongoing discussions with the MMF and CLFN/PCN regarding how the resources are used by those communities. Further, notes from the PIP meeting with Shamattawa indicate that this community believes that their treaty rights may be impacted, implying effects to resource use. Finally, the proponent acknowledges that contact with some potentially affected Aboriginal groups has not been completed. The extent of hunting and fishing by Aboriginal groups or persons other than the KCN communities or members is not identified 'to date.'

## QUESTION:

We require further information to confirm the extent of use (or lack of use) for traditional purposes by Aboriginal persons of the resources likely to be affected by the project. If further information is collected indicating resource use by Aboriginal persons not party to the Adverse Effects Agreements, assess these effects and describe measures that will be undertaken to mitigate effects to current use of lands and resources by Aboriginal persons not party to the Adverse Effects Agreements off-setting programs.

## RESPONSE:

The Keeyask Cree Nations (KCNs), most notably the Cree Nation Partners, are the primary resource user of the Project Area, which is located in the Split Lake Resource Management Area. To date, use of the Resource Use Local Study Area (encompassing areas directly affected by the Project) has not been identified by Aboriginal groups or individuals who are not members of the KCNs communities.

The Public Involvement Program (PIP) provides meaningful opportunities for involvement by potentially affected and interested Aboriginal persons, communities and groups who may be affected by the Project. This includes Norway House Cree Nation, O-Pipon-Na-Piwin Cree Nation, Shamattawa First Nation, Manitoba Keewatinowi Okimakanak and Keewatin Tribal Council. Public meetings and/or workshops have been held or requested in Thompson, Gillam, Shamattawa, Leaf Rapids, Churchill, and the Northern Affairs communities of Pikwitonei, Thicket Portage, Wabowden, Nelson House, Ilford, and Cross Lake. Details are published in the Public Involvement Supporting Volume and its appendices. To date, these efforts have not identified non-KCN Aboriginal resource users active in areas directly affected by the Project. A third, and final, round of the Public Involvement Program is planned with the same groups for early 2013.

To further explore for potential use, Manitoba Hydro, acting on behalf of the Keeyask Hydropower Limited Partnership, has met with Manitoba Metis Federation (MMF), since 2008, on numerous occasions to explore the interests of its members in the Project area. The Keeyask Generation Project is located in an area where MMF asserts that Métis rights, interests and way of life will be impacted by the Project. The outcome of these discussions has led to a Letter of Agreement dated September 21, 2012, which outlined an approach for reaching agreement on a Métis land use and socio-economic study to be undertaken by the MMF. This study, which is still being negotiated, is expected to provide documentation with respect to current use of lands and resources for traditional purposes in the Project area by MMF Members.

To date, several meetings have been held with Cross Lake First Nation (Pimicikamak Cree Nation) (CLFN (PCN)) representatives to introduce the Project, the environmental studies conducted, the Project VECs, and potential environmental effects. Meetings have also been conducted to learn about the concerns and issues of CLFN (PCN) in relation to the Project (details are located in Appendix 4A of the Public Involvement Supporting Volume). A recent request for funding (2012) for a resource use/land use and occupancy study has been received. Manitoba Hydro, on behalf of the Keeyask Hydropower Limited Partnership, and CLFN (PCN) are in discussions concerning a study related to the Project.

Although Shamattawa First Nation chose not to participate in Round 1 of the PIP, the Partnership met with Shamattawa First Nation Chief and Council on April 24, 2012, during Round 2 of the Public Involvement Program. The purpose of the meeting was to provide information about the Project regarding biophysical and socio-economic effects and to obtain input on possible mitigation measures and monitoring opportunities. At that time, Shamattawa First Nation indicated that they anticipated they would be affected in areas outside the Keeyask Project area and felt that they had been excluded from consultation processes and the Keeyask Hydropower Limited Partnership (see

Public Involvement Supporting Volume: Appendix 3C p. 64-68). A formal response to these concerns will be provided during round three of the PIP and documented in a supplemental filing.

As indicated in Section 1.2.2.1 of the Resource Use Section of the Socio-Economic Supporting Volume, and noted above, ongoing discussions/studies are anticipated with MMF and CLFN (PCN) to identify any potential use of areas affected by the Project and concerns brought forward by SFN are being addressed by the Partnership and Manitoba Hydro (as appropriate). As well, an additional round of the public involvement program is planned for early 2013. If it is determined through these processes that other traditional Aboriginal resource users have the potential to be impacted by the Project, appropriate mitigation strategies will be considered.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.3.2.3.1 Description of the Mainstem; p. 3-15

# DFO-0001

## PREAMBLE:

"Biological components of the aquatic habitat were based on the period during which field studies were conducted in the area, generally between 1997 and 2006. This period included both high and low flows, and therefore would indicate inter-annual variability related to flows."

## QUESTION:

Detailed background reports have not been provided in the EIS. These should be made available for review.

## RESPONSE:

By “biological components of aquatic habitat” it is assumed that the reviewer is referring to aquatic macrophytes. A description of changes in macrophyte distribution in relation to inter-annual variations in flow is provided in Aquatic Environment Supporting Volume Section 3.3.2.3.1. Also see data reports 01-06, 02-10, 03-16, 04-17, 06-08.

These reports are on a CD of reports previously provided to DFO: Drummond 2009 November 13; Katapodis 2009 December 17; and Chudobiak 2011 October 31. These reports have also been provided to Manitoba Conservation and Water Stewardship (MCWS). The Partnership is providing additional electronic copies of these reports to DFO under separate cover.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.3.1 Pre-1997 Conditions and 3.3.2 Current Conditions (Post-1996); p. 3-11 and 3-12

# DFO-0002

## PREAMBLE:

"No analysis of trends in aquatic habitat was conducted, since the water regime was established in 1977 and has been operated within set bounds since that time."

## QUESTION:

However, has aquatic habitat and changes in fish stocks changed since 1977, despite apparent constancy in water regime? Moreover, habitat changes were not actually assessed to support this claim. Can the existing environment be adequately portrayed if not assessed/sampled? This also does not account for natural changes in habitat with flow events outside of regulation. For example, a flow/ice event approximately 10 years ago changed the flow patterns at Gull Rapids, creating a new channel that flows northeast to Stephens Lake. Please consider the entire period of record for analysis.

## RESPONSE:

The availability of habitat information before the Project is very limited, aside from parameters related to the water regime. Available historic information for aquatic habitat is provided in the Aquatic Environment Supporting Volume Sections 3.3.1 and 3.3.2.

The Physical Environment Supporting Volume Section 6.3.1.1.2 demonstrates that historic changes in the morphometry of the river, i.e., those changes that can be described using a retrospective approach such as mineral erosion, are small. Rates of erosion are non-existent for about half the shoreline area, and for the remainder, these rates of change are relatively low as compared to other lakes and rivers in northern Manitoba. While episodic events like ice scour are known to occur, the substrate patterns in the river are predominantly hard and appear to be governed by high inflows. Mobilized materials will transport into lentic bays where currents are slow or absent, or alternatively any eroded fines will transport down river until relatively slow water velocity is present. In both cases, fine sediments would deposit in existing areas of fine sediment and not change the habitat type. Any changes in availability, including the example of new channel formation cited, are very local and expected to have an undetectable influence on biota as no unique habitat is being created or lost.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Map 3A-3 Substratum Data Collection Index Map; p. N/A

# DFO-0003

## PREAMBLE:

"Substrate composition could not be determined immediately upstream, within, or downstream of rapid sections due to safety concerns."

## QUESTION:

Please define "immediately". Substrate composition be should be confirmed in the dewatered areas in Gull Rapids prior to any construction. Resolution should be similar to that already conducted in the vicinity of Gull Rapids. This information is crucial for proper accounting of habitat destruction in the rapids.

## RESPONSE:

The distribution of sampling effort above and below Gull Rapids is shown in Aquatic Environment Supporting Volume Map 3A-3. Mapping of bottom types extended to approximately 330 m upstream of Gull Rapids and 330 m downstream of Gull Rapids. In Gull Rapids, substrate composition was assessed using aerial photography collected during low water levels when portions of the rapids were dewatered. Classification of the rapids habitat was based on the observed substrate in the dewatered area and applied to the permanently wetted area to provide a general description of the habitat. It can be expected that the unobserved area is the most hydraulically active which suggests the riverbed would be mainly bedrock with some scattered boulder. Most of the available structure in this area would arise from undulation in the surface of the bedrock.

As discussed during a site visit with DFO, direct sampling of the portion of Gull Rapids that will be dewatered is not possible under existing conditions due to the hazardous conditions. Water velocity is fast (> 3-5 m/sec modeled estimates) and large standing waves are present (see Aquatic Environment Supporting Volume Maps 3-12, 3-13).

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.3.2.3.1 Description of Mainstream p. 3-15

# DFO-0004

## PREAMBLE:

"For the purposes of predicting habitat conditions in the post-Project environment and quantifying areal changes in habitat area between the pre and post-Project environments, conditions at 95th percentile flow (pre-Project) and full supply level (FSL) in the reservoir post-Project were used. "

## QUESTION:

This analysis is incomplete. While the 95th percentile accommodates the majority of flows, changes in fish habitat at lower flows are not shown and may be more crucial. Moreover, the 95th percentile flow will be relatively uncommon. The 50th percentile would represent a more normal flow condition and changes in this habitat are not presented. Please provide the results of this analysis which includes the 5th and 50th percentile flows.

## RESPONSE:

The 95$^{th}$ percentile approach describes the total area of habitat that is available except under very high magnitude but low frequency events. The median condition would leave about half of the habitat undescribed, which is undesirable when assessing the loss/alteration of habitat. Post-project, water levels on the reservoir will be constrained within a one metre range. Inflows will affect water levels in the upper, riverine section of the reservoir where there is relatively little change in wetted area with changes in flow. Therefore, 95$^{th}$ percentile inflows provide a realistic description of habitat available Post-project. The appropriate basis of comparison in the existing environment would then also be the 95$^{th}$ percentile inflow.

It is recognized that the availability of certain types of habitat vary with inflow in both the existing and Post-project environments. Variation with flow in the existing environment is described in Aquatic Environment Supporting Volume, Section 3.3.2.3.1. The existing environment habitat data demonstrate that small changes in lentic and lotic habitat occur over wide ranges of inflow. River stage affects habitat availability most in lentic habitat where bed slope is low. This effect was covered in the section on macrophyte habitat availability which addressed river stage directly using observational data collected over nearly the full range of inflow (see Aquatic Environment Supporting Volume, Section 3.3.2.3.1.

In the Post-project environment, effects of inflow on habitat were described where relevant (see for example discussion of substrate composition in the reservoir, Aquatic Environment Supporting Volume 3.4.2.2.3). In general, inflows have the greatest effect on habitat downstream of the generating station as it affects operation of the generating station (e.g., spilling vs. not spilling). This is discussed in Aquatic Environment Supporting Volume Section 3.4.2.3.1.

With respect to the statement, "The 50$^{th}$ percentile would represent a more normal flow condition", there is typically a wide range of inflow in the system and flows are not normally distributed (see Physical Environment Supporting Volume Figure 4.3.3), so the 50$^{th}$ percentile is not likely to repeat as often as may be expected. Further, and as shown in Aquatic Environment Supporting Volume Figure 3-2, the 50th percentile occurred only during three years during 2000 - 2006. Even when it did occur, this state occurred for short a duration (week) amidst a longer trend of change.

Sampling programs for habitat and biota were distributed over a wide range in flow. In the Aquatic Environment Supporting Volume, the variation in specific aspects of habitat with flow was described in order to set the context for the 95$^{th}$ percentile comparisons. Fifth percentile inflows were described in addition to 95$^{th}$ for the IEZ/depth (Aquatic Environment Supporting Volume Table 3-8) before and after the project. Other descriptions of variations due to inflow included: the change in area of flooded creek habitat due to the range of IEZ (i.e. 5$^{th}$ – 95$^{th}$ variation) (Aquatic Environment Supporting Volume Table 3-9); velocity (Aquatic Environment Supporting Volume Map 3-18); and effect of IEZ on plants (Aquatic Environment Supporting Volume Figure 3-4). Models of deposition were built over a wide range of discharge (Aquatic Environment Supporting Volume Table 3B-2) and tested for relative importance of variables at 5$^{th}$ and 95$^{th}$ percentile flows (Aquatic Environment Supporting Volume able 3B-3, 3B-4, and 3B-5). The differences between the predicted depositional boundaries at 5$^{th}$ and 95$^{th}$ percentiles are shown for lotic habitat in Aquatic Environment Supporting Volume Map 3B-3. These analyses provide information on habitat availability under different flow conditions in both the existing and post-Project environments; however, as discussed at the beginning of this response, it is felt that comparisons of habitat areas at the 95$^{th}$ percentile inflows provide an appropriate overall summary of changes in habitat area.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.2.3.1 Aquatic Habitat at Impoundment; p. N/A

# DFO-0005

## PREAMBLE:

"intermittently-exposed zone"

## QUESTION:

Please confirm whether the "intermittently-exposed zone" is in the forebay, below the GS or both. Please also provide an analysis of the effects of water control on dewatering and re-watering areas below the GS and whether habitat losses and fish kills will occur as a result of this.

## RESPONSE:

The “intermittently exposed zone” (IEZ) is both in the forebay (reservoir) and below the generating station. It is the area that is wetted at high flows (95$^{th}$ percentile) and dewatered at low flows (5$^{th}$ percentile). The effects of water controls on dewatering and re-watering areas below the generating station are discussed in Aquatic Environment Supporting Volume Section 3.4.2.3.1. As discussed in this section, the tailrace is backwatered by Stephens Lake and small water level fluctuations caused by cycling of turbines at the generating station occur within the larger range of water level variations caused by regulation of Stephens Lake by the Kettle Generating Station. The area downstream of the spillway would be watered and dewatered depending on spillway operation.

Effects of water level fluctuations on fish downstream of the generating station are discussed in Aquatic Environment Supporting Volume Section 5.4.2.3. Fish stranding is not expected as a result of water level fluctuations in the tailrace due to cycling at the station. Potential fish stranding after spillway operation is being mitigated through the provision of channels to connect isolated pools to Stephens Lake.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.2.4.1.2 Habitat Classifications; p. 3-6

# DFO-0006

## QUESTION:

Is the habitat classification in Section 3.2.4.1.2 related to suitability for fish habitat? Its use for Fish Community Assessments (Section 5) is challenged as the methodology is unproven and thereby likely unacceptable. The use of Habitat-based CPUE modelling was not supported by DFO, due to: 1) the high inter-annual and spatial variation in CPUE, often requiring several years of trend through time data, 2) only one published example of this method was provided and it this was from a marine environment and 3) very small samples sizes that do not account for variation. Can the proponent provide additional published support for this methodology and/or provide a sensitivity analysis which confirms that changes observed in CPUE are linked to changes in habitat and not other variation (e.g. natural annual variability)?

## RESPONSE:

The habitat classification system presented in Aquatic Environment Supporting Volume Section 3.2.4.1.2 was modified to be more biologically relevant for the fish community assessment. The modifications are described in Aquatic Environment Supporting Volume Appendix 3D. The fish community impact assessment is fundamentally based on standard HSI methods, but uses study area-specific CPUE values rather than habitat suitability variables, which are often based on expert opinions or data from outside the study area.

The reviewer notes that the use of CPUEs as a measure of habitat use is likely not acceptable due to the high inter-annual and spatial variation in CPUE, often requiring several years of trend through time analysis. We feel that CPUE is an appropriate measure of relative habitat use to determine whether key species/groups of fish will increase or decrease in relative abundance in the reservoir in comparison to the existing environment for the following reasons:

- CPUE has been used as a metric in the assessment of fisheries stocks for decades. The use of CPUE (regardless of gear type) by many fisheries biologists and other scientist speaks to the universal nature of its acceptance;
- CPUEs used for the impact assessment were composites calculated based on gillnetting studies conducted between 1997 and 2004 (i.e., 7 years of data over a variety of discharge conditions);
- Gillnets set in different habitat types were comparable in their ability to catch fish, yielding appropriate between habitat comparisons;

- Results of the habitat model are not being used as precise estimates of future abundance , but rather to determine likely direction of change and relative magnitude. This approach acknowledges the variability in CPUEs; and
- Results are not being used in isolation of other assessment methods (see discussion at end of this response).

With respect to the reviewer's comment that there is only one published example of a similar approach, we note that the availability of a large amount of site specific sampling in the area of interest allows a more direct assessment of habitat use than is typically applied in a habitat suitability index approach. Habitat suitability variables are typically used when site-specific empirical data are not available or are inadequate. HSI analysis consists of three categories:

- Category I criteria - Habitat suitability criteria developed from professional opinion and experience, synthesis from literature, or through negotiated definitions.
- Category II criteria - Habitat suitability criteria developed by observing microhabitat conditions occupied by a target organism engaged in a specific activity (e.g., spawning, resting, feeding). Also known as utilization criteria because it does not account for habitat availability.
- Category III criteria - Habitat suitability criteria developed by observing used, unused, and/or available microhabitat conditions for a target organism engaged in a specific activity. Also known as electivity or preference criteria because habitat availability is accounted for.

In our opinion, use of CPUE data most closely resembles a Category 3 HSI. We are aware of the biases of CPUE data; however, it must be recognized that all types of sampling are subject to some form of bias. CPUE data used in this instance could provide reasonable comparisons of the relative abundance of fish in sampled habitats. As discussed in Appendix 3D, a relative CPUE for habitats that could not be sampled with gill nets was developed based on expert opinion and the information presented in the appendix.

In our opinion, use of relative CPUE among habitat types as a basis for comparison of overall changes between the pre- and post-Project environments is appropriate given that:

- adequate sampling was conducted to provide a description of relative CPUEs in different habitats; and
- the intent of the analysis is not to predict absolute numbers of fish but to provide a description of relative change (e.g., will amount of walleye habitat increase or decrease?).

It should also be noted that habitat modeling was one of three methods used to conduct the assessment. As described in the EIS, the assessment also considered

alternations to key habitats in the study area and experience from similar reservoirs. Together, these three approaches provide the basis for assessing changes to fish species such as northern pike, walleye and lake whitefish with a high degree of confidence.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 3A Aquatic Habitat Methods; p. N/A

# DFO-0007

## PREAMBLE:

Depth Zones Section

## QUESTION:

In reviewing methods for aquatic habitat assessment in Appendix 3A, while the bathymetric surveying was very detailed, the validation of sonar data does not appear to be structured and repeated such that there is statistical confidence in the results obtained. There is no description of a comparison between the results expected and results observed and therefore the fidelity of the observations. Can the proponent present this sensitivity analysis or point the reviewer to the report which document this? Alternatively, can a study be proposed to test repeatability of bathymetric data collection (test areas beyond the survey area could be tested in the upcoming field season)?

## RESPONSE:

The reviewer refers to "bathymetric surveys" but the section referenced contains a description of acoustic surveys to determine the type of bottom (substrate); therefore, the following response refers to this methodology.

Validation of bottom type is based on field surveys where the substrate is directly determined (e.g., by use of ponar dredges). As shown in Aquatic Environment Supporting Volume Appendix 3A, validation surveys were completed over several years and covered all habitat types. Acoustic bottom typing based on Quester Tangent is an unsupervised method using principle components analysis (PCA) and clustering. In this method, the correspondence between acoustic classes and bottom sample classes is done by visual inspection of the output.

The boundaries between habitat types upstream of Gull Rapids are abrupt and showed good correspondence between validation samples (collected by ponar dredge or other direct sampling method) and sonar (see Aquatic Environment Supporting Volume Appendix 3A). In areas of particular interest, including the young-of-the-year sturgeon habitat in Gull Lake and at the inlet to Stephens Lake, more effort was placed on direct sampling of the bottom using a ponar dredge. For example, the area sampled by ponar in Stephens Lake (>4 km downstream of Gull Rapids) was surveyed first to determine where the main boundaries between substrate classes occurred. This was followed by additional field surveys in 2009 and 2010 (2009 - Aquatic Environment Supporting

Volume Map 3A-3; and 2010 - Aquatic Environment Supporting Volume map 3A-4) that focused mainly on validation samples to determine the bottom composition. Acoustic bottom typing was used to confirm the patterns established by the validation sample and to improve finding the edges but, due to the importance of the sand habitat, and the potential for a fine layer of silt on the sand (which could be transparent to acoustics) mapping was undertaken based primarily on validation data.

With respect to the reviewer's request for a description of a comparison between the results expected and results observed and, therefore, the fidelity of the observations, methods such as Quester Tangent do not produce such an analysis. Only supervised classification, such as Discriminant Analysis methods, produce measures of classification agreement.

Based on the use of direct sampling of substrate type in areas of high sensitivity (i.e., YOY lake sturgeon habitat), it is not clear why sampling would be conducted outside of the area of interest to test the repeatability of bottom type data collection, as requested by the reviewer. When this method is used, samples of bottom type are collected concurrently with sonar data and the two data sets are used to create maps of substrate.

If the reviewer is interested in bathymetric survey methods, all depth and bottom elevation mapping is described in the Physical Environment Supporting Volume Section 4.2.5.4.5.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.1.1 Overview; p. 3-25

# DFO-0008

## PREAMBLE:

"The main effects on habitat availability are losses due to dewatering, and disruption to available lotic habitat due to diversion."

## QUESTION:

Given that the impacts will extend for several consecutive years, impacts to fish habitat in the Nelson River and Stephens Lake can be considered as permanent and not as a temporary disruption. Please make this correction in the EIS.

## RESPONSE:

The text quoted above is taken from the paragraph below and is underlined. The sentence quoted refers to changes that occur during Stage 1 construction, when some habitat is lost due to dewatering (inside a cofferdam) and the remaining flowing water habitat is disrupted (i.e., altered in a negative way) due to diversion, which changes flow patterns and increases flows in the south channel of Gull Rapids. We feel that the paragraph below provides a correct description of sequential habitat changes during construction. Please note that the use of the word “disrupted” is not meant in terms of the usage by DFO as in a Harmful Alteration Disruption or Destruction (HADD) of habitat. We are aware of the specific definitions to each of these terms applied by DFO in the context of a HADD.

Instream activity during Stage I of the construction period (June 2014 to September 2017) dewaters habitat in the north and central channels of Gull Rapids (reaches 8 and 9), and diverts most river flows to the south channel (Map 3-24). Stage I of construction avoids the spring period, but overlaps with the fall period at two cofferdam sites, as described below. <u>The main effects on habitat availability are losses due to dewatering, and disruption to available lotic habitat due to diversion.</u> Substrate quality also will be disrupted due to erosion, transport, and deposition of bank and cofferdam materials into the downstream area primarily due to river staging in the Gull Rapids area. The area of habitat loss within the footprint of the Project infrastructure is about 30% of the dewatered area in Stage I. In Stage II, which begins in the fourth open water season of construction (September 2017 to December 2019), the spillway cofferdam is partially removed which increases wetted area, and the south dam is built in two stages (Map 3-24). As a result, lotic habitat will be disrupted near the spillway where flows are concentrated and increase velocities. New lentic habitat will be created below the south dam, but will vary in area due to inflows and construction activity, until the spillway

construction is complete. Cofferdams will be removed from the powerhouse and tailrace area in year 6 (2019). Substrate quality will be disrupted in Stage II temporarily due to the erosion, transport, and deposition of mobilized materials from river staging in Gull Rapids and to a lesser extent, the Gull Lake area, into the downstream area.

A summary of the temporary and permanent changes to aquatic habitat for each of the two phases of construction is provided in Table 3-6.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.1.1 Overview; p. 3-25

# DFO-0009

## PREAMBLE:

"Substrate quality will also be disrupted due to erosion, transport, and deposition of bank and cofferdam materials into the downstream are primarily due to river staging in the Gull Rapids area."

## QUESTION:

Loss in some cases is expected to be permanent, at least in part (e.g. sand lens below Gull Rapids). As such, part of this impact needs to be described in the context of permanent loss. Please make this correction in the EIS

## RESPONSE:

For clarification on the context of the quoted statement, please see DFO-0008. The statement is describing changes during the construction period and does not use the word "disrupted" in the context used by DFO for a HADD (Harmful Alteration, Disruption and Destruction) of habitat. As discussed for DFO-0008, temporary and permanent alterations in habitat that occur during the construction phase are summarized in Aquatic Environment Supporting Volume Table 3-6. Permanent alterations that begin during construction (e.g., flooding in the reservoir) are considered when assessing the operational phase of the Project.

It should be noted that the sedimentation analysis did not predict a loss of the sand lens below Gull Rapids. As noted in Aquatic Environment Supporting Volume Section 3.4.2.3.1, at impoundment "construction activities are expected to result in the deposition of a layer of sediment estimated to be up to 0.6 cm thick near the inflow of the river to Stephens Lake, and then diminish to 0.1 cm towards the Kettle GS." However, over time, deposited sediments will disperse and substrate composition will be restored to that of the existing environment: Aquatic Environment Supporting Volume Section 3.4.2.3.2 states, "construction is expected to result in the deposition of a thin layer of sediment in the mainstem portion of Stephens Lake; this will persist in the operation period. These sediments, however, are expected to be re-distributed according to particle size after high flow events (i.e., sand and gravel will sort by size similar to the pattern observed in the existing environment)."

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.1.1 Overview; p. 3-25

# DFO-0010

## PREAMBLE:

"New lentic habitat will be created below the south dam, but will vary in area due to inflows and construction activity, until the spillway construction is complete."

## QUESTION:

The spillway is expected only to be operated every four years, so the “new” habitat will be of limited use. Please account for this lower productivity in this section of the EIS (habitat value and compensation).

## RESPONSE:

Please see the response to DFO-0008 for the full context of the text quoted above. The text refers to Stage II of construction, when flow is being diverted through the spillway and, specifically, when the south dam is under construction, creating an area of standing water (“lentic” habitat) in an area that is high velocity habitat in the existing environment (hence, “new” lentic habitat). The extent of standing water (lentic) versus flowing water (lotic) habitat in this area during the construction period varies based on inflows and stage of construction.

The reviewer states that the spillway is expected to be operated every four years and asks for this lower productivity to be accounted for in the EIS. Intermittent operation of the spillway will occur during the operation phase, not the construction phase referenced in the quoted statement above. Dewatering of habitat in the south channel of Gull Rapids is discussed in Aquatic Environment Supporting Volume Section 3.4.2.3.1. Effects to fish, including measures to provide alternate spawning habitat, are discussed in Aquatic Environment Supporting Volume Sections 5.4.2.3 and 6.4.2.3. Required compensation for this habitat loss, in the context of an Authorization for the Harmful Alteration, Disruption and Destruction of habitat under the *Fisheries Act,* will be described in the Fish Habitat Compensation Plan currently being developed by the Partnership. It is anticipated that the Fish Habitat Compensation Plan will be provided to DFO in the first quarter of 2013.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.1.2 Stage I Changes to Aquatic Habitat; p. 3-26

# DFO-0011

## PREAMBLE:

"The total area dewatered during Stage I of construction is estimated to be 131.5 ha, inclusive of the Project infrastructure that accounts for about 30.6 ha (Table 3-6, Map 3-24)…The total area dewatered during Stage II of construction is estimated to be 123.9 ha, of which the Project infrastructure accounts for about 29.2 ha (Table 3-6, Map 3-24). Note that in Map 3-24, the infrastructure that is permanently flooded in Stage II of construction (i.e. substrate alteration), is shown within the dewatered areas for Stage I."

## QUESTION:

With reference to Table 3-6 and Map 3-24, given that areas will be dewatered and coffer dams in place for at least three years (Stage 1) and 1-3 additional years (Stage II), each of these impacts should be defined as permanent losses, not as disruptions. Much or all the area in the dewatered area will be utilized as borrow and/or river bed re-shaping (blasting) to facilitate flow to the new GS and spillway - as such current habitat function permanently destroyed. Moreover, neither the table or map (or text) account for the change in habitat use (and therefore value) from limited spawning habitat to, at best, feeding areas. Please revise estimates of habitat loss in the EIS taking into account these considerations.

## RESPONSE:

As noted in the response to DFO-0008, changes to habitat that begin during the construction phase and become permanent features during the operation phase are described under operation. These permanent changes include increases in water depth, decreases in velocity, changes in substrate, and dewatering of the riverbed. Effects of these habitat changes, including losses, on the fish community, including lake sturgeon, are discussed in the Aquatic Environment Supporting Volume Sections 5.4.2 and 6.4.2. The discussion of effects to fish considers the habitat function in the existing and Post-project environments and changes in availability of habitat; therefore, in our opinion, no revisions to estimates of habitat loss in the EIS are required.

Estimates of changes in area of aquatic habitat, relevant to the issuance of the Authorization for the Harmful Alteration, Disruption and Destruction of fish habitat under the *Fisheries Act*, will be provided in the Fish Habitat Compensation Plan currently being developed by the Partnership. It is anticipated that the Fish Habitat Compensation Plan will be provided to DFO in the first quarter of 2013.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.1.4 Construction of Causeways for Temporary Haul Roads to N-5 and G-3 Borrow Areas; p. 3-28

# DFO-0012

## QUESTION:

"The construction of two temporary causeways will be built to access the N-5 and G-3 borrow areas…for about seven years during the construction period."

This would be considered a permanent loss of fish habitat. Please make this correction in the EIS.

## RESPONSE:

The area of aquatic habitat covered by the causeways is minimal compared to the total amount of aquatic habitat available in Stephens Lake and does not represent any high value, unique habitat type; fish access to habitat on the other side of the causeways will be provided either via culverts or an excavated channel. Therefore, these causeways are considered a low risk to fish habitat and no effects to fish production are anticipated.

The causeways are considered temporary because they will be removed after seven years. Habitat within and adjacent to the footprint of the causeways will be enhanced by using coarse material to increase habitat diversity. Additional information will be provided in the Fish Habitat Compensation Plan, which will be provided to DFO in the first quarter of 2013.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.1.6 Loss/Alteration of Habitat at South Access Roads; p. 3-28

# DFO-0013

## PREAMBLE:

"3.4.1.6 Loss/Alteration of Habitat at South Access Road Stream Crossings."

## QUESTION:

Any loss of habitat (riparian, stream bed, etc) will be permanent (this is not clear currently in the EIS). Also, there is no mention of sizing culverts to maintain 3Q10 fish passage for fish that contribute to an aboriginal, recreational or commercial fishery. Please make the correction on HADD in the EIS. Please provide requested information on flows and passage (3Q10) for proposed crossings.

## RESPONSE:

Habitat losses at the stream crossings are described as permanent ("long-term") in the EIS. The summary of residual effects (Aquatic Environment Supporting Volume Table 3-11) describes the residual effects of stream crossings as "Large (in magnitude), small (in geographic) extent, long-term, site specific at culverts and negligible effect to habitat in stream as a whole."

Details with respect to the design of the south access road stream crossings, including flows and sizing of culverts, will be provided to DFO when designs are completed. It should be noted that the EIS does not address or mention the HADD *per se*; therefore, there is no need to correct the HADD in the EIS. Based on fish habitat surveys conducted at the stream crossings and preliminary design information, the initial assessment suggests that these crossings will represent a low risk to fish habitat and may not represent a HADD. Detailed information of the proposed stream crossings will be provided to DFO in 2013.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 3.4.2.2.3 Aquatic Habitat at Year 30; p. 3-34 to 3-36

# DFO-0014

## QUESTION:

Depositional areas and changes described on pages 3-34 to 3-36, but does not talk about changes to specific habitats. Please provide details on how, specifically, proposed deposition will impact fish habitats and how this will be monitored.

## RESPONSE:

Aquatic Environment Supporting Volume Section 3.4.2.2.3 summarizes the relevant results of the physical environment studies and how these physical processes (sediment deposition) are expected to develop habitat in the reservoir over time. Changes to substrate, and the predicted condition 30 years after impoundment, are also described in Section 3.4.2.2.3. Aquatic Environment Supporting Volume Map 3-34 provides substrate in the existing and (predicted) post-Project environment. Areas of different habitat types, including substrate categories classified as either “hard” or “soft” and either “mineral” or “organic” for 1, 5, 15 and 30 years Post-project are provided in Table 3D-1.

Effects of changes in substrate to fish use of these areas in the reservoir are discussed in Aquatic Environment Supporting Volume Section 5.4.2.2.1 (spawning habitat for walleye and lake whitefish) and Section 6.4.2.2.2 (rearing habitat for lake sturgeon). Indirect effects to fish will occur through effects of deposition of mineral sediments on plants (Section 3.4.2.2.3) and benthic invertebrates (Section 4.5.4.2.2).

Monitoring of the sedimentation in specific fish habitats will be described in the Aquatic Effects Monitoring Plan (AEMP). DFO-0015 provides further information on the submission of the AEMP.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.2.2 Aquatic Environment Monitoring; p.8-12

# DFO-0015

## PREAMBLE:

"A detailed monitoring plan will be provided in the Aquatic Effects Monitoring Plan"

## QUESTION:

When will this be provided? Should be in the EIS.

## RESPONSE:

The Partnership is currently preparing an Aquatic Effects Monitoring Plan in support of Federal *Fisheries Act* requirements. Although it is not required under the EIS Guidelines, the Partnership will provide a preliminary version of the plan to regulators in the second quarter of 2013. A description of proposed monitoring and follow-up activities, as required by the Guidelines, is provided in Section 8.2.2 of the Response to the EIS Guidelines.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.2.2 Aquatic Environment Monitoring; p. 8-12

# DFO-0016

## PREAMBLE:

"This monitoring plan will be implemented during the construction phase of the Project, and will continue into the operational phase."

## QUESTION:

Should be provided in the EIS and must be provided prior to issuance of regulatory decision. Providing input on monitoring frequency is impossible without seeing detailed monitoring plan.

## RESPONSE:

Please see response to DFO-0015.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.2.3.2 Keeyask Environmental; p. 6-4

# DFO-0017

## PREAMBLE:

"Information on movements through Gull Rapids was used to help determine whether fish passage might be required for the Keeyask Project. Lake sturgeon habitat use in the existing environment was described in part by calculating gillnet catch-per-unit-effort (CPUE) in various habitat types."

## QUESTION:

CPUE is, in general, a very limited metric for estimating population size and even more limited to describe habitat use. Description of CPUE needs to be interpreted with caution. Comparison of CPUE between years requires that sampling is standardized and/or an unbiased sample design is employed. Sampling usually needs to be conducted over several years to account for interannual bias. Variation in any metric such as CPUE needs to be reported. Please provide results of analyses of variation in CPUE and how natural variation was accounted for. Please provide the specific reports which examine the fish community for DFO review.

## RESPONSE:

As discussed in DFO-0006, CPUE has been used by fisheries biologists and other scientists for decades. However, as suggested by the reviewer, CPUE (especially for lake sturgeon) is a limited metric for estimating both population size and habitat use, and results should be interpreted with caution. CPUE was not used, in isolation, as a basis for conclusions on lake sturgeon habitat use in the Keeyask Study Area. Further, CPUE was not used to estimate lake sturgeon population size in the Keeyask study area. Population estimates included in the EIS were developed using a mark and recapture (encounter histories) technique and were analysed using a Robust Design model (hybrid population model) in the Program MARK. Lake sturgeon habitat use was described in part by gill net CPUE; however, additional data sources were also drawn upon, including acoustic and radio telemetry results, HSI model results, and scientific literature.

Variation in CPUE among sites and habitat types was not reported in the summary tables provided in the EIS. An approximate measure of capture variability can be obtained from the tables by comparing, for example, the number of sturgeon captured and the number of sites fished. A measure of CPUE variability was not provided in the EIS because of the negative binomial distribution of the CPUE values (many gill nets with zero catches) and because CPUE was not used in statistical analyses (i.e., only used as a relative measure).

As the reviewer suggests, sampling of fish populations for the assessment of abundance and habitat use patterns needs to be conducted over several years to account for inter-annual variability. In relation to the Keeyask project, baseline data on sturgeon gill-net captures and movements were collected over a nine year period and, as with any long-term study, the more frequent the sampling, or the more years of data that are collected, the more insight into natural variability will be obtained.

As indicated in DFO-0001, DFO and MCWS have previously been provided with copies of all reports containing data used in the EIS, and additional copies will be provided. Specific reports that examine lake sturgeon and the fish community are report numbers:

Lake sturgeon: 01-14; 02-19; 03-08; 04-05; 05-05; 06-04; 08-01

Fish community: 99-01; 01-07; 01-05; 01-13; 02-09; 02-05; 02-16; 02-20; 04-03; 04-16

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.2.4 Assessment Approach; p. 6-5

# DFO-0018

## PREAMBLE:

6.2.4 Assessment Approach "Habitat Suitability Index models were developed in consultation with Fisheries and Ocean Canada…."

## QUESTION:

While suitability indices were agreed to, the use of these in habitat modelling was not. Please make this clarification in the EIS.

## RESPONSE:

It is correct that the habitat suitability indices were developed in consultation with DFO and MCWS; the final decisions as to the use of these indices in habitat modeling in the EIS were made by the Partnership. While the EIS cannot be revised, *per se*, responses to information requests form part of the overall environmental impact assessment record.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.1 Pre-1997 Conditions; p. 6-8

# DFO-0019

## PREAMBLE:

"Over-harvesting, both historical (primarily commercial) and at the time of publishing (domestic), were the biggest problems faced by the sturgeon stocks…Because of the time required for sturgeon to reach sexual maturity and catchable size, impacts of previous hydroelectric developments would be slow to appear in the population."

## QUESTION:

The historical loss and fragmentation of sturgeon habitats in the Lower Nelson River (e.g. spawning grounds) is not well addressed in the EIS. Impacts from, for example, from the loss of recruitment, may take decades to be realized in a long lived species such as sturgeon. Moreover, these comments do not completely agree with conclusions on impacts to and recovery potential of lake sturgeon in Designated Unit (Lake Sturgeon DU3 RPA - DFO 2010). Please address these deficiency in the EIS by providing a more fulsome discussion of aquatic ecosystem change in the lower Nelson River.

## RESPONSE:

Historical information on lake sturgeon is provided in Section 6.3.1. The description is based on commercial harvest records, scientific studies and ATK from the KCNs. As noted in this section, “Published scientific information on lake sturgeon in the study area prior to 1997 is limited. From 1953–1956 and in 1959, biological data were collected by the Manitoba Fisheries Branch from lake sturgeon harvested at commercial fishing locations along the Nelson River, including Gull Lake (MacDonell 1997). However, these data were published for the fishery as a whole rather than individual locations (Kooyman 1955; Sunde 1959; Sunde 1961).”

The reviewer is correct that impacts from loss of recruitment may take decades to be realized in a species as long-lived as lake sturgeon. Given that the first generating station on the lower Nelson River was constructed in the early 1970s, only a single generation of sturgeon would have matured since that time (assuming a 25 year generation time). In addition, many of the sturgeon in the population today were born prior to the advent of hydroelectric development on the lower Nelson River; therefore, it is not possible to draw definitive conclusions about the long term (over many generations) effects of the habitat alterations by hydroelectric development on lake sturgeon in the lower Nelson River (although it is possible to observe the shorter-term effects of hydroelectric development on sturgeon populations [e.g. shifts in habitat use]).

The reviewer states that the comments quoted in the preamble do not completely agree with conclusions on impacts to and recovery potential of lake sturgeon in Designated Unit (Lake Sturgeon DU3 RPA - DFO 2010). The complete paragraph with the quoted section underlined is quoted below.

"Studies providing biological data or population statistics on lake sturgeon for the post-Kelsey GS period were limited to the Sipiwesk Lake area (Sopuck 1987; Patalas 1988). The sturgeon population in Sipiwesk Lake likely uses the entire reach of the Nelson River from Eves/Whitemud falls to the Kelsey GS, spawning at several locations including in the Landing River and at various rapids and falls upstream of Sipiwesk Lake (McCart 1992). A field program conducted by the NRSCB in this reach of the Nelson River in order to establish a sustainable level of harvest concluded that large-scale changes to the available habitat did occur as a result of LWR (Macdonald 1998). However, habitat availability was not considered to be a limiting factor for the sturgeon in the area. In addition, no obvious year class failure attributable to the construction of Kelsey GS could be detected, though it was too early to detect any year class changes caused by Jenpeg GS (Macdonald 1998). <u>Over-harvesting, both historical (primarily commercial) and at the time of publishing (domestic), were the biggest problems faced by the sturgeon stocks (Macdonald 1998). Because of the time required for sturgeon to reach sexual maturity and catchable size, impacts of previous hydroelectric developments would be slow to appear in the population (Macdonald 1998).</u>"

As is apparent when the text is quoted in context, the conclusions quoted are from Macdonald (1998) in relation to effects to lake sturgeon in the upper Nelson River in the post-Kelsey Generating Station period. In our opinion, the conclusions are not different in substance from those of the RPA; however, any questions regarding the reason for a discrepancy would need to be directed to the authors of the RPA.

Available historic information for lake sturgeon, including ATK, is summarized in Aquatic Environment Supporting Volume Section 6.3.1 and we are not aware of any studies that would substantially increase or alter the reported information. For a fulsome discussion of aquatic ecosystem change in the Lower Nelson River, documents authored by the Cree Nation Partners, York Factory First Nation and Fox Lake Cree Nation were submitted as part of the EIS. (Note: Fox Lake's was provided as a supplemental filing). These documents provide important Aboriginal traditional information on how the lower Nelson River aquatic ecosystem has changed.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Table 6-6; p. 6-62

# DFO-0020

## PREAMBLE:

"Four adults and 20 sub-adults were captured between Birthday and Gull Rapids during other Keeyask gillnetting studies conducted during summer and fall of 1999-2009 (Table 6-6). The sub-adult catch (number (n) = 15fish) during the summer of 2009 index gillnetting program included ten relatively small sturgeon (191-230 mm total length) believe to have hatched in spring 2008. Based on these captures and the 15 YOY captured in 2008 it appears that there was relatively high recruitment in this reach in 2008."

## QUESTION:

These are very small sample sizes to derive any credible assumptions on any life history parameter. Floy tagging results are too generalistic to derive specific conclusions on life history patterns. Please provide the detailed reports which document sampling which was conducted, results and analysis.

## RESPONSE:

The sample sizes referred to in Aquatic Environment Supporting Volume Table 6-6 are relatively small compared to sample sizes of common, readily captured fish (e.g., walleye). This is a common problem when collecting data for species present in extremely small numbers, in particular when targeting a life-stage (i.e., young-of-the-year, YOY) that may not be present in the environment each year and that inhabit environments that are difficult to sample (i.e., deep channel with current). The capture of YOY lake sturgeon in the Nelson River is an important finding as these are the first recorded captures of YOY lake sturgeon in the Nelson River, and among the first recorded from a large river. Data on the habitat preferences, growth, and survival of YOY or young lake sturgeon in large rivers is virtually non-existent in the scientific literature. The collection of 15 YOY in 2008 and the capture of this same cohort as 1 year-olds in 2009 (n = 15) provides an indication that recruitment in 2008 was high relative to recruitment in other years, as the other cohorts/year classes were less well represented.

To provide further clarification, lake sturgeon less than approximately 8 years of age occupy a similar habitat type in the Nelson River. When this habitat is sampled with gillnets of various mesh sizes ranging from 1 to 6 inch mesh during fall, the lake sturgeon catch appears to represent the age structure of the younger year classes (i.e., <8 years of age). These data provide an indication of relative recruitment success.

We agree that Floy-tagging results are too generalistic to derive specific conclusions on life history patterns. Floy-tagging results were not used in isolation to derive specific conclusions on any life history parameter.

As indicated in DFO-0001, DFO and MCWS have previously been provided with copies of all reports containing data used in the EIS. Reports that document sampling for lake sturgeon: 01-14; 02-19; 03-08; 04-05; 05-05; 06-04; 08-01, 09-03.

Tagging reports may also provide some information of interest to the reviewer relevant to this question. These include numbers: 01-02; 02-18; 03-15; 04-08; 05-02; 06-02; 08-02.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.3.2 Gull Rapids and Nelson River to Stephens Lake; p. 6-19**

# DFO-0021

## PREAMBLE:

"It is assumed most of the spawning lake sturgeon captured in or near the (Gull) rapids moved upstream from Stephens Lake as none of the sturgeon that were tagged upstream between Birthday and Gull Rapids were recaptured in spawning condition in the Gull Rapids vicinity (see Section 6.3.2.7)."

## QUESTION:

This claim is not supported for several reasons: 1) the capture rate of sturgeon (including spawning) was very low and therefore probability of catching a sturgeon from any given area is diminished, 2) unless fish movements are tracked over time, where they originate cannot be definitive. While sturgeon may have originated from Stephens Lake, they may also have originated elsewhere in the Nelson River. Unfortunately, the data cannot provide this discrimination. Please provide detailed reports which examine lake sturgeon spawning and movement.

## RESPONSE:

Data used in development of the lake sturgeon section of the Keeyask EIS were collected over a nine year period from 2001 – 2009. It is recognized that the CPUE of lake sturgeon downstream of Gull Rapids during spring was low (i.e., <0.1 LKST/45.9 m/24 hr) in each year that gillnetting was conducted at this location. Although the CPUE of lake sturgeon was low, a low CPUE does not necessarily indicate that the probability of capturing the fish that are present in the area is diminished; rather, it suggests that few fish are present in the area. Furthermore, male sturgeon captured downstream of Gull Rapids in spawning condition are frequently recaptured several times in a single year. These data suggest that a high proportion of the low numbers of lake sturgeon present in this area during spring are being captured.

If fish from upstream of Gull Rapids were indeed moving downstream and spawning in the Gull Rapids vicinity, it would be expected that at least a proportion of the spawning fish captured below Gull Rapids would be fish tagged from upstream. Spawning male lake sturgeon are highly mobile and are easily captured in the vicinity of the location that they have selected to spawn during a given year. Given the ease of capture of male sturgeon, if sturgeon from upstream of Gull Rapids were moving downstream and spawning in the vicinity of Gull Rapids, marked fish from upstream would be expected to be captured and represented in the gill net catch. In addition, despite considerably

higher numbers of sturgeon marked upstream of the rapids relative to downstream, a considerably higher proportion of the low sturgeon catch below Gull Rapids is represented by fish originally tagged downstream of Gull Rapids. If fish from upstream were moving downstream to spawn then given the high number of tags applied, a higher proportion would be expected to be from upstream. Finally, acoustic telemetry data also suggested that downstream lake sturgeon movements through Gull Rapids were rare.

With respect to the reviewer's comment that "unless fish movements are tracked over time, where they originate cannot be definitive", it is acknowledged that Floy-tagging data does not provide a distinction on where a fish may have originated. However, gillnet catch data, mark and recapture information collected at several locations over multiple years, coupled with multi-year acoustic telemetry monitoring that monitors fish movements over time, can provide valuable information on, for example, the relative abundance of fish spawning at a given location and where those fish travelled from, the frequency of movements between waterbodies/past potential barriers, and the timing during which movements may have occurred.

As indicated in DFO-0001, DFO and MCWS have previously been provided with copies of all reports containing data used in the EIS. Lake sturgeon reports that examine movement and spawning include numbers: 01-14; 02-19; 03-08; 04-05; 05-05; 06-04; 08-01, 09-03.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.3.1 Nelson River from Clark Lake to Gull Rapids; p. 6-15**

# DFO-0022

## PREAMBLE:

"Under the 5th, 50th, and 95th percentile flow scenarios, HSI models for lake sturgeon spawning habitat in the existing environment show that there is a WUA of between 13ha and 18ha within and at the base of Gull Rapids…Under the 5th, 50th, and 95th percentile flow scenarios, HSI models for lake sturgeon spawning habitat in the existing environment show that there is a WUA of between 13 ha and 18 ha within and at the base of Gull Rapids. Two additional variables were added to the HSI model to account for observations made during egg deposition studies: 1) the direction of river flow, and 2) distance from the origin of white water and/or a hydraulic feature."

## QUESTION:

It is recognized that only in the spawning HSI model were additional parameters used in addition to the traditional parameters of depth, substrate and velocity. Also recognizing that in using these additional parameters in the WUA of lake sturgeon spawning habitat is greatly reduced (in most cases at 100 fold). Given the potential magnitude of these affects, please provide published examples of the use of the distance and direction parameter in other studies.

## RESPONSE:

The two variables that were added to the HSI model to account for observations made during egg deposition studies (i.e., the direction of river flow and distance from the origin of white water and/or a hydraulic feature) are constraint variables, in that they constrain the suitable area identified solely on the basis of depth, velocity and substrate. These constraint variables were developed based on detailed spawning studies conducted at the Pointe du Bois Generating Station on the Winnipeg River and reflect the widespread observation that lake sturgeon do not spawn at all locations in a river with suitable depth, substrate and velocity, but cue in on specific hydraulic features that are associated with rapids and/or falls (including tailraces). Work at Pointe du Bois, including a discussion of the two constraint variables, was presented at the annual meeting of the Canadian Dam Association (Brown et al., 2009).

The use of these two constraint parameters in relation to the Pointe du Bois project has been discussed at length with DFO since 2007. To address DFO's concerns with the field sampling conducted to develop these parameters, DFO participated in the planning and implementation of the Pointe du Bois Aquatic Effects Monitoring Plan, 2012 spring

spawning study. Analysis of these data has found that distance is a robust variable that can effectively spatially constrain model outputs to yield realistic and predictable values. The work conducted at Pointe du Bois provides, as noted by DFO, the state of knowledge of understanding lake sturgeon spawning and egg deposition.

The observation that lake sturgeon spawn at barriers is widespread in the literature dating back to Stone (1900) and Stone (1901). An example of the use of a model with distance for lake sturgeon spawning at barriers is Ecclestone (2012). Egg mats have also been used recently by S. Cooke and associates to examine lake sturgeon spawning below a barrier on the Richelieu River as part of the NSERC HydroNet Program (see Smokorowski et al. 2011 for more information on HydroNet). Ecclestone (2012) also provides additional references to lake sturgeon spawning in relation to specific hydraulic features, as follows:

"A waterfall and fan, that presents either a complete or partial barrier to migration, is a key topographical feature that is present at nearly all Lake Sturgeon spawning sites (Priegel and Wirth, 1974; LaHaye et al., 1992; Nilo et al., 1997; Rusak & Mosindy, 1997; Seylor 1997a; Seylor 1997b; McKinley et al., 1998; Auer & Baker, 2002; Peterson et al., 2007; Chiotti et al., 2008)."

"Sturgeon spawning areas may be associated with waterfalls because they offer hydraulic complexity and a diversity of substrate and flow conditions (Le Haye et al., 1992; Perrin et al., 2003; Sulak & Clugston, 1998). In the Big Manistee River, Lake Sturgeon spawning occurred at the base of barchans that were produced by waterfalls, as they provided turbulent and irregular water flows (Chiotti et al., 2008)."

"To improve the predictive ability of the habitat suitability models (HSM) between spawning sites, is it recommended that the model include the relative distance of the potential spawning site from the uppermost barrier and the presence and absence of a waterfall or comparative hydrological feature."

In the Keeyask area, in the absence of the two constraint variables (most importantly the distance function), HSI results indicate that suitable habitat for lake sturgeon spawning is widespread throughout the river, which is known to not be accurate (see DFO-0023 for the results of the three variable spawning habitat model in the existing and post-Project environments). The intentional exclusion of information to refine lake sturgeon spawning models implies that impacts to specific habitats such as rapids, known from observation to be important, do not require special attention. Based on the three variable model results provided in DFO-0023, the Project reduces the total amount of spawning habitat both upstream and downstream of the generating station; however, large areas of spawning habitat remain.

Based on the five variable HSI model (which incorporates the two constraint variables), it was concluded in the EIS that Post-project there would no longer be spawning habitat available downstream of the generating station, and that habitat currently available at Birthday Rapids would no longer be suitable. These results were used as the basis for developing alternate spawning habitat in Stephens Lake and developing a contingency plan for spawning habitat creation at Birthday Rapids. The development of alternate spawning habitat was based on the current understanding of conditions required by lake sturgeon to spawn. The total area of habitat created was based on the sizes of structures known to attract lake sturgeon, as well as the amount of suitable habitat present in other areas (e.g., Weir River), that support substantial spawning populations.

It should be noted that the EIS uses HSI as one of a suite of assessment methods, and that the use of HSI models was to assess the likely suitability of spawning habitat in the post-Project environment in comparison to pre-Project conditions. The assessment also considered effects to key habitats (such as spawning locations at rapids) and the fate of lake sturgeon in other reservoir environments.

## REFERENCES:

Brown, D., MacDonell, D., Sydor, K. and Barnes, N. 2009. An integrated computational fluid dynamics and fish habitat suitability model for the Pointe du Bois Generating Station. Canadian Dam Association Annual Meeting Proceedings.

Ecclestone, A. 2012. Movement patterns, habitat utilization, and spawning habitat of Lake Sturgeon (Acipenser fulvescens) in the Pic River, a northeastern Lake Superior tributary in Ontario, Canada. Unpublished M.Sc. Thesis, Trent University Peterborough, Ontario, Canada 174p.

Smokorowski, K.E., D. Boisclair, N. Bergeron, K. Clarke, S.J. Cooke, R. Cunjak, J. Dawson, B. Eaton, F. Hicks, P. Higgins, C. Katopodis, M. Lapointe, P. Legendre, M. Power, R. Randall, J. Rasmussen, G. Rose, A. Saint-Hilaire, B. Sellars, G. Swanson, N. Winfield, R. Wysocki, and D. Zhu. 2011. NSERC's HydroNet: A national research network to promote sustainable hydropower and healthy aquatic ecosystems. Fisheries 36:480-488

Stone, L. 1900. The spawning habits of the lake sturgeon (Acipenser rubicundus). Transactions of the American Fisheries Society 29: 118-128.

Stone, L. 1901. Sturgeon hatching in the Lake Champlain basin. Transactions of the American Fisheries Society 30:137-143

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: N/A; p. N/A

# DFO-0023

## PREAMBLE:

Lake sturgeon spawning HSI Modelling and commensurate maps

## QUESTION:

Please present WUA for all lake sturgeon spawning habitat for all presented flows using just the depth, substrate and velocity suitability curves.

## RESPONSE:

The results of the three variable HSI model are provided as an attachment to this submission. Please see DFO-0022 for a discussion of the three versus five variable model results.

# LAKE STURGEON SPAWNING HABITAT

# THREE VARIABLE HABITAT SUITABILITY INDEX MODEL RESULTS

Habitat suitability index (HSI) modelling was used to predict changes to lake sturgeon spawning habitat that may result from the Keeyask Generation Project (see Section 6D.2 of Aquatic Environment Supporting Volume Appendix 6D for methods and HSC curves). As discussed in the Aquatic Environment Supporting Volume, Habitat Suitability Criteria were identified for velocity, depth and substratum (Aquatic Environment Supporting Volume Figure 6D-10 to Figure 6D-12). Two additional variables were added to the HSI model to account for observations made during the egg deposition studies conducted at the Pointe du Bois Generating Station on the Winnipeg River: 1) the direction of river flow; and 2) distance from the origin of white water and/or a hydraulic feature (OSc; Figure 6D-13). The direction of flow classified as unsuitable those areas with water movement in an upstream direction (i.e., back eddies) where sturgeon would need to face downstream to spawn. The distance to hydraulic feature was added to the model after eggs were only observed in a fraction of the habitat classified as suitable using only depth, velocity, and substrate. Results for the five variable HSI are provided in the Aquatic Environment Supporting Volume (Section 6.3.2.3.1).

The results for the three variable HSI are provided in this submission in Tables 1-6 (HSI quartile areas/weighted usable areas) and maps 1-3 (weighted usable areas only). It should be noted that this approach overestimates the availability of spawning habitat and includes habitats where sturgeon do not spawn, based on results of field surveys during the spawning period (see Aquatic Environment Supporting Volume Section 6.3.2.3.1).

**Table 1. Lake sturgeon 5th percentile spawning habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS) – Three variable model**

**Existing Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Gull Lake | | | Upstream Total | Gull Rapids | | Downstream of Gull Rapids | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach[1] 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | | Reach 9A | Reach 9B | Reach 11 | Reach 12 | | |
| 0 | Not Suitable | 32.8 | 17.0 | 20.7 | 19.6 | 21.9 | 311.4 | 160.5 | 315.9 | **899.9** | 89.2 | 33.0 | 213.0 | 682.2 | **1017.4** | **1917.3** |
| 0.001–<0.25 | Low | 70.9 | 41.3 | 20.0 | 56.0 | 84.3 | 240.3 | 26.9 | 4.9 | **544.7** | 97.5 | 61.9 | 225.5 | 108.8 | **493.7** | **1038.4** |
| 0.25–<0.5 | Moderate | 22.9 | 24.1 | 19.6 | 27.3 | 53.6 | 337.8 | 79.1 | 4.2 | **568.5** | 25.9 | 20.0 | 72.2 | 0.0 | **118.1** | **686.6** |
| 0.5–<0.75 | High | 15.2 | 18.0 | 22.6 | 23.3 | 58.4 | 435.2 | 106.6 | 5.6 | **685.0** | 19.1 | 10.8 | 31.2 | 0.0 | **61.2** | **746.2** |
| 0.75–1 | Very High | 44.7 | 83.7 | 163.4 | 145.0 | 407.1 | 193.6 | 240.4 | 1.6 | **1279.6** | 56.1 | 69.5 | 20.2 | 0.0 | **145.8** | **1425.4** |
| **Total Wetted Area** | | **186.6** | **184.2** | **246.4** | **271.2** | **625.3** | **1518.3** | **613.6** | **332.2** | **3977.7** | **287.9** | **195.2** | **562.1** | **791.0** | **1836.1** | **5813.8** |
| **Total Suitable Area (0.001–1)** | | **153.8** | **167.2** | **225.6** | **251.6** | **603.4** | **1206.9** | **453.0** | **16.3** | **3077.8** | **198.6** | **162.2** | **349.1** | **108.8** | **818.7** | **3896.5** |

**30 Year Post-Project Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Keeyask GS Reservoir | | | | Upstream Total | Downstream of Keeyask GS | | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | Reach 9A | | Reach 9B | Reach 11 | Reach 12 | | |
| 0 | Not Suitable | 32.2 | 11.1 | 22.4 | 28.5 | 285.2 | 3772.4 | 1156.0 | 1209.1 | 612.3 | **7129.3** | 7.1 | 318.1 | 694.8 | **1020.1** | **8149.4** |
| 0.001–<0.25 | Low | 71.9 | 31.6 | 18.7 | 36.3 | 113.6 | 272.5 | 108.0 | 4.5 | 126.1 | **783.2** | 35.8 | 92.2 | 97.6 | **225.7** | **1008.8** |
| 0.25–<0.5 | Moderate | 22.9 | 15.0 | 26.1 | 28.7 | 83.4 | 86.3 | 110.9 | 0.5 | 13.1 | **386.8** | 16.1 | 73.4 | 0.0 | **89.6** | **476.4** |
| 0.5–<0.75 | High | 14.2 | 12.2 | 28.5 | 29.4 | 134.0 | 3.4 | 6.6 | 0.0 | 1.2 | **229.6** | 2.0 | 41.9 | 0.0 | **43.9** | **273.5** |
| 0.75–1 | Very High | 45.9 | 119.4 | 164.3 | 197.4 | 328.9 | 0.0 | 0.2 | 0.0 | 0.0 | **856.1** | 23.8 | 37.2 | 0.0 | **61.0** | **917.0** |
| **Total Wetted Area** | | **187.2** | **189.4** | **259.9** | **320.3** | **945.1** | **4134.6** | **1381.6** | **1214.1** | **752.8** | **9385.0** | **84.9** | **562.9** | **792.4** | **1440.2** | **10825.2** |
| **Total Suitable Area (0.001–1)** | | **154.9** | **178.2** | **237.5** | **291.8** | **659.9** | **362.2** | **225.6** | **5.0** | **140.4** | **2255.6** | **77.7** | **244.8** | **97.6** | **420.1** | **2675.8** |

1. Location of reaches outlined in Aquatic Environment Supporting Volume Map 6D-1.

**Table 2. Lake sturgeon 5th percentile spawning weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS) – Three variable model**

**Existing Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Gull Lake | | | Upstream Total | Gull Rapids | | Downstream of Gull Rapids | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach[1] 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | | Reach 9A | Reach 9B | Reach 11 | Reach 12 | | |
| WUA 0.001–<0.25 | Low | 8.4 | 5.5 | 1.2 | 5.3 | 7.3 | 47.7 | 1.1 | 0.3 | **76.6** | 9.0 | 7.7 | 15.8 | 10.3 | **42.9** | **119.5** |
| WUA 0.25–<0.5 | Moderate | 7.6 | 8.3 | 4.1 | 9.9 | 18.2 | 156.6 | 4.4 | 0.5 | **209.6** | 8.4 | 7.7 | 22.5 | 16.2 | **54.7** | **264.3** |
| WUA 0.5–<0.75 | High | 7.2 | 9.2 | 9.9 | 14.3 | 30.3 | 306.8 | 39.5 | 2.1 | **419.2** | 10.7 | 8.2 | 35.1 | 0.0 | **53.9** | **473.1** |
| WUA 0.75–1 | Very High | 47.5 | 85.8 | 176.4 | 148.1 | 423.9 | 182.0 | 319.5 | 5.8 | **1389.1** | 43.9 | 61.1 | 42.8 | 0.0 | **147.7** | **1536.8** |
| **Total WUA (0.001–1)** | | **70.7** | **108.7** | **191.5** | **177.7** | **479.7** | **693.1** | **364.5** | **8.6** | **2094.5** | **71.9** | **84.6** | **116.2** | **26.5** | **299.2** | **2393.7** |

**Year 30 Post-Project Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Keeyask GS Reservoir | | | | Upstream Total | Downstream of Keeyask GS | | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | Reach 9A | | Reach 9B | Reach 11 | Reach 12 | | |
| WUA 0.001–<0.25 | Low | 8.2 | 4.1 | 0.6 | 0.9 | 2.3 | 0.0 | 0.2 | 0.0 | 12.4 | **28.8** | 2.9 | 13.0 | 14.7 | **30.5** | **59.3** |
| WUA 0.25–<0.5 | Moderate | 8.1 | 4.8 | 4.2 | 7.1 | 19.5 | 54.6 | 22.2 | 1.1 | 0.4 | **122.0** | 4.7 | 24.1 | 0.0 | **28.8** | **150.8** |
| WUA 0.5–<0.75 | High | 6.5 | 6.3 | 12.8 | 14.1 | 39.0 | 41.2 | 54.6 | 0.3 | 0.0 | **174.8** | 1.5 | 20.0 | 0.0 | **21.5** | **196.3** |
| WUA 0.75–1 | Very High | 48.5 | 121.7 | 184.8 | 216.5 | 421.3 | 2.5 | 3.8 | 0.0 | 0.0 | **999.1** | 24.9 | 62.2 | 0.0 | **87.0** | **1086.2** |
| **Total WUA (0.001–1)** | | **71.3** | **136.9** | **202.4** | **238.6** | **482.1** | **98.4** | **80.8** | **1.4** | **12.8** | **1324.6** | **34.0** | **119.2** | **14.7** | **167.9** | **1492.5** |

1. Location of reaches outlined in Aquatic Environment Supporting Volume Map 6D-1.

**Table 3. Lake sturgeon 50th percentile spawning habitat areas in hectares, by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS) – Three variable model**

**Existing Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Gull Lake | | | Upstream Total | Gull Rapids | | Downstream of Gull Rapids | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach[1] 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | | Reach 9A | Reach 9B | Reach 11 | Reach 12 | | |
| 0 | Not Suitable | 45.9 | 18.5 | 25.4 | 20.4 | 57.9 | 461.9 | 216.1 | 384.2 | **1230.3** | 82.4 | 34.7 | 213.0 | 682.2 | **1012.2** | **2242.5** |
| 0.001–<0.25 | Low | 82.8 | 55.5 | 20.4 | 62.8 | 107.5 | 138.5 | 14.5 | 2.7 | **484.7** | 84.3 | 72.5 | 156.2 | 69.3 | **382.3** | **867.0** |
| 0.25–<0.5 | Moderate | 19.0 | 27.0 | 18.7 | 51.8 | 94.9 | 220.5 | 24.9 | 3.0 | **459.8** | 21.4 | 20.3 | 55.5 | 39.5 | **136.7** | **596.5** |
| 0.5–<0.75 | High | 10.4 | 16.4 | 22.1 | 37.1 | 66.5 | 313.4 | 88.3 | 4.6 | **558.9** | 17.3 | 10.7 | 57.7 | 0.0 | **85.7** | **644.5** |
| 0.75–1 | Very High | 33.2 | 73.5 | 170.3 | 121.3 | 349.4 | 552.7 | 333.1 | 7.1 | **1640.7** | 82.6 | 57.0 | 79.7 | 0.0 | **219.3** | **1860.0** |
| **Total Wetted Area** | | **191.3** | **190.9** | **257.0** | **293.3** | **676.2** | **1687.1** | **676.9** | **401.7** | **4374.4** | **287.9** | **195.2** | **562.1** | **791.0** | **1836.1** | **6210.5** |
| **Total Suitable Area (0.001–1)** | | **145.4** | **172.4** | **231.5** | **272.9** | **618.3** | **1225.2** | **460.8** | **17.5** | **3144.1** | **205.5** | **160.5** | **349.1** | **108.8** | **823.9** | **3968.0** |

**30 Year Post-Project Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Keeyask GS Reservoir | | | | Upstream Total | Downstream of Keeyask GS | | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | Reach 9A | | Reach 9B | Reach 11 | Reach 12 | | |
| 0 | Not Suitable | 44.4 | 13.8 | 25.4 | 28.6 | 293.2 | 3772.1 | 1156.6 | 1208.9 | 612.4 | **7155.3** | 7.1 | 318.1 | 694.8 | **1020.1** | **8175.4** |
| 0.001–<0.25 | Low | 84.4 | 41.2 | 11.7 | 24.6 | 74.6 | 50.5 | 34.1 | 3.0 | 46.0 | **370.3** | 40.0 | 45.2 | 54.5 | **139.7** | **510.0** |
| 0.25–<0.5 | Moderate | 18.2 | 20.5 | 19.8 | 26.5 | 55.6 | 276.3 | 131.0 | 1.8 | 86.2 | **635.9** | 11.7 | 46.7 | 43.1 | **101.5** | **737.4** |
| 0.5–<0.75 | High | 9.9 | 14.4 | 23.0 | 26.3 | 66.3 | 31.7 | 53.5 | 0.1 | 7.1 | **232.5** | 5.6 | 56.1 | 0.0 | **61.7** | **294.2** |
| 0.75–1 | Very High | 35.4 | 104.6 | 185.8 | 216.8 | 463.9 | 3.7 | 6.9 | 0.0 | 1.1 | **1018.4** | 20.5 | 96.8 | 0.0 | **117.3** | **1135.6** |
| **Total Wetted Area** | | **192.4** | **194.6** | **265.7** | **322.9** | **953.6** | **4134.3** | **1382.2** | **1213.9** | **752.8** | **9412.4** | **84.9** | **562.9** | **792.4** | **1440.2** | **10852.6** |
| **Total Suitable Area (0.001–1)** | | **148.0** | **180.8** | **240.4** | **294.3** | **660.4** | **362.2** | **225.6** | **5.0** | **140.4** | **2257.1** | **77.7** | **244.8** | **97.6** | **420.1** | **2677.2** |

1. Location of reaches outlined in Aquatic Environment Supporting Volume Map 6D-1.

**Table 4. Lake sturgeon 50th percentile spawning weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS) – Three variable model**

**Existing Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Gull Lake | | | Upstream Total | Gull Rapids | | Downstream of Gull Rapids | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach[1] 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | | Reach 9A | Reach 9B | Reach 11 | Reach 12 | | |
| WUA 0.001–<0.25 | Low | 9.1 | 6.8 | 1.8 | 6.7 | 10.6 | 26.7 | 0.5 | 0.0 | **62.2** | 9.0 | 7.7 | 15.8 | 10.3 | **42.9** | **105.1** |
| WUA 0.25–<0.5 | Moderate | 6.4 | 9.1 | 5.4 | 16.8 | 33.5 | 104.6 | 2.7 | 0.6 | **179.0** | 8.4 | 7.7 | 22.5 | 16.2 | **54.7** | **233.8** |
| WUA 0.5–<0.75 | High | 4.8 | 9.5 | 10.1 | 22.9 | 40.5 | 221.1 | 12.5 | 1.5 | **322.9** | 10.7 | 8.2 | 35.1 | 0.0 | **53.9** | **376.8** |
| WUA 0.75–1 | Very High | 35.1 | 74.4 | 179.0 | 126.6 | 359.2 | 519.7 | 398.1 | 10.6 | **1702.7** | 64.7 | 50.5 | 92.1 | 0.0 | **207.3** | **1910.0** |
| **Total WUA (0.001–1)** | | **55.4** | **99.7** | **196.3** | **173.0** | **443.8** | **872.1** | **413.8** | **12.7** | **2266.8** | **92.8** | **74.1** | **165.5** | **26.5** | **358.9** | **2625.7** |

**Year 30 Post-Project Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Keeyask GS Reservoir | | | | Upstream Total | Downstream of Keeyask GS | | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | Reach 9A | | Reach 9B | Reach 11 | Reach 12 | | |
| WUA 0.001–<0.25 | Low | 8.9 | 4.4 | 0.5 | 0.8 | 0.8 | 0.0 | 0.1 | 0.0 | 3.7 | **19.2** | 4.0 | 6.2 | 8.9 | **19.1** | **38.3** |
| WUA 0.25–<0.5 | Moderate | 6.4 | 7.1 | 3.3 | 5.2 | 14.9 | 3.6 | 5.3 | 0.8 | 20.5 | **67.1** | 3.3 | 17.7 | 17.7 | **38.7** | **105.8** |
| WUA 0.5–<0.75 | High | 5.2 | 8.0 | 9.4 | 12.7 | 24.4 | 127.8 | 62.9 | 0.9 | 0.2 | **251.5** | 3.9 | 30.9 | 0.0 | **34.8** | **286.2** |
| WUA 0.75–1 | Very High | 36.4 | 105.7 | 200.4 | 229.5 | 501.0 | 26.6 | 44.2 | 0.1 | 0.0 | **1144.0** | 21.4 | 108.5 | 0.0 | **129.9** | **1273.9** |
| **Total WUA (0.001–1)** | | **56.9** | **125.3** | **213.7** | **248.2** | **541.1** | **158.0** | **112.4** | **1.8** | **24.3** | **1481.7** | **32.6** | **163.3** | **26.5** | **222.5** | **1704.2** |

1. Location of reaches outlined in Aquatic Environment Supporting Volume Map 6D-1.

**Table 5. Lake sturgeon 95th percentile spawning habitat areas in hectares, by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS) – Three variable model**

**Existing Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Gull Lake | | | Upstream Total | Gull Rapids | | Downstream of Gull Rapids | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach[1] 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | | Reach 9A | Reach 9B | Reach 11 | Reach 12 | | |
| 0 | Not Suitable | 68.3 | 26.1 | 32.7 | 27.1 | 126.2 | 577.4 | 242.0 | 409.3 | **1509.1** | 71.0 | 47.8 | 213.0 | 682.2 | **1014.0** | **2523.0** |
| 0.001–<0.25 | Low | 90.6 | 67.8 | 26.9 | 92.7 | 175.1 | 73.3 | 8.6 | 0.3 | **535.5** | 86.6 | 76.9 | 124.8 | 34.9 | **323.2** | **858.7** |
| 0.25–<0.5 | Moderate | 13.3 | 34.0 | 22.9 | 62.7 | 118.1 | 115.7 | 12.2 | 1.9 | **380.8** | 34.8 | 24.0 | 32.1 | 31.3 | **122.2** | **503.0** |
| 0.5–<0.75 | High | 6.4 | 14.0 | 15.1 | 30.0 | 69.7 | 200.1 | 28.7 | 3.1 | **367.1** | 21.3 | 13.2 | 34.6 | 23.9 | **93.1** | **460.2** |
| 0.75–1 | Very High | 21.1 | 55.7 | 170.3 | 93.5 | 258.7 | 840.0 | 413.1 | 12.5 | **1864.7** | 74.2 | 33.3 | 157.5 | 18.7 | **283.7** | **2148.3** |
| **Total Wetted Area** | | **199.7** | **197.6** | **267.8** | **306.0** | **747.9** | **1806.5** | **704.6** | **427.1** | **4657.1** | **287.9** | **195.2** | **562.1** | **791.0** | **1836.1** | **6493.2** |
| **Total Suitable Area (0.001–1)** | | **131.4** | **171.5** | **235.1** | **278.9** | **621.7** | **1229.0** | **462.6** | **17.8** | **3148.1** | **216.8** | **147.4** | **349.1** | **108.8** | **822.1** | **3970.2** |

**30 Year Post-Project Environment**

| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Keeyask GS Reservoir | | | | Upstream Total | Downstream of Keeyask GS | | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | Reach 9A | | Reach 9B | Reach 11 | Reach 12 | | |
| 0 | Not Suitable | 69.4 | 17.0 | 32.0 | 34.4 | 305.7 | 3770.7 | 1156.4 | 1208.5 | 612.4 | **7206.6** | 7.1 | 318.1 | 694.8 | **1020.0** | **8226.6** |
| 0.001–<0.25 | Low | 87.9 | 55.7 | 10.0 | 20.1 | 32.6 | 8.4 | 1.4 | 0.0 | 33.7 | **249.8** | 24.3 | 17.8 | 28.1 | **70.2** | **320.0** |
| 0.25–<0.5 | Moderate | 13.8 | 31.7 | 24.1 | 35.1 | 59.7 | 51.4 | 38.2 | 3.3 | 24.6 | **281.7** | 11.5 | 25.1 | 27.2 | **63.8** | **345.5** |
| 0.5–<0.75 | High | 5.3 | 23.4 | 21.7 | 31.1 | 49.1 | 233.8 | 83.9 | 1.3 | 73.0 | **522.6** | 11.1 | 37.8 | 39.8 | **88.7** | **611.4** |
| 0.75–1 | Very High | 23.1 | 70.9 | 185.6 | 206.4 | 521.1 | 68.7 | 102.2 | 0.4 | 9.2 | **1187.6** | 30.9 | 164.1 | 2.5 | **197.5** | **1385.0** |
| **Total Wetted Area** | | **199.5** | **198.8** | **273.4** | **327.0** | **968.2** | **4133.0** | **1382.1** | **1213.6** | **752.8** | **9448.3** | **84.9** | **562.9** | **792.4** | **1440.2** | **10888.5** |
| **Total Suitable Area (0.001–1)** | | **130.1** | **181.8** | **241.4** | **292.7** | **662.5** | **362.2** | **225.6** | **5.0** | **140.4** | **2241.7** | **77.8** | **244.8** | **97.6** | **420.1** | **2661.9** |

1. Location of reaches outlined in Aquatic Environment Supporting Volume Map 6D-1.

**Table 6. Lake sturgeon 95th percentile spawning weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS) – Three variable model**

**Existing Environment**

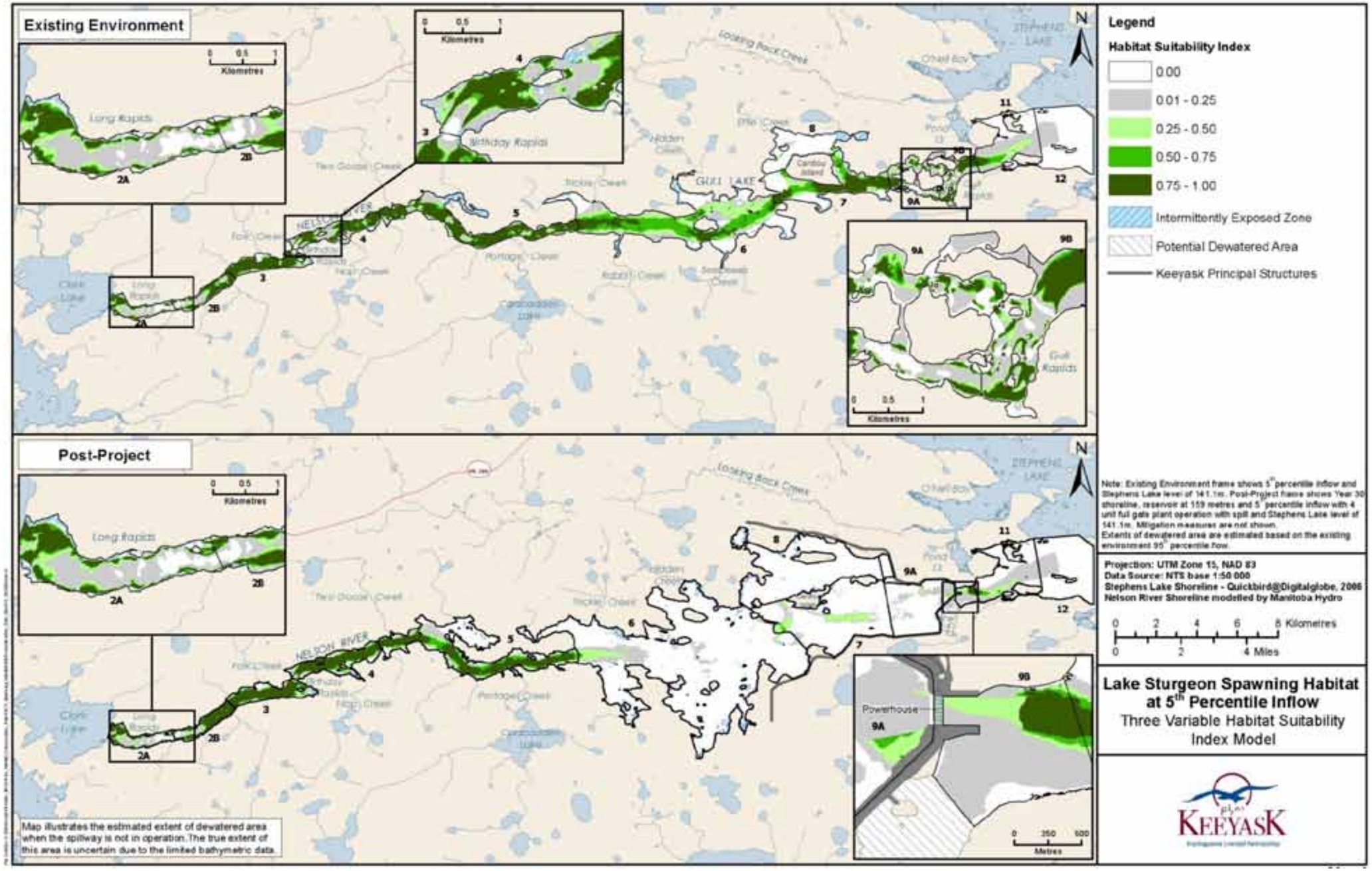
| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Gull Lake | | | Upstream Total | Gull Rapids | | Downstream of Gull Rapids | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach[1] 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | | Reach 9A | Reach 9B | Reach 11 | Reach 12 | | |
| WUA 0.001–<0.25 | Low | 8.2 | 7.7 | 3.4 | 12.6 | 22.6 | 12.6 | 0.5 | 0.0 | **67.6** | 10.5 | 8.2 | 12.8 | 5.9 | **37.4** | **105.0** |
| WUA 0.25–<0.5 | Moderate | 4.5 | 11.4 | 7.0 | 20.4 | 35.6 | 54.9 | 2.8 | 0.0 | **136.6** | 13.3 | 8.4 | 15.5 | 11.3 | **48.5** | **185.1** |
| WUA 0.5–<0.75 | High | 3.2 | 8.1 | 7.6 | 15.4 | 43.7 | 141.4 | 6.8 | 1.0 | **227.1** | 13.5 | 8.6 | 20.6 | 14.7 | **57.3** | **284.4** |
| WUA 0.75–1 | Very High | 21.9 | 55.8 | 174.7 | 100.8 | 270.2 | 790.0 | 429.8 | 14.8 | **1858.0** | 58.2 | 29.9 | 158.0 | 15.3 | **261.4** | **2119.4** |
| **Total WUA (0.001–1)** | | **37.8** | **83.0** | **192.7** | **149.3** | **372.1** | **998.9** | **439.8** | **15.8** | **2289.3** | **95.5** | **55.1** | **206.7** | **47.2** | **404.6** | **2693.9** |

**Year 30 Post-Project Environment**

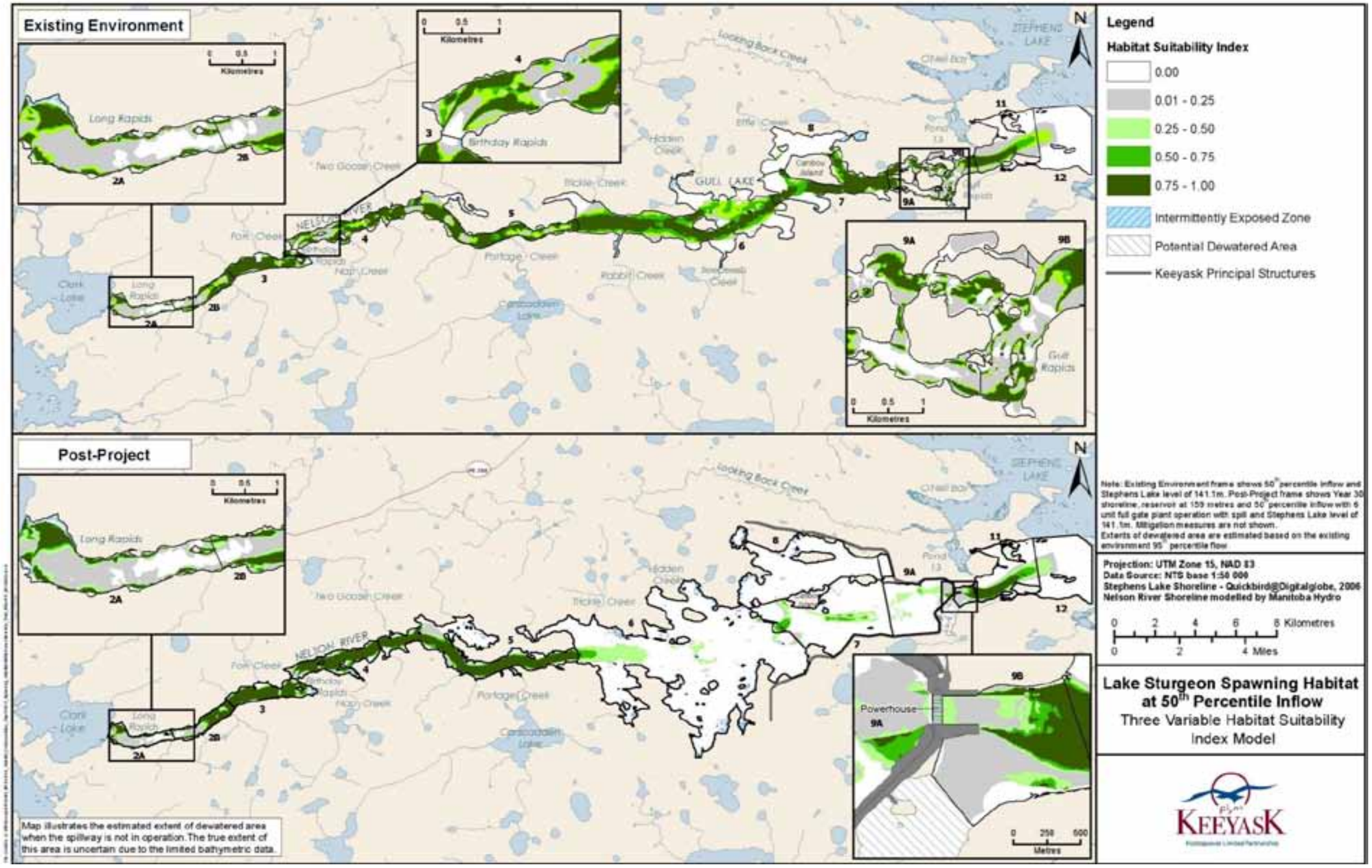
| HSI | Suitability Classification | Upstream of Birthday Rapids | | | Downstream of Birthday Rapids | | Keeyask GS Reservoir | | | | Upstream Total | Downstream of Keeyask GS | | | Downstream Total | Overall Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 2A | Reach 2B | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Reach 8 | Reach 9A | | Reach 9B | Reach 11 | Reach 12 | | |
| WUA 0.001–<0.25 | Low | 8.1 | 5.8 | 1.3 | 2.6 | 1.2 | 0.0 | 0.1 | 0.0 | 4.1 | **23.2** | 2.6 | 2.7 | 5.3 | **10.7** | **33.9** |
| WUA 0.25–<0.5 | Moderate | 4.7 | 10.9 | 5.4 | 6.6 | 8.4 | 0.0 | 0.4 | 0.0 | 4.4 | **40.8** | 3.7 | 8.8 | 9.9 | **22.4** | **63.1** |
| WUA 0.5–<0.75 | High | 3.0 | 13.6 | 10.3 | 16.5 | 27.3 | 10.6 | 12.4 | 1.6 | 26.2 | **121.6** | 5.7 | 20.2 | 24.5 | **50.4** | **172.0** |
| WUA 0.75–1 | Very High | 23.3 | 71.9 | 193.6 | 210.2 | 531.4 | 228.8 | 158.3 | 1.4 | 0.2 | **1419.1** | 29.5 | 165.3 | 2.1 | **196.8** | **1615.9** |
| **Total WUA (0.001–1)** | | **39.1** | **102.3** | **210.7** | **235.9** | **568.4** | **239.4** | **171.1** | **3.0** | **34.9** | **1604.7** | **41.5** | **196.9** | **41.8** | **280.3** | **1884.9** |

1. Location of reaches outlined in Aquatic Environment Supporting Volume Map 6D-1.

**Map 1. Lake sturgeon spawning habitat at 5th percentile inflow – three variable habitat suitability index model**

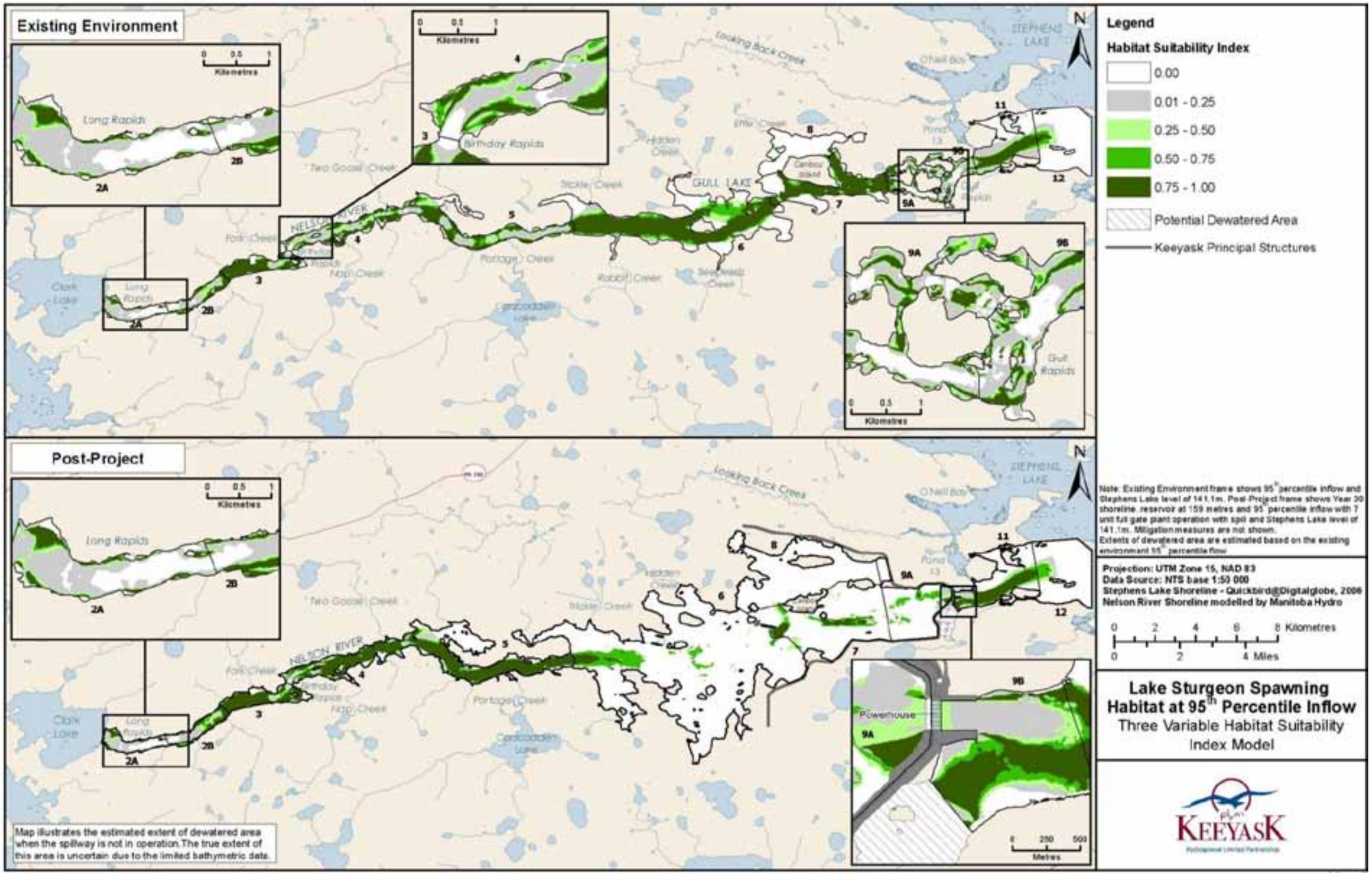


3 **Map 2. Lake sturgeon spawning habitat at 50th percentile inflow – three variable habitat suitability index model**




4

5 **Map 3. Lake sturgeon spawning habitat at 95th percentile inflow – three variable habitat suitability index model**




6

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 6D Lake Sturgeon Habitat Suitability Index Modelling Results; p. N/A

# DFO-0024

## PREAMBLE:

Appendix 6D

## QUESTION:

Please present Habitat Units (HU's) for all tables in section 6D.

## RESPONSE:

The tables in Section 6D provide Weighted Useable Areas (WUAs) which are the equivalent of habitat units (HU's). As defined by the U.S. Fish and Wildlife Service 1980, "the relationship: Habitat area x Habitat quality (HSI) = Habitat units (HUs), provides the basic framework by which habitats are inventoried and analysed for the species or guilds of interest. The habitat quality measure (HSI) can be determined by a number of methods, as long as the method is documented and includes quantification of the evaluation criteria". In this case, WUA or HU is calculated using the mathematical product of the area of each pixel multiplied by the suitability indices (Si). In our analysis, an individual Si is not weighted as the relative importance of each variable remains unclear. The HSI results which were already scaled by area, were tabulated as totals. In addition, the WUAs were broken down into quartiles to show the underlying proportion or distributions of habitat value in the tables and maps.

## REFERENCES:

U.S. Fish and Wildlife Service. 1980. *Habitat Evaluation Procedure (HEP) Manual*. U.S. Fish and Wildlife Service, Washington, DC.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.0 Lake Sturgeon; p. N/A

# DFO-0025

## PREAMBLE:

Chapter 6

## QUESTION:

For all HSI maps, outline of existing environment (the shorelines of the Nelson River and Stephens Lake) should be shown in the post project environment maps. The additional aquatic area gained by creation of the forebay should be illustrated and given a suitability of 0, recognizing that this is terrestrial habitat that will undergo substantial change before it becomes productive aquatic habitat (EIS suggests at least 5 years). Please provide revised maps showing these changes.

## RESPONSE:

The HSI analysis is based on long term (30 year) habitat conditions in the reservoir. At that time, flooded habitat with suitable substrate, depth and velocity is expected to support lake sturgeon foraging.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A Aquatic Mitigation and Compensation Measures: Evaluation of Alternatives and Rationale for Selected Measures; p. N/A

# DFO-0026

## PREAMBLE:

Maps 6-48, 6-49

## QUESTION:

Unclear as to how sand/gravel habitat will be created post project in the forebay, particularly in years 1-5. Does this include compensatory measures proposed in Appendix 1A? Please provide detailed information/model which demonstrates the creation of sand post project.

## RESPONSE:

The creation of YOY habitat in the reservoir is described in Aquatic Environment Supporting Volume Appendix 1A (compensatory measure). Barges will be used to transport and deposit material on the riverbed if monitoring of YOY recruitment indicates that successful recruitment is not occurring in the reservoir. Detailed construction methods will be developed when site conditions can be assessed after reservoir creation.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.0 Lake Sturgeon; p. N/A

# DFO-0027

## PREAMBLE:

Chapter 6

## QUESTION:

HSI model verification for existing environment not conducted. Can model verification be conducted prior to construction? Can verification of physical environment be conducted prior to construction. Post project verification of HSI and physical models should be conducted.

## RESPONSE:

The EIS uses HSI analysis as one of a suite of assessment methods for predictive purposes. Other methods include assessment of changes to key habitats in the existing environment and comparison to similar (or proxy) systems. No further verification of aquatic or physical models is planned prior to Project construction.

The Aquatic Effects Monitoring Plan (AEMP) will describe monitoring for effects to lake sturgeon, with emphasis on the success of mitigation/compensation measures. There is no plan to verify the HSI model *per se*. Information on the development of the AEMP is provided in DFO-0015. Physical parameters will be monitored as part of the Physical Environment Monitoring Plan and will include parameters and locations important for the assessment of effects to the aquatic environment.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.3.2 Gull Rapids and Nelson River to Stephens Lake; p. 6-19**

# DFO-0028

## PREAMBLE:

"The model also suggests that there is more spawning habitat available at the base of the rapids than within them, due to the prevalence of excessively high velocities within the rapids proper."

## QUESTION:

Is this a valid conclusion at all flows? How would spawning habitat distribution change without constraining the model by distance and flow direction?

## RESPONSE:

The pattern described in the quoted statement for the 5 variable model also occurs for the 3 variable model (see DFO-0023 for model results). As flows increase, the amount of higher value habitat in the 5 variable model decreases while the extent of lower value habitat remains similar. The similar extent among flows would be expected in a distance constrained model. As shown in the material attached with respect to DFO-0023, the three variable model always estimates more suitable habitat below Gull Rapids than within, irrespective of inflow. However, as flows increase the area of suitable habitat found immediately at the base of the rapids decreases (reach 9B) as the velocity suitability index is exceeded. This local decrease in suitable area with higher inflow is offset in the three variable model by an increase in the extent of the higher value suitability (HSI = 0.75 - 1.0), which extends through much of Reach 11 at the 50$^{th}$ percentile, and even into Reach 12, more than 5 km from the base of the rapids, at the 95th percentile.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.3.2 Gull Rapids and Nelson River to Stephens Lake; p. 6-19

# DFO-0029

## PREAMBLE:

"Currently, lake sturgeon spawn within Gull Rapids and larvae drift downstream into lower velocity areas of the river or the western portion of Stephens Lake where an area of gravel/sand and sand has formed (Section 3). Lake sturgeon larvae have been reported to drift up to 60 km downstream of the spawning site (Appendix 6A). Therefore, larvae spawned further upstream may also be drifting downstream through Gull Rapids and settling in these areas."

## QUESTION:

This statement does not reconcile with another conclusion in the EIS that movement through Gull Rapids is not required for lake sturgeon life history. Why?

## RESPONSE:

The statement that movement of lake sturgeon through Gull Rapids is not required for sturgeon life history was made in reference to the upstream movement of adults through Gull Rapids for spawning (see Aquatic Environment Supporting Volume Section 6.3.7.7.2). As discussed in this section, when lake sturgeon move through Gull Rapids, the movements do not appear to be linked to spawning at upstream spawning locations during the current year. Therefore, provided that lake sturgeon spawning habitat is created downstream of the Keeyask Generating Station, lake sturgeon in Stephens Lake should have all habitats available that are required to fulfill their life history.

The statement quoted by the reviewer refers to the downstream drift of larval lake sturgeon from spawning areas. Larval drift patterns, specifically from spawning sites upstream of the generating station, such as Long Rapids and Birthday Rapids, will be affected by the Project. In the post-Project environment, due to changes in flow patterns, lake sturgeon larvae may no longer drift to, and settle in, known rearing areas north of Caribou Island. Further, if larvae are currently drifting from upstream spawning sites through Gull Rapids into Stephens Lake, this is unlikely to occur once the reservoir has been formed. This potential loss of larval drift to the Stephens Lake sturgeon population from upstream spawning areas is part of the rationale for stocking lake sturgeon into Stephens Lake (see Aquatic Environment Supporting Volume Section 6.4.2.3.2).

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.3.2 Gull Rapids and Nelson River to Stephens Lake; p. 6-19

# DFO-0030

## PREAMBLE:

Rearing

## QUESTION:

Did the condition of YOY lake sturgeon between various capture sites (Caribou Island, Stephens Lake, etc) differ?

## RESPONSE:

To minimize handling time, weights were not collected from the YOY lake sturgeon captured thus this comparison is not possible. Furthermore, the sample size is not large enough to make comparisons between capture sites as most of the YOY were captured north of Caribou Island in similar habitats (i.e., over sand with low-moderate water velocities) and only one YOY was captured in Stephens Lake. However, if we use length as an indication of condition (i.e., faster growth), YOY length varied between 128 and 170 mm within Gull Lake and the one YOY captured in Stephens Lake was within this length range (144 mm).

Please see DFO-0046 for additional information on this topic.

## R REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 2.5.2.2.2 Dissolved Oxygen; p. 2-54

# DFO-0031

## PREAMBLE:

Overwintering

## QUESTION:

Overwintering habitat, use and movements not well documented in the EIS. Please provide detailed reports which examined this. If this work was not conducted as part of this EIS, please provide expected movements based on published information from similar systems.

## RESPONSE:

It is acknowledged that overwintering habitat, habitat use and movements of fish/lake sturgeon are not as well documented as other seasons. This is because extreme cold and unsafe ice conditions make the Nelson River extremely difficult to sample during winter. Three years of radio telemetry data were collected for lake sturgeon with limited success. Acoustic telemetry studies were extended as far into fall as possible prior to ice up and provided information on lake sturgeon movements during low water temperatures. In 2011, a study with long-term acoustic tags was initiated to provide additional information on lake sturgeon movements, including during the construction phase of the Project. To improve the understanding of lake sturgeon movements in the area during winter, selected receivers were left in place during the winter. Unfortunately, ice extending deep into the river channel disrupted many of the upstream and some of the downstream receivers, reducing the amount of data collected. Initial results of this study will be provided to regulators when reports presenting Year 1 of the overwintering data are completed in 2013.

With respect to lake sturgeon movements during winter in other systems, sturgeon movement rates during winter in Lake of the Woods were described as significantly lower relative to other times of the year, likely related to the decrease in water temperature (Rusak and Mosindy 1997). Studies cited in Kerr et al. (2011) found that lake sturgeon occupy deeper areas of rivers and lakes in areas of low water velocity during winter.

With respect to other fish species, three years of movement/habitat use data were collected during winter for each of the VEC species.

It should be noted that creation of a reservoir in general increases the availability of over-wintering habitat. One issue with respect to overwintering conditions in a reservoir

is a reduction in dissolved oxygen due to flooding of terrestrial areas. This was addressed through detailed analysis (see Physical Environment Supporting Volume, Dissolved Oxygen and Temperature and summary of results in Aquatic Environment Supporting Volume Section 2.5.2.2.2).

The provision of data reports is discussed in DFO-0001. Radio-telemetry results for lake sturgeon are provided in reports 01-14; 02-19; 03-08; 04-05. Movement data for other fish species are provided in report numbers 02-03; 03-06; and 05-03.

## REFERENCES:

Kerr, S. J., M. J. Davison, and E. Funnell. 2011. A review of lake sturgeon habitat requirements and strategies to protect and enhance sturgeon habitat. Fisheries Policy Section, Biodiversity Branch. Ontario Ministry of Natural Resources. Peterborough, Ontario. 58 pp. + appendices.

Rusak, J. A. and T. Mosindy. 1997. Seasonal movements of lake sturgeon in Lake of the Woods and the Rainy River, Ontario. Canadian Journal of Zoology 74:383-395.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.7.2 Movements Through Large Rapids; p. 6-27

# DFO-0032

## PREAMBLE:

Fish Movements – Importance of Movements.

## QUESTION:

Conclusions in this section that upstream or downstream movement of adult lake sturgeon are not spawning migrations do not agree with local traditional knowledge that Gull Rapids and Birthday Rapids are important spawning grounds for Stephens Lake sturgeon. Please speak to these discrepancies in the EIS or correct.

## RESPONSE:

We agree that local traditional knowledge states that Gull Rapids and Birthday Rapids are important spawning grounds for lake sturgeon (see Response to EIS Guidelines 6.2.3.3.5 “Lake Sturgeon”). We are not aware of traditional knowledge that states that sturgeon from Stephens Lake swim upstream through Gull Rapids to spawn at Birthday Rapids.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.7.2 Movements Through Large Rapids; p. 6-27

# DFO-0033

## PREAMBLE:

Fish Movements – Importance of Movements.

## QUESTION:

Acoustic and telemetry tagging clearly show movement of lake sturgeon through Gull Rapids. However, due to the limited number of telemetry data, conclusions on habitat use and the types of migration (e.g. spawning) are not practical. Please provide detailed reports showing movement.

## RESPONSE:

As noted in the Aquatic Environment Supporting Volume Section 6.3.2.7.2, acoustic telemetry and mark and recapture data clearly show that a portion of lake sturgeon in Stephens Lake and Gull Lake move through Gull Rapids. Of the recorded movements through the rapids where the timing can be determined, all have occurred between July and October. These data suggest that movements occur after the spawning season and, therefore, are not related to spawning in the current year.

It should be noted that conclusions on habitat use and types of movement (e.g., spawning) presented in the Aquatic Environment Supporting Volume are not based solely on acoustic telemetry information but included gill net CPUE, mark and recapture, and scientific literature.

See DFO-0031 for a list of reports describing lake sturgeon movement.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.3.2.7.2 Movements Through Large Rapids; p. 6-27

# DFO-0034

## PREAMBLE:

Fish Movements – Importance of Movements.

## QUESTION:

Habitat impacts as a result of the loss of migration upstream and downstream through Gull Rapids (Stage II construction) should be recognized.

## RESPONSE:

As noted in Section 6.4.1 (introduction to construction assessment), "Effects that begin during construction but are a permanent feature of operation (e.g., flooding of terrestrial area) are considered under the operation period (Section 6.4.2)." During Stage 2 construction, when all flow is passed by the spillway, sturgeon will no longer be able to move upstream over Gull Rapids. Effects of the blockage of upstream movement are discussed in the operation phase assessment, specifically Section 6.4.2.3.2.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.1 Construction Period; p. 6-29

# DFO-0035

## PREAMBLE:

"Disruption of spawning activity due to disturbance by construction activity and habitat loss/alteration."

## QUESTION:

Spawning habitat loss in much of Gull Rapids will be permanent. Resumption of spawning may occur in the remaining natural (and constructed) spawning habitat, but this is uncertain. Please make this correction in the EIS.

## RESPONSE:

The quoted statement is in a list of bullets that describes pathways of effect assessed for the construction period. Section 6.4.1.2.6 of the Aquatic Environment Supporting Volume provides the description of changes to spawning habitat during the construction period and indicates sequential habitat loss during the construction period, as follows:

“Cofferdam construction in the north and central channels and on the north bank of the south channel (Stage I Diversion) will eliminate lake sturgeon spawning and foraging habitat in the footprint of these structures and immediately downstream of them. Despite elevated flows and increased water velocity through the south channel during this phase, a reduced amount of spawning and foraging habitat is expected to remain in the vicinity of the islands along the south bank of this channel, where suitable habitat currently exists; however, it is not known whether sturgeon will use this habitat (Map 6-7 to Map 6-9). Given this uncertainty, construction processes, such as blasting and the release of TSS, will be managed on the basis that lake sturgeon are continuing to spawn in the south channel during construction, to allow for appropriate protection of sensitive early life stages.

Complete closure of the river through construction of cofferdams across the south channel (Stage II Diversion) will destroy remaining spawning and foraging habitat in the footprint of these structures. The cofferdams will not affect lake sturgeon in the Nelson River upstream of Gull Rapids as those fish use habitat upstream of the rapids.“

Effects of permanent loss of spawning habitat in Gull Rapids, and plans to address this loss through construction of a spawning structure, are discussed in Aquatic Environment Supporting Volume Section 6.4.2.3.1.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.1.2.6 Loss and Alteration of Habitat in Footprint of Instream Structures; p. 6-31**

# DFO-0036

## PREAMBLE:

"The cofferdams will not affect lake sturgeon in the Nelson River upstream of Gull Rapids as those fish use habitat upstream of the rapids."

## QUESTION:

This is not a reasonable conclusion, given little long term information on documented sturgeon habitat use and movement and no evidence of distinct populations (6.3.2.5) between Stephens Lake and Clark Lake. Please provide detailed report(s) which examine the impacts of protracted inaccessibility to lake sturgeon spawning success.

## RESPONSE:

The statement, “The cofferdams will not affect lake sturgeon in the Nelson River upstream of Gull Rapids as those fish use habitat upstream of the rapids”, was made because cofferdams are not influencing the physical conditions (i.e., water levels and flows) upstream of Gull Rapids (see DFO-0035 for the complete paragraph). As discussed below, the portion of the total population moving downstream from Gull Lake into Gull Rapids is very small.

The Aquatic Environment Supporting Volume Section 6.3.2.7.1 describes results of tagging studies in the reach of the river between Clark and Gull Lakes. Of 577 lake sturgeon tagged in Gull Lake over an eight year period, the recapture rate of these fish in Gull Rapids or downstream (2 of 166 fish) was much lower than the recapture rate of fish upstream of the rapids (164 of 166 fish).

These data indicate movements through the rapids do occur. This finding is consistent with studies of lake sturgeon populations from other river systems. In many populations, long distance movements are relatively uncommon with the exception of movements to spawning areas. Other studies have found that movements between distinct basins, or through sets of rapids, are relatively uncommon. See Aquatic Environment Supporting Volume Appendix 6A for a review of the scientific literature as it relates to lake sturgeon movement.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2 Operation Period; p. 6-32

# DFO-0037

## PREAMBLE:

"Increase in lake sturgeon movements upstream to Split and Clarke lakes due to velocity changes as a result of impoundment (e.g. reduction in velocity at Birthday Rapids)."

## QUESTION:

This avoidance of slack water habitat will extend to much of the forebay, not just at Birthday Rapids. The HSI curves for all sturgeon life stages are heavily influenced by velocity, a recognition that lake sturgeon select high velocity riverine environments.

## RESPONSE:

There may be some misinterpretation of this statement. The statement quoted above suggests that lake sturgeon movements through Birthday Rapids may become more frequent in the post-Project environment since Birthday Rapids may be less of an impediment to upstream lake sturgeon movement. Several studies in the scientific literature have suggested that lake sturgeon remain within distinct basins separated by sets of rapids. Therefore, reduced flows at Birthday Rapids in the post-Project environment may result in an increase in lake sturgeon movement past Birthday Rapids. As such, the increased movement through Birthday Rapids would not be due to an avoidance of slack water habitat that extends through much of the forebay.

With respect to DFO's statement that “the HSI curves for all lake sturgeon life stages are heavily influenced by velocity, a recognition that lake sturgeon select high velocity riverine environments”, this appears to be contrary to what is known about the species. Adult lake sturgeon may indeed select for high velocity environments during spring when spawning. However, at other times of the year, adult lake sturgeon are generally found in medium, low/standing velocity environments. This is also true for the other life stages of lake sturgeon. Juvenile lake sturgeon, for example, are known to rarely enter high velocity riverine environments; evidence in the scientific literature suggests that juveniles may avoid moving through these environments. It is unlikely that YOY lake sturgeon in large rivers select for high velocity riverine environments as it would be difficult for them to forage.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2 Operation Period; p. 6-32

# DFO-0038

## PREAMBLE:

"Habitat changes in the reservoir due to changes in water levels and flow that will result in the loss or alteration of existing habitat (riverine channels in Gull Lake…and the creation of new habitat."

## QUESTION:

The creation of "new" habitat in the forebay should be discounted to half that of the current riverine environment. Recognizing that the forebay will not stabilize ecologically for a number of years, productivity will be low or non-existent initially. Productivity will, however, increase with time. As a result, WUA's for all post project HSI analyses should be calculated in consideration of this change in productivity over time using a defensible methods approach. This approach would discount the value of habitat in the post project environment for the number of years required for the full productivity of the new forebay to be realized. At a minimum, this appears to be 5 years, but could be indefinite ("…downstream emigration was documented for lake sturgeon moving out of the [new] Limestone reservoir within the first five years after impoundment (NSC 2012). Over time, some lake sturgeon that move upstream may return downstream to the reservoir.") This suggests that not only will usable habitat be lost in the reservoir, but the loss of a natural population this area may occur as well. While conservation stocking is proposed to mitigate this, there is no proof that the stocked sturgeon will remain in the new forebay either.

## RESPONSE:

The quoted bullet is one of a long list of potential effects. Please see Aquatic Environment Supporting Volume Section 6.4.2.2.2 for a description of changes to lake sturgeon habitat in the reservoir. Conditions in the reservoir in the early years of impoundment vary in suitability for different life history functions, as discussed in this section. The HSI model analysis was based on conditions in the reservoir 30 years after impoundment; the intent of the model was not to describe changes in habitat suitability over time, therefore the adjustments in suitability criteria suggested by the reviewer are not required.

The reviewer indicates that the loss of lake sturgeon through emigration may not be mitigated by conservation stocking as there is no proof that stocked sturgeon will remain in the new reservoir. As discussed in Aquatic Environment Supporting Volume Appendix 1A, Part 2, stocking has been used to enhance depleted sturgeon populations

in many systems and, though some stocked sturgeon are expected to emigrate, a portion of the stocked sturgeon would also be expected to stay.

It should be noted that the EIS was based on a multi-pronged approach, including evaluation of changes to the existing environment, in particular key habitats, experience from other reservoirs, and HSI modeling.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2 Operation Period; p. 6-32

# DFO-0039

## PREAMBLE:

"Alteration of habitat in the river channel between Gull Rapids and Stephens Lake."

## QUESTION:

Much of the habitat in this reach will be permanently destroyed with only small portions undergoing alteration. Please revise in the EIS to show permanent loss.

## RESPONSE:

The quoted text is in a list of potential effects to lake sturgeon provided at the start of the operations section. The complete list with the quoted text underlined is as follows:

“Through the following pathways, the Project has the potential to affect lake sturgeon during operation:

- Increase in lake sturgeon movements upstream to Split and Clark lakes due to velocity changes as a result of impoundment (e.g., reduction in velocity at Birthday Rapids);
- Habitat changes in the reservoir due to changes in water levels and flow that will result in the loss or alteration of existing habitat (riverine channels in Gull Lake, Birthday Rapids) and creation of new habitat;
- Creation of a barrier to upstream fish movement at Gull Rapids due to the presence of the generating station;
- Changes in downstream movement of larval, juvenile and adult fish due to the creation of the reservoir and presence of the generating station structures (i.e., dam, spillway, trash racks and turbines);
- Loss of Gull Rapids;
- Alteration of habitat in the river channel between Gull Rapids and Stephens Lake;
- Potential for fish to become stranded after spillway operation; and
- Changes in harvest levels.“

The bullet preceding the bullet quoted by the reviewer refers to habitat lost in Gull Rapids (reaches 9A-9B in the assessment). The bullet in question refers to habitat below Gull Rapids that is not being destroyed (reach 11 in the assessment). In this area, the primary change is alteration in the distribution and magnitude of velocity which is shown in the Aquatic Environment Supporting Volume, Map 3-30 where increases and decreases in velocity are compared before and after the project.

The effects of changes to this reach of the river on lake sturgeon are discussed in Aquatic Environment Supporting Volume Section 6.4.2.3, and include an assessment of both habitat losses in Gull Rapids and alterations in this reach of the river, as well as the other factors such as changes in fish movements.

## REFERENCE: Volume: Aquatic Environment Supporting Volume Section: 6.4.1.2.7 Net Effects of Construction with Mitigation; p. 6-31

# DFO-0040

## PREAMBLE:

6.4.1.2.7 Net Effects of Construction with Mitigation

## QUESTION:

Given information presented in this EIS, it is highly uncertain that permanent loss of Gull Rapids as spawning, migration and rearing habitat for lake sturgeon (and several other species) can be mitigated. This is due to: 1) lack of detailed information for the proposed lake sturgeon stocking program and uncertainty regarding the acceptability of this program (see comments on stocking), 2) questionable representation of the amount and value of spawning habitat currently in and around Gull Rapids and 3) lack of understanding of the importance of maintaining migration through Gull Rapids and the avoidance of habitat fragmentation in the Nelson River. Please speak to this uncertainty in the EIS.

## RESPONSE:

The summary of residual effects of the Project and description of uncertainty is provided in Section 6.4.3.3 of the Aquatic Environment Supporting Volume, as follows:

"The lake sturgeon response to the construction of the Project will result in moderate adverse effects over a medium spatial extent (lower reservoir and Stephens Lake) in the medium-term. In the long-term, no adverse effects to lake sturgeon numbers in the area directly affected by the Project are expected due to mitigation measures to provide habitat for all life history stages and the implementation of an extensive stocking program. An overall increase in the number of sturgeon in the Kelsey Generating Station to Kettle Generating Station reach of the Nelson River is expected in the long-term as a result of population augmentation due to stocking. There would be a commitment to extensive monitoring and adaptive management to modify and supplement stewardship as required to meet this goal. The adverse effects during construction are reversible (because the population will recover). The effects are continuous as they will last beyond the construction period. Finally, effects are of high ecological context due to the sensitivity of the species and the vulnerability of the population.

The technical lake sturgeon assessment is based on an analysis of their use of existing habitats and the habitat present post-Project, HSI models developed for the pre- and post-Project environments, and observations of lake sturgeon populations in a proxy

reservoir (i.e., Stephens Lake) and other reservoirs. These approaches provide moderate to high certainty regarding the prediction of adverse effects in the absence of mitigation. There is low to moderate certainty regarding the success of mitigation measures to create YOY habitat in the reservoir and moderate certainty regarding the success of mitigation measures to create spawning habitat in the reservoir and Stephens Lake. However, there is moderate to high certainty regarding effects to abundance following the implementation of a stocking program, resulting in an overall moderate to high certainty for the predicted increases in regional lake sturgeon numbers."

As described above, there is a moderate to high certainty in the occurrence of adverse effects to lake sturgeon in the absence of mitigation. There is low to moderate certainty regarding the success of habitat mitigation measures; however, there is moderate to high certainty that stocking can successfully increase population numbers. In addition, the Partnership is committed to adaptive management, to modify mitigation measures until success is achieved.

Each of the points raised by the reviewer with respect to uncertainty are addressed below.

1. The lack of detailed information for the proposed lake sturgeon stocking program and uncertainty regarding the acceptability of this program (see comments on stocking).

Details on the lake sturgeon stocking program are provided in Aquatic Environment Supporting Volume Appendix 1A Part 2. See responses to DFO-0089 to DFO-0097, DFO-0099 and DFO-0100 regarding specific questions raised with respect to the program.

2. Questionable representation of the amount and value of spawning habitat currently in and around Gull Rapids.

With respect to the long term survival of the Stephens Lake sturgeon population, the essential requirement is that an adequate amount of functioning spawning habitat be available post-Project. Rationale for the proposed constructed habitat and contingency measures that will be applied if the initial structure does not function as intended are discussed in Aquatic Environment Supporting Volume Appendix 1A, Part 1. At present, the near absence of spawning sturgeon in Stephens Lake is likely the greatest impediment to successful use of the constructed spawning habitat in the initial years following impoundment. See also DFO-0045.

3. Lack of understanding of the importance of maintaining migration through Gull Rapids and the avoidance of habitat fragmentation in the Nelson River.

Studies have shown that a portion of the sturgeon upstream of Gull Rapids and a portion of the few lake sturgeon present in Stephens Lake move through Gull Rapids.

The majority of the movements that have been recorded to date have occurred in July to October. Effects to and the importance of movements to lake sturgeon are discussed in Aquatic Environment Supporting Volume Section 6.4.2.3.2 as follows:

"The GS will block upstream movements of adult lake sturgeon from below the GS, and downstream movements from the reservoir, except for fish that pass over the spillway or past the turbines. Currently, adult lake sturgeon move upstream and/or downstream over Gull Rapids (Section 6.3.2.7); however, these movements do not appear to be related to the fulfillment of a particular life history function (e.g., spawning). Access to habitat in the Gull Lake area does not appear to be critical to the lake sturgeon population downstream of Gull Rapids, and likewise, sturgeon in Gull Lake do not appear to require habitat in Stephens Lake. Consequently, provision of upstream and downstream passage at the GS would provide no clear benefit to either the Gull Lake or the Stephens Lake sturgeon populations.

The mitigation approach for potential effects of a physical barrier to upstream movement of either population is to provide habitat for all life history stages both upstream and downstream of the generating station. The objective is to create/maintain self-sustaining populations in both areas. This approach avoids reliance on untested fish passage methods. (No fishways that successfully allow movement of lake sturgeon upstream and downstream past a facility the size of the, or in the climatic setting of the Keeyask Generating Station exist.) However, a need was identified to include upstream fish passage in the Project design to maintain existing connections among fish populations. This reflects a precautionary approach with respect to uncertainty regarding the importance of maintaining connections among populations. Provision of fish passage would provide lake sturgeon with access to a greater habitat area, including riverine habitat upstream of Birthday Rapids, and avoid creating a partially isolated population in Stephens Lake."

The adoption of this precautionary approach to develop fish passage, in consultation with DFO and MCWS, should address the reviewer's concerns with respect to fish movements. See also DFO-0021, DFO-0029, DFO-0032, and DFO-0036.

Overall, it should be noted that changes in habitat are an unavoidable consequence of the Keeyask Generating Station being constructed. However, as discussed in Section 6.4.2.2.1, there are examples of reservoirs where lake sturgeon populations have been maintained, if certain criteria are met, as follows:

"However, sturgeon numbers have been maintained in other reservoirs (e.g., Nelson River above Kelsey GS, Winnipeg River between Slave GS and Pointe du Bois GS) or subsequent declines have been attributed to other factors (e.g., harvest). The reasons behind the sustained presence or decline in a lake sturgeon population at a given reservoir are complex, and appear related to a variety of factors including: the

availability of suitable habitat to support all life history functions; sturgeon immigration and emigration; and fishing mortality."

In developing mitigation for the Keeyask project, a substantial effort was made by the Partnership to maintain/create habitat for all life history stages upstream and downstream of the station. In addition, risks to the lake sturgeon population due to its small size are being addressed through the implementation of a stocking program which, as noted above, is described in Appendix 1A Part 2.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.2.1 Applicability of Proxies; p. 6-35

# DFO-0041

## PREAMBLE:

"The majority of lake sturgeon captured in these reservoirs are taken in the upper, more riverine areas. Researchers on the Winnipeg River have also found that sturgeon are most abundant in the upper reaches of the reservoirs where conditions are more characteristic of riverine conditions."

## QUESTION:

This contradicts the conclusions elsewhere in the EIS that the new forebay will create highly suitable habitat for all life stages of lake sturgeon. Please explain and address this discrepancy.

## RESPONSE:

The Partnership could not locate the statement that “the new forebay will create highly suitable habitat for all life stages of lake sturgeon.” In fact, as discussed in Section 6.4.2.2.2, certain types of habitat may be absent from the reservoir and will need to be created (e.g., YOY habitat) and conditions in the newly flooded areas will not be highly suitable as foraging habitat in the first years of impoundment.

As the reviewer noted, in Nelson River reservoirs, such as Long Spruce and Limestone, gillnet catch data and a very limited amount of acoustic telemetry data suggest that lake sturgeon mainly occupy the upper reaches of these reservoirs. Similar results have been observed in at least a few reservoirs on the Winnipeg River.

With respect to the reviewer’s assertion that the EIS states that highly suitable habitat will be present for all life stages of lake sturgeon, it is possible that the reviewer is referencing HSI model results for adult lake sturgeon foraging habitat. In the EIS, the HSI model for foraging adult lake sturgeon 30 years after impoundment indicates that highly suitable habitat will be widespread in the reservoir. Results for the other life stages (YOY and sub-adult), however, indicated that only a very small area of highly suitable habitat would exist in the reservoir.

Similar to other methods used in the assessment, habitat suitability indices must be interpreted with caution. These indices consider the depth, water velocity and substrate parameters separately, and not in combination. Adult lake sturgeon are found in the upper end of reservoirs likely because that habitat is preferred relative to the habitat in the lower end of the reservoirs. There is a difference between suitable and preferred habitat: there is no question that the lower end of reservoirs are “suitable” because lake

sturgeon are sometimes found in these areas; the upper ends of reservoirs appear to be preferred as sturgeon tend to occupy these areas in greater numbers.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.2.2 Habitat; p.6-35

# DFO-0042

## PREAMBLE:

"The existing environment HSI model for lake sturgeon spawning habitat indicates that there is a WUA of between 9 and 12 ha from Clark Lake to Gull Rapids."

## QUESTION:

As previously mentioned (6-15), the method of calculating spawning habitat WUA's will need to be revisited as the estimate of 9 to 12 ha is likely a substantial underestimate.

## RESPONSE:

Please see response to DFO-0022. In our opinion, the spawning model used in the assessment presents the most realistic HSI analysis of spawning habitat available and no revision is required; however, results of the 3 variable model are provided in DFO-0023.

It should be noted that HSI models were used as one part of the environmental assessment, which also considered changes to key habitats and experience gained from other reservoirs. Based on all three methods of analysis, spawning habitat would need to be created for lake sturgeon in Stephens Lake. Based on the HSI, spawning habitat at Birthday Rapids would no longer be suitable; however, based on experience elsewhere (e.g., in Nelson River upstream of the Kelsey GS), sturgeon may continue to spawn in inundated rapids. Therefore, the approach proposed by the Partnership is to monitor and then modify the shoreline at Birthday Rapids if required to create conditions suitable to attract spawning sturgeon.

With respect to the total area of spawning habitat, the important factor is that there is sufficient habitat to support the needs of the existing and future sturgeon population. Hundreds of sturgeon are known to spawn in areas of a few hectares of suitable habitat; therefore, the focus of habitat creation needs to be on creating appropriate conditions rather than attempting to recreate the total area that may be present in the existing environment.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.2.2. Habitat; p. 6-37

# DFO-0043

## PREAMBLE:

"The majority of the lake sturgeon captured in the Long Spruce and Limestone reservoirs are taken in the upper end of the reservoirs where conditions are more characteristic of riverine habitat (NSC 2012). These observations suggest that, while the amount of usable foraging habitat (i.e., WUA) upstream of the Keeyask GS will be higher in the post-project environment, not all this habitat may be selected by either sub-adult or adult fish."

## QUESTION:

This suggests that post the project environment WUA for these life stages may need to be modified using this system specific observations. Please consider these changes in the WUA tables and discuss this in the EIS.

## RESPONSE:

As discussed in DFO-0041, similar to other methods used in the assessment, habitat suitability indices must be interpreted with caution. These indices consider the depth, water velocity and substrate parameters separately, and not in combination. Adult lake sturgeon are found in the upper end of reservoirs likely because that habitat is preferred relative to the habitat in the lower end of the reservoirs. There is a difference between suitable and preferred habitat: there is no question that the lower end of reservoirs are “suitable” because lake sturgeon are sometimes found in these areas; the upper ends of reservoirs appear to be preferred as sturgeon tend to occupy these areas in greater numbers.

As noted by the reviewer, system-specific observations should be given a higher weight when developing HSI models. As noted by DFO in DFO-0018, DFO participated in the development of suitability criteria. Whether higher weightings should be given to system-specific observations and lower weightings be given to what has been reported in the scientific literature or what has been observed in other systems was discussed. Decisions were made at that time (with DFO involvement) to consider all sources of data in the development of HSI curves. It must be noted, however, that system-specific data were used where possible in development of the curves.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.1 Habitat; p. 6-40

# DFO-0044

## PREAMBLE:

"To compensate for the loss of spawning habitat, several areas will be developed to provide suitable spawning habit"

## QUESTION:

All proposed compensation works should have relevant suitability curves applied and commensurate WUA and HU's calculated.

## RESPONSE:

As confirmed with DFO at a technical review meeting on Nov. 8, 2012, the HSI analysis will not be used to determine the amount of compensatory habitat required for the Authorization for the Harmful Alteration, Disruption and Destruction of fish habitat under the *Fisheries Act*. Therefore, no further HSI modeling, or alterations to existing HSI models, is required.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.1 Habitat; p. 6-41

# DFO-0045

## PREAMBLE:

"Lake sturgeon could also use habitat in the river below the spillway in years when the spillway is operating at sufficient discharges during the spawning and egg incubation period".

## QUESTION:

Please provide details on performance/success of lake sturgeon spawning habitat use and successful hatch from similar structures developed at the Grand Rapids and Limestone GS's.

## RESPONSE:

Lake sturgeon spawning structures have not been developed at either the Grand Rapids or Limestone generating stations.

However, lake sturgeon spawn downstream of numerous generating stations throughout their range, including the Pointe du Bois, Slave Falls, Seven Sisters, McArthur, Great Falls, and Pine Falls generating stations on the Winnipeg River. None of these stations have specific spawning structures developed in the downstream environment; yet lake sturgeon find suitable areas for spawning.

In the lower Nelson River, sturgeon stocks are too low downstream of most of the generating stations to adequately assess whether the absence of recorded spawning is due to an absence of suitable habitat. A large population of sturgeon is present in the river below the Limestone Generating Station, but in this river reach, sturgeon spawn in the Weir or Angling rivers or the Lower Limestone Rapids, and do not appear to move as far upstream as the generating station to spawn.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.1 Habitat; p. 6-41

# DFO-0046

## PREAMBLE:

"The capture of 3 month old (approximate) YOY sturgeon over cobble/boulder substrate along the south shore between the rapids and the lake, suggests that older YOY can survive in what is thought to be less than optimal habitat…"

## QUESTION:

Were YOY found to consistently utilize these habitats? If so, did they exhibit diminished condition or fitness?

## RESPONSE:

This statement refers to the capture of two YOY (see Section 6.3.2.3.2). Weights were not collected from the YOY fish making the comparison of condition factor impossible. However, both YOY lake sturgeon that were captured in Stephens Lake were within the length range of YOY fish captured in Gull Lake in 2008, suggesting that growth rate is similar.

Although there may be insufficient data to answer this question based on YOY captures, if growth or condition of YOY lake sturgeon was lower in Stephens Lake relative to Gull Lake, and assuming juvenile movement is limited between the two waterbodies, differences would be expected in the condition and growth of sub-adult (i.e., 1, 2 and 3 year old) lake sturgeon as well. Data collected in Gull Lake and in Stephens Lake in on-going studies since 2008 (not included in the EIS), and based on a substantially larger sample size, have suggested that the condition and growth of sub-adult lake sturgeon are similar between the two waterbodies.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.1 Habitat; p. 6-41

# DFO-0047

## PREAMBLE:

"Because the number of lake sturgeon residing downstream of Gull Rapids is considerably reduced compared to historic levels, a stocking program will be implemented to avoid possible effects of a temporary reduction in rearing habitat should it occur".

## QUESTION:

Given the loss of known high quality YOY habitat north of Caribou Island (future forebay), the known YOY rearing habitat below Gull Rapids must be protected. What measures will be taken to ensure that this habitat will not change, both during construction and operation?

## RESPONSE:

Based on the sedimentation analysis, there will be no long-term change in substrate composition of the YOY habitat downstream of Gull Rapids. Monitoring will determine whether this prediction is correct.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.2 Movements; p. 6-43

# DFO-0048

## PREAMBLE:

"The phased approach to fish passage…will permit trial implementation of fish passage for lake sturgeon with minimal risk to the Stephens Lake population."

## QUESTION:

The stated risk to the Stephens Lake sturgeon population is not identified. Note, the proponent has been requested to investigate the cost/benefits of various fish passage designs, including cost, environmental cost/benefit, etc. The proponent has retained a consultant for this investigation, which has produced a preliminary report on this comparison. The detailed results of this report should be made available in the EIS for review.

## RESPONSE:

The stated risk to the Stephens Lake sturgeon population is that numbers of adult lake sturgeon in Stephens Lake are extremely low; therefore, removing these potential spawners from the lake by upstream transportation would hinder the development of a self-sustaining population in Stephens Lake.

A report describing various approaches to fish passage is undergoing final review and will be provided to DFO and MCWS under separate cover prior to the end of 2012. Based on discussions with DFO and MCWS Fisheries Branch, a decision was made not to complete the evaluation of various fish passage designs until data had been gathered on post-project fish behaviour.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.2 Movements; p. 6-43

# DFO-0049

## PREAMBLE:

"The phased approach to fish passage…will permit trial implementation of fish passage for lake sturgeon with minimal risk to the Stephens Lake population."

## QUESTION:

Trap and truck was identified as the fish passage option for Keeyask, this method has traditionally been used at high head dams and information behind the rationale for the selection of this option is required. What criteria will be used to determine if and when trap and truck should be implemented?

## RESPONSE:

A discussion of various methods of fish passage will be provided in the report referenced in DFO-0048.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.2 Movements; p. 6-43

# DFO-0050

## PREAMBLE:

"Sturgeon moving downstream from the Keeyask reservoir would need to pass either the spillway (when it's in operation) or past the trash racks and turbines…Although experimental studies of turbine effects have not been conducted with lake sturgeon, studies of fish movements in the Limestone reservoir have recorded downstream passage by lake sturgeon both over the spillway and past the turbines."

## QUESTION:

What is the survival of sturgeon that pass: 1) through the turbines and 2) over the spillway? How does this survival change with size? What provisions for safe downstream passage have been considered?

## RESPONSE:

With respect to DFO's questions on the survival of sturgeon that pass through the turbines or over the spillway, data on lake sturgeon movement through generating stations is limited. Further, because experimental studies of turbine effects on lake sturgeon have not, to the Partnership's knowledge, been conducted, as stated in the Aquatic Environment Supporting Volume "There is no information available on turbine mortality rates for sturgeon."

There are several studies, however, that have been conducted in Manitoba that provide information relevant to:

- the frequency with which lake sturgeon move downstream through generating stations;
- the mode (spillway vs. turbines) of downstream passage; and
- whether or not passage was survived.

Downstream movement of lake sturgeon through the Slave Falls Generating Station (GS) in the Winnipeg River was investigated by McDougall (2011). Mean entrainment rates of lake sturgeon at the Slave Falls GS were 3.1%/year for adults tagged throughout the Slave Falls Reservoir and 17.9%/year for subadults tagged in the lowermost section of the Slave Falls Reservoir. In total, 11 lake sturgeon (adults and subadult combined) tagged during the study passed through the station. Of these 11, seven either conclusively passed, or were likely to have passed, via the bottom-draw regulating gates (a structure unique to the Slave Falls station). Routes of four could not conclusively be

determined. Eight of the 11 passage events were known to have survived, while the remaining three were deemed likely to have survived passage.

In 2007, 16 lake sturgeon ranging in length from 595 to 895 mm fork length were captured downstream of the Limestone GS, tagged with acoustic transmitters, and released into the Limestone Forebay. Of these 16 fish, after three years of study, eight were confirmed to have moved downstream through the Limestone GS. Five of these fish are known to have moved through the GS as no spill was occurring at this time of passage. For the remaining three, the spillway was in operation, thus movement could have occurred via spillway or turbines. Seven of these fish survived passage. Survival of the one remaining fish was not confirmed.

In 2011 and 2012, a total of 60 acoustic tags were applied to lake sturgeon in the Nelson River between Clark Lake and the Kettle GS; 31 upstream of Gull Rapids and 29 downstream of Gull Rapids. As of October 2012, none of the fish tagged upstream of Gull Rapids had moved downstream through Gull Rapids into Stephens Lake; however, two of the sturgeon tagged in Stephens Lake moved downstream through the Kettle GS. The route that both fish took through the GS is unknown as the spillway was operating when they moved through. These fish measured 796 mm and 880 mm in fork length. There has not been an instance of an adult lake sturgeon that has moved downstream to the Kettle GS and subsequently disappeared.

With respect to DFO's question regarding the provisions for safe downstream passage that have been considered, the Partnership has identified that optimizing the design of turbines to increase fish survival and reduce injury rates is the best option for downstream passage. A discussion of changes to turbine design to reduce effects to fish is provided in Aquatic Environment Supporting Volume Appendix 1A Attachment 1.

## REFERENCES:

McDougall, C.A. 2011. Investigating downstream passage of Lake Sturgeon, *Acipenser fulvescens*, through a Winnipeg River generating station. M.Sc. Thesis. University of Manitoba, Winnipeg, Manitoba. X + 175 pp.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.2 Movements; p. 6-43

# DFO-0051

## PREAMBLE:

"There is no information available on turbine mortality rates for sturgeon."

## QUESTION:

Mortality rate for sturgeon should be based on: 1) known mortality for species of a similar size (e.g. pike) for both spillway and turbine and 2) the number of individuals passing the turbines can be calculated based on fish passage studies (e.g. Missi Falls) and a commensurate relative abundance estimates. Please provide detailed reports which describe this.

## RESPONSE:

As discussed in DFO-0050, there is no experimental information on turbine mortality rates for lake sturgeon that the Partnership are aware of. In the absence of data based on lake sturgeon, DFO suggested that the mortality rate of a species of similar size to lake sturgeon (i.e., large northern pike) could be used as a proxy for estimating the mortality rate. While using a species of similar size is one approach in the absence of other data, the turbines at Kelsey are not similar to the turbines that will be used at Keeyask; the Keeyask turbines incorporate several features that are expected to improve survival over the kind tested at Kelsey (see DFO-0102). Therefore, using results from turbine mortality studies at the Kelsey Generating Station to directly predict lake sturgeon mortality through turbines at Keeyask, is not advisable. Table 2 in the Aquatic Environment Supporting Volume Appendix 1A, Attachment 1 contains a list of measured mortality rates from many species, sizes and types of turbines and provides an indication of the range in mortality rates that have been observed. Information from Table 2 for larger fish and a few key turbine parameters is attached[1]. Survival estimates range from 65-93% and tend to be greater for turbines with a larger diameter and slower rotational speed. As described in DFO-0102, the turbines at the Keeyask Generating Station will have a larger diameter (8.35 m) and slower rotational rate (75 rpm) than any of the generating stations listed in the attached table; these properties are expected to reduce the incidence of fish injury and mortality.

With respect to mortality for sturgeon passing the spillway, there are no experimental studies to directly measure mortality. The spillway design does not incorporate features

[1] Note that the turbine diameter of the Kelsey GS has been corrected to 5.84 m here and was erroneously presented as 7.92 m in Table 2 in the Aquatic Environment Supporting Volume.

such as baffle blocks, which are associated with elevated mortality at other generating stations (see Aquatic Environment Supporting Volume Section 5.4.2.3.7).

DFO requested that the number of individual sturgeon be estimated from studies that have been conducted using hydroacoustic technology to determine the total number of fish passing a facility (e.g., Missis Falls Control Structure, Great Falls Generating Station) and a commensurate relative abundance estimate for lake sturgeon. In our opinion, the number of sturgeon passing downstream cannot be extrapolated from these studies given that sturgeon are primarily a benthic species and would behave differently at a generating station intake than species in the water column. Direct records of tagged sturgeon passing generating stations (summarized in DFO-0050) provides a better estimate of the magnitude of downstream movements.

1 Summary of information extracted from Aquatic Environment Supporting Volume Appendix 1A, Part 1, Attachment 1 Table 2

| Station | Species | Size (mm) | Turbine | Blades | Runner Speed (rpm) | Diam. (m) | 48 d Survival |
|---|---|---|---|---|---|---|---|
| **Safe Harbor** | shad | 425 | Mixed Flow | 7 | 76.6 | 6.10 | 0.843 |
| **Kelsey** | walleye | 431 | Propeller | 5 | 102.9 | 5.84 | 0.877 |
| **Kelsey** | walleye | 447 | Propeller | 6 | 102.9 | 5.84 | 0.804 |
| **Kelsey** | pike | 595 | Propeller | 5 | 102.9 | 5.84 | 0.756 |
| **Kelsey** | pike | 661 | Propeller | 6 | 102.9 | 5.84 | 0.659 |
| **Beaucaire** | eel | 690 | Bulb | 4 | 94 | 6.24 | 0.93 |
| **Fessenheim** | eel | 704 | Kaplan | 4 | 88 | 6.67 | 0.924 |
| **Ottmarsheim** | eel | 750 | Kaplan | 5 | 94 | 6.25 | 0.799 |
| **Robert Moses** | eel | 1020 | Propeller | 6 | 99 | 6.10 | 73.5 (88h) |

KEEYASK Hydropower Limited Partnership

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 6B.1 Field Data Collection and Analysis; p. 6B-1

# DFO-0052

## PREAMBLE:

Appendix 6B Field Data Collection and Analysis

## QUESTION:

Gillnet and larval drift sampling described in Appendix 6B should be viewed as reconnaissance or "search" sampling. Sampling does not appear to be an index and therefore any statistics related to CPUE as an indication of population size or relative abundance should be viewed with caution. Please provide the detailed study reports.

## RESPONSE:

We agree. Larval drift sampling should be viewed as search sampling. For example, attempting to quantify the volume of water filtered by a larval drift trap in a large river (e.g., the Nelson River) would be questionable as many unmeasurable factors (i.e., angle of net, drift net fouling by debris) influence the volume of water sampled, thus preventing an accurate measure. These data were not considered "index" in the EIS.

CPUE is a limited metric for estimating both population size and habitat use, and therefore, should be interpreted with caution. This is why CPUE was not used, in isolation, as a basis for conclusions on lake sturgeon habitat use in the Keeyask Study Area. Further, CPUE was not used to estimate population size in the Keeyask study area. Population estimates included in the EIS were developed using a mark and recapture (encounter histories) technique and were analysed using a Robust Design model (hybrid population model) in the Program MARK. Habitat use, however, was described in part by gill net CPUE, but additional data sources were also drawn upon, such as acoustic and radio telemetry results, HSI model results, ATK, and scientific literature to draw conclusions about lake sturgeon habitat use. Variation was not reported in the summary tables provided in the EIS; however, these data were included in data reports that have been provided to DFO.

Provision of data reports is discussed in DFO-0001. Several reports could be referred to for larval drift sampling or lake sturgeon CPUE/relative abundance, including: 01-14; 02-19; 03-08; 04-05; 05-05; 06-04; and 08-01.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 6B.1 Field Data Collection and Analysis; p. 6B-1

# DFO-0053

## PREAMBLE:

Appendix 6B Field Data Collection and Analysis

## QUESTION:

With the exception of adult spring spawning data collection, other sampling periods are quite short. Please provide the detailed study reports.

## RESPONSE:

Adult spring spawning data collection occurred over six week periods at various locations from 2001 to 2008. In addition to these data, larval drift data were collected at various locations over three to four week periods following the estimated date of spawning to ensure that sampling was conducted over the entire window that lake sturgeon larvae could be drifting. Sampling to identify foraging habitat was accomplished by gillnetting, radio telemetry and acoustic telemetry. During the years that gillnetting was conducted, it generally occurred over a two-week period. Foraging habitat information was also collected in the Clark Lake to Kettle Generating Station reach of the Nelson River during radio tracking flights conducted on an approximate bi-weekly basis (more frequently during spring, less frequently during winter) and by stationary acoustic receivers that continuously log information on acoustic transmitters within their range. Finally, information on lake sturgeon overwintering habitat and movements were collected by radio telemetry, acoustic telemetry (described above) and mark-recapture (sampling periods during spring – 6 weeks, and during summer/fall - 2 weeks). The length of the sampling periods described above should be considered adequate to provide information on spawning, larval drift, foraging, overwintering and movement of lake sturgeon, especially when data collection has been on-going since 2001.

Provision of reports is addressed in DFO-0001. Detailed reports include: 01-14; 02-19; 03-08; 04-05; 05-05; 06-04; and 08-01.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 6B.1 Field Data Collection and Analysis; p. 6B-1

# DFO-0054

## PREAMBLE:

Appendix 6B Field Data Collection and Analysis

## QUESTION:

Details on mark recapture information are lacking in terms of annual movements. Raw data used for population estimates should be made available.

## RESPONSE:

A report describing the population estimates will be provided to regulators for review prior to the end of 2012.

## REFERENCE: Volume: Project Description Supporting Volume; Section: 3.10.2 Management Plans to be Developed; p. 3-32

# DFO-0055

## PREAMBLE:

Management Plans to be Developed

## QUESTION:

All cited management plans should be provided as part of the EIS submission.

## RESPONSE:

While the development and submission of the management plans is beyond the scope of the EIS Guidelines, we are pleased to submit the following management plans (attached separately) as part of this filing:

- Preliminary South Access Road Construction Environmental Protection Plans (finalized after license);
- Preliminary Generation Station Construction Environmental Protection Plans (finalized after license);
- Heritage Resources Protection Plan;
- Construction Access Management Plan;

We are currently developing three documents in support of the Federal Fisheries Act HADD Authorization process and expect to have the following issued in the foreseeable future:

- Preliminary In-stream Construction Sediment Management Plan (with relevant physical environment monitoring plans appended);
- Preliminary Aquatic Effects Monitoring Plan; and
- Preliminary Fish Habitat Compensation Plan.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.3.3 Environmental Mitigation/Compensation; p. 4-14

# DFO-0056

## PREAMBLE:

Construction Mitigation - DFO notes that timing for the majority of in-stream work is scheduled between July 16 to September 15

## QUESTION:

In 2015, construction of the spillway cofferdam is scheduled for July 16 to October 4 (extending into the Whitefish spawning period)…what additional mitigation and/or construction techniques are proposed during this sensitive period?

## RESPONSE:

The construction schedule included in the EIS indicates that the Spillway Stage I Cofferdam will be constructed between July 16 and October 14, 2015. This construction schedule is based on the preliminary design of the Project and the Partnership's current estimates and assumptions regarding the workforce, equipment fleet and construction methodology and durations. Efforts were made to avoid sensitive time periods, but due to the sequencing and duration of some activities this is not always possible.

During the initial phase of planning, construction of the spillway cofferdam was scheduled to start June 2015. However, this was adjusted to avoid sensitive spawning periods. Avoidance of spring spawning periods was given priority over avoidance of the fall spawning period. Accordingly, the start of construction of the spillway cofferdam was delayed to July 16 to avoid the spring and summer spawning fish.

In addition to scheduling the work to avoid spring and summer spawning fish, the following additional mitigation measures have been made or will be in place to reduce impacts on fall spawning fish:

- Cofferdam design, construction methodology and sequencing have been developed to minimize erosion and sediment inputs during construction (Project Description Supporting Volume, Section 2.5.1.2.1)
- Methodologies to minimize generation of suspended solids during cofferdam construction and removal include the following:
    - Much of the Stage 1 Spillway cofferdam will be located in areas of the south channel with lower velocities;
    - Methods to place and remove material in the river were selected to minimize the generation of suspended solids from the cofferdam materials;

- The cofferdam is designed to prevent erosion due to wave action;
- The cofferdam is designed to minimize scour of cofferdams and shorelines due to high flows and velocities;
- Placement rates will be controlled by monitoring downstream TSS as outlined in the In-stream Construction Sediment Management Plan; and
- The cofferdam will be removed in stages to minimize sediment inputs.

- A Sediment Management Plan (SMP) for in-stream construction activities is being developed to minimize the impacts of in-stream construction activities in the Nelson River (to be provided to regulatory agencies in the first quarter of 2013 – also see CEAA-0011). It also outlines the monitoring and management of total suspended solids (TSS) inputs into the waterway that may occur as a result of shoreline erosion, in-stream construction, river management, and commissioning of the Spillway and the Powerhouse. Appendix A of the SMP will outline a number of mitigation measures to avoid or minimize the TSS inputs into the waterway.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.3.3 Environmental Mitigation/Compensation; p. 4-14

# DFO-0057

## PREAMBLE:

Construction Mitigation - DFO notes that timing for the majority of in-stream work is scheduled between July 16 to September 15

## QUESTION:

Please provide detailed contingency plans for construction techniques proposed should a request to extend construction beyond proposed dates occur. DFO would appreciate the opportunity to review contingency plans in advance to ensure appropriate decisions with a timely response can be provided.

## RESPONSE:

The construction schedule included in the Response to EIS Guidelines is based on the preliminary design of the Project and the Partnership's current estimates and assumptions regarding the workforce, equipment fleet and construction methodology and durations. It should be noted that once contractors are hired, they may propose innovative changes to the design and methods of construction that may alter schedule duration. All applicable regulatory processes will be followed and approvals, permits and authorizations will be obtained where changes to schedule and design require them prior to implementation. It is prudent to note that some construction activities are seasonally sensitive, and delays of a few weeks during critical periods have the potential to result in loss of a year to the schedule.

While a large portion of in-stream work is scheduled to occur between July 15 to September 15, the Response to EIS Guidelines outlines a number of in-stream construction activities that extend beyond September 15. Should there be a need to extend these activities further into the restricted period or should there be a need to extend other activities into the restricted period Manitoba Hydro will confer with appropriate regulatory authorities and seek applicable permissions.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. N/A

# DFO-0058

## PREAMBLE:

Monitoring

## QUESTION:

DFO notes that there are no monitoring plans submitted within the EIS. We look forward to reviewing the following management and monitoring plans (as proposed to be developed in chapter 8 of the EIS): Sediment Management Plan; Fish Habitat Compensation Plan; Waterways Management Plan; Aquatic Effects Monitoring Plan; Physical Environment Monitoring Plan

## RESPONSE:

It should be noted that the Waterways Management Program was described in the Response to EIS Guidelines Appendix 4B. In a general sense, monitoring plans such as the Physical Environment Monitoring Plan will be finalized in response to the Manitoba Environment Act License requirements but preliminary versions will be provided in the second quarter of 2013. Management plans not already provided will be submitted in the first quarter of 2013. Of these the following three documents will be developed in support of the Federal Fisheries Act HADD Authorization process:

- Preliminary In-stream Construction Sediment Management Plan;
- Preliminary Aquatic Effects Monitoring Plan; and
- Preliminary Fish Habitat Compensation Plan.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. N/A

# DFO-0059

## PREAMBLE:

Monitoring

## QUESTION:

How will peat deposition be monitored? And assumptions in the EIS verified? (ex. Estimate only 1% of peat will be transported downstream)

## RESPONSE:

Note: this question is similar to DFO-0071, EC-0011.

A Physical Environment Monitoring Plan (PEMP) is being developed that includes a number of components pertaining to sediment monitoring for both mineral and organic sediments and floating peat mats. CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary PEMP. The Partnership intends to provide a preliminary version of that report to regulators in the second quarter of 2013.

Sediment monitoring will involve periodic collection of sediment data at various locations, which will include grab samples for grain size analysis to help identify changes in sediment type and/or sediment cores to identify sediment deposition rates and types of sediment deposited. Water samples collected at monitoring sites upstream and downstream of the generating station will be tested for total suspended solids as well as volatile suspended solids (VSS). VSS indicates the organic content of the suspended material and monitoring downstream may indicate if there is a detectable change in VSS due to the Project. Monitoring results can be compared with baseline data and EIS predictions to identify effects and verify predictions.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7C Field Maps (Open Water) and 7D Monitoring Locations (Winter); p. N/A

# DFO-0060

## PREAMBLE:

Monitoring

## QUESTION:

Please provide a detailed map of baseline sedimentation sampling sites and proposed monitoring sites? Ideally, future monitoring sites should be located near the baseline sampling sites for accurate comparisons.

## RESPONSE:

The existing environment monitoring baseline maps are included in the Physical Environment Supporting Volume, Appendices 7C and 7D.

The Physical Environment Monitoring Plan, which is currently being developed by the Partnership, will include the locations of future sedimentation monitoring sites. Monitoring will be done at a number of locations within newly flooded areas and at or close to existing monitoring sites that are not inundated, where it is safe and practicable to do so. The monitoring plan will be provided to regulatory authorities in the second quarter of 2013.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7B Detailed Description of the Environmental Setting for Mineral Sedimentation; p. N/A

# DFO-0061

## PREAMBLE:

Bed Load

## QUESTION:

Between 2005-2007, approximately 350 bedload samples were collected, but this yielded few measurable samples (Appendix 7B). The EIS reports an estimated an average bedload of 4 g/m/s. How reasonable is this estimate given the insufficient samples to estimate the annual bedload discharge? What method(s) will be used to monitor bedload?

## RESPONSE:

The EIS acknowledged that there are insufficient data to estimate annual bedload flux through the Nelson River system. The EIS also acknowledged that bedload transport rates may be less than the average retrieved sample rate of 4 g/m/s (grams per metre per second) due to the large number of zero samples. That being said, the available data indicate that bedload transport rates are generally low. This is expected for the lower Nelson River system because the river bottom is comprised of bedrock or coarse material and because the system has lakes and reservoirs where sediments deposit. See 0020 from Natural Resource Canada for additional reasons why a low bed load is expected.

A recent study completed in the study area in 2011 using an Acoustic Doppler Current Profiler also confirmed the finding of very low bed load. This finding is from an unpublished ongoing research study undertaken by Manitoba Hydro to test a new method for bedload monitoring and is not part of Keeyask environmental assessment studies.

The Physical Environment Monitoring Plan (PEMP) will include monitoring using standard bedload samplers. CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary PEMP. The Partnership intends to provide a preliminary version of that report to regulators in the second quarter of 2013.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7E Sedimentation Field Data 2005 to 2007, Table 7E.1-4; p. 7E-5

# DFO-0062

## PREAMBLE:

Bed Load

## QUESTION:

It seems that only 50th percentile flow examined – why not 5th and 95th?

## RESPONSE:

As reported in the Physical Environment Supporting Volume, Table 7E.1-4 of Appendix E, the bed load measurements were carried out under variable flow regimes in the open water months of 2005 to 2007 when the discharge ranged from as low as 3,900 $m^3/s$ to above 6,000 $m^3/s$. This range corresponds to discharges exceeding the $80^{th}$ percentile (Physical Environment Supporting Volume, Section 4, Figure 4.3-2). No samples were collected during low flows ($5^{th}$ percentile) or average flows ($50^{th}$ percentile) because the discharge on the lower Nelson River was above average during the period that the field studies were carried out.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring and Follow-Up; p. N/A

# DFO-0063

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

Is the relationship between turbidity/TSS developed using local (Gull Lake/Stephens Lake) data? Was there to be an ongoing calibration of the turbidity/TSS relationship to reduce induced error?

## RESPONSE:

The TSS - turbidity relationship was estimated based on the data collected from 2006 to 2009 at monitoring sites located within the project area from the exit of Clark Lake to the Kettle Generating Station. The relationship will be reviewed and revised using future monitoring data collected during construction phase.

## REFERENCE: REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.2.1.5 Mineral Sediment Deposition, Chart 7.4-1; p. 7-24

# DFO-0064

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

Background TSS assumed to be 20 mg/l. EIS does not explain the rationale for using this number when the range is 5mg/l to 30mg/l. Please provide detailed rationale for choosing 20mg/l.

## RESPONSE:

The assumed background of 20 mg/L in the chart of results (Physical Environment Supporting Volume, Section 7, Chart 7.4-1) was chosen for illustrative purposes to demonstrate how much of an increase occurs from an assumed background for the different construction activities. The assumed background of 20 mg/L is close to the existing average TSS of about 14 mg/L at a site downstream of Gull Rapids (Physical Environment Supporting Volume, Section 7.3.2.1, Table 7.3-2).

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.2.5.1 Mineral Sedimentation and Appendix 7A.2.2 Stephens Lake Sedimentation During Construction Model; p. 7-11 and 7A-25.

# DFO-0065

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

Assumption that 70% of all fine particles will remain in suspension past Kettle GS. How can they determine this? Has this been modelled? How will the model/assumptions be tested?

## RESPONSE:

Physical Environment Supporting Volume, Section 7, Section 7.2.5.1 states that:

"Probable impacts of erosion during construction in Stephens Lake were assessed using a one-dimensional model HEC-6, which spans from downstream of the proposed Keeyask Generating Station to Kettle Generating Station. The model was used to assess transport of additional sediment, which may result from construction activities, within Stephens Lake."

Appendix 7A, Section 7A.2.2 Stephens Lake Sedimentation During Construction Model provides details on the model that was developed. The HEC-6 model was calibrated to baseline data.

The Physical Environment Monitoring Plan will include total suspended solids monitoring downstream.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. N/A

# DFO-0066

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

Suggest that discrete data loggers (TSS) are better than continuous collection data loggers. Discrete loggers should be verified using point sampling to verify data loggers especially in the first year. The use of discrete data loggers for existing environment and post project post project environment. The continuous data loggers are too variable and subject to error due to bio-fouling.

## RESPONSE:

The main purpose of implementing the In-stream Construction Sediment Management Plan (SMP) during construction is to monitor turbidity as a surrogate for total suspended solids (TSS) in real-time. This will allow construction staff to be aware of increases in TSS very soon after the increases occur. Real time information is required so that increases in TSS beyond specified thresholds that are due to construction can be addressed as soon as practicable. This will allow Manitoba Hydro to act promptly in response to increases in TSS levels in the Nelson River that are above the action thresholds identified in the SMP. Using discrete measurements of TSS from water samples would not meet the objectives of the SMP because it takes too long for discrete water samples to be analysed and converted to TSS measurements.

The SMP provides details on monitoring and maintenance that addresses the issue of bio-fouling. The data loggers that will be used for continuous turbidity monitoring are equipped with self-cleaning optical sensors using integrated wipers to remove bio-fouling to maintain high data accuracy. The loggers will be visited every two weeks to maintain and clean the monitoring system (and free them of algae and vegetation debris) to avoid erratic spikes in data. During each visit, the loggers will be recalibrated and their functionality will be verified using a separate logger to obtain discrete measurements at the time of the maintenance visit. The loggers used to obtain discrete and continuous measurements are an identical make and model.

CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary SMP. The Partnership intends to provide a preliminary version of that report to regulators in the first quarter of 2013.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. N/A

# DFO-0067

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

EIS proposes to have the first post project monitoring station 1km downstream of the construction site in the "fully mixed zone". The location of the first monitoring station downstream of Keeyask construction site is too far away to assess impacts and effectiveness of mitigation. It is recommended that a turbidity/TSS monitoring site be placed at the construction site.

## RESPONSE:

During the construction phase of Project, the first downstream monitoring site (SMP-2) for the In-stream Construction Sediment Management Plan (SMP) is proposed to be located approximately 1.5 km downstream of all in-stream sediment sources from the Project. Moving this location closer to the construction site is problematic due to high water velocities and turbulent flow conditions in the area just downstream of Gull Rapids. Based on experience from baseline monitoring programs, these conditions can result in significant safety hazards for people and equipment.

The Preliminary In-Stream Construction Sediment Management Plan will be submitted in the first quarter of 2013.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-Up; p. N/A

# DFO-0068

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

Can the Proponent provide an analysis showing that its monitoring will have a high degree of confidence, or the power, to detect TSS above the action threshold?

## RESPONSE:

Refer to response DFO-0084.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 2.5.2.2.5 Total Suspended Solids/Turbidity; p. 2-66 to 2-68.**

# DFO-0069

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

The Proponent appears not to discuss effects of TSS specific to the individual VEC fish species. The Proponent's impact assessment appears to rely primarily on lethal TSS concentration effects. Can the Proponent provide an expanded discussion of sub-lethal or chronic impact risk assessment for anticipated TSS changes?

## RESPONSE:

Available scientific literature regarding both acute and chronic toxicity of TSS on VEC fish species was compiled, reviewed, and included where relevant in the Aquatic Environment Supporting Volume. See Section 2.5.2.2.5, p. 2-66 to 2-68.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 4.0 Surface Water and Ice Regimes; p. N/A

# DFO-0070

## PREAMBLE:

Sedimentation - TSS

## QUESTION:

Existing environment sedimentation models based on low, med and high flows (2059, 3032 and 4,327 cms). Do these relate to percentile flows? Post-project sedimentation modelling simulated under 50th percentile for year 1, 5, 15 and 30 years after impoundment, and under 5th and 95th percentile flow for 1 and 5 years after impoundment. Why different flow regimes for different time periods? The post-project sedimentation environment was also simulated under the 50th and 95th percentile flows using the eroded shore mineral volumes as estimated, considering peaking mode of operation for the time frames of 1 and 5 years after impoundment. Proposed monitoring to valid models?

## RESPONSE:

The three flows (2059, 3032 and 4327 $m^3/s$) represent the post-project $5^{th}$, $50^{th}$ and $95^{th}$ percentile "all-seasons" flows, i.e., open-water and winter flows for the entire year (see Physical Environment Supporting Volume, Section 4).

Based on the $50^{th}$ percentile results, most of the changes in total suspended solids concentrations are predicted to occur between years 1 and 5. Similar trends were predicted for the $5^{th}$ and $95^{th}$ percentile flow scenarios. No modeling was carried out for 15 and 30 years for the low and high flow conditions because the results are expected to be similar to the $50^{th}$ percentile.

The Physical Environment Monitoring Plan will include a plan for monitoring sedimentation during the construction and operation phases of the project. CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary PEMP. The Partnership intends to provide a preliminary version of that report to regulators in the second quarter of 2013.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7A, Model Descriptions; p. N/A

# DFO-0071

## PREAMBLE:

Peatland Erosion.

## QUESTION:

Did not look at peat downstream of the generating station, claiming that peat would not go past the GS (only 1% would get past the GS – is this reasonable?). What monitoring is proposed to confirm this?

## RESPONSE:

Note: this question is similar to DFO-0059 and EC-0011.

The estimate of the quantity of floating peat (i.e., the 1% referred to) that may be transported downstream is based on the results from peat transport modeling, which is described in Appendix 7A of the Physical Environment Supporting Volume. Whether the amount of floating peat transported downstream is 1% or more, material that is large enough to pose a hazard to navigation will be dealt with through the Waterways Management Program (JKDA, Schedule 11-2; also provided in Response to EIS Guidelines, Chapter 4, Appendix 4B). Boat patrols will record the amount and types of debris removed from the waterway both upstream and downstream of the Keeyask Generating Station. Boat patrols will be able to observe if there are substantial increases in the amount of peat debris downstream of the generating station that is a hazard to navigation.

Suspended sediment monitoring will also be undertaken, as further described in the response to DFO-0059.

**REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.2.3 Peat Sedimentation - Upstream of Projects; p. 7-35 Volume: Aquatic Environment Supporting Volume; Section: 3.4.2.2 Outlet of Clark Lake to the Keeyask Generating Station; p. N/A**

# DFO-0072

## PREAMBLE:

Peatland Erosion.

## QUESTION:

Visual distribution (maps) of peatland deposition not presented in the EIS. How will peat deposition impact on known/suspected areas of fish habitat in the future forebay?

## RESPONSE:

Information on peat transport and sedimentation is provided in the Physical Environment Supporting Volume, Section 7.4.2.3. As discussed in this section, the majority of peat will be released in the initial years after impoundment and will settle in the bay of origin.

Effects of peat uplift and deposition on aquatic habitat are discussed in the Aquatic Environment Supporting Volume, Section 3.4.2.2. In the long term (30 years after impoundment), predicted substrate composition was based on a predictive model that examined the deposition of both mineral and organic material (see Aquatic Environment Supporting Volume, Map 3-34). Organic sediments remained in areas of persistent organic deposition found at the ends of bays with local tributaries. Other areas of the reservoir are mainly turbid water masses and are dominated by silt depositional processes with relatively thick deposits of silt. The empirical model used to estimate the boundary between organic deposition and silt substrate is described in the Aquatic Environment Supporting Volume, Section 3.4.2.2.3. The composition and distribution of the substrate for the intervening years is interpreted from the Physical Environment and Aquatic Environment studies in the Aquatic Environment Supporting Volume, Section 3.4.2.2.4.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.3.8 Sedimentation; p. 6-215

# DFO-0073

## PREAMBLE:

Deposition - EIS states deposition loads will not change post project – about 3cm/year, based on about 30 cm of sediment deposited in ten years since Kettle GS was built. "Based on extensive modelling (using Stephens Lake) and field verification", the majority of mineral sediments resulting from shoreline erosion are predicted to deposit in near shore areas…after year 1, rates predicted at 0-3 cm/y. Offshore = 0-1 cm/y after year 1. The south nearshore areas in Gull Lake predicted to experience highest deposition rate of 4-6 cm/y for year 1 under baseloaded conditions.

## QUESTION:

Do not provide sedimentation rates based on a range of flows. No detail on sampling conducted to establish baseline other than at Kettle GS. How will the sedimentation model be tested for accuracy? What monitoring will be conducted to validate model assumptions?

## RESPONSE:

Deposition rates for various flows were not developed because deposition rates in the future environment with the project would be very similar to existing environment deposition rates. Rates are similar because the nearshore velocities are essentially the same. Since the hydraulic conditions are similar, the deposition rates would depend primarily on the shore erosion volumes.

No sampling was conducted at other sites because Stephens Lake (Kettle Reservoir), located immediately downstream, is considered to be the most appropriate proxy area for conditions that may develop in the future Keeyask reservoir.

The Physical Environment Monitoring Plan, which will be provided to regulators in the second quarter of 2013, will include a plan for future sedimentation monitoring. Please see response to DFO-0059 for further description of sediment monitoring considerations.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7A.1.1.3 Post-Project Nearshore Sedimentation Model; p. 7A-6

# DFO-0074

## PREAMBLE:

Sedimentation

## QUESTION:

Given the variation in sedimentation rates over time and the challenges in estimating sedimentation level, does the sedimentation analysis include a sensitivity analysis to reflect possible ranges in sedimentation and the effects on fish and fish habitat both upstream and downstream?

## RESPONSE:

A conceptual model (as discussed in 7A.1.1.3 of Appendix 7A in the Physical Environment Supporting Volume) was developed to assess impact on the nearshore sediment transport and deposition under a range of erosion and deposition scenarios. Also, a sensitivity analysis was performed on the deposition rates using a range of inputs of eroded shore volumes. The predicted range of deposition rates (e.g. 1-2 cm/yr) represents 50% to 80% of the eroded shoreline material that could be deposited in the nearshore area.

As discussed in Appendix 7A, the total suspended solids models for both upstream and downstream reaches were calibrated and validated using variable hydraulic and sedimentation conditions observed in different open water months, thus covering a wide range of variability.

The results of the sedimentation analyses, which incorporate the predicted range of deposition rates, were utilized in the aquatic environment assessments of fish and particularly fish habitat, as reported in the Aquatic Environment Supporting Volume (Section 3.4.1 for during construction and Section 3.4.2 during operation).

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.1 Construction Period; p. N/A

# DFO-0075

## PREAMBLE:

The EIS notes "Placement and removal of cofferdams/groins during Stage II Diversion will occur over three years (2017, 2018, and 2019) during the open water seasons. Most of these activities are predicted to result in increases in TSS of less than 5 mg/L above background, which would be within the…CCME guidelines for the protection of aquatic life. The exceptions include placement of the South Dam Rock Fill Groin, which is predicted to result in TSS increases of up to 15 mg/L above background, with increases of greater than 5 mg/L for a period of approximately 10 days in early September 2017. An increase in TSS of 7 mg/L for a period one month is also predicted during removal of the Tailrace Summer Level Cofferdam in September/October 2019.

## QUESTION:

The Proponent predicts several instances of average TSS increases greater than the CCME guideline for longer term impacts (e.g., inputs lasting between 24 h and 30 d should not exceed 5 mg/L above background). Are there additional opportunities, both reasonable and practical, to further prevent and mitigate sediment releases such that the guidelines can be met? For example, if a given TSS exceedance is in part due to shoreline erosion, would pre-emptive shoreline stabilization be an option?

## RESPONSE:

Note: the preamble text quoted from the EIS is found in the Aquatic Environment Supporting Volume, Water and Sediment Quality, Section 2.5.1.1.3 (page 2-43), second paragraph.

Predicted effects were characterized using worst case scenarios to be conservative (Physical Environment Supporting Volume, Section 7.4.1). For example, a total suspended solids increase of 7 mg/L during removal of the Tailrace Summer Level Cofferdam was predicted for a low flow condition (approx. 1,600 $m^3/s$). At average and higher flows the predicted concentration increase would be about 3-4 mg/L (i.e., less than 5 mg/L).

Reasonable and practical methods to mitigate sediment are described in the In-stream Construction Sediment Management Plan (SMP). The objective of the SMP is to minimize the impacts of instream sediment due to construction activities in the Nelson River.

CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary SMP. The Partnership intends to provide a preliminary version of that report to regulators in the first quarter of 2013.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7A Model Descriptions; p. N/A

# DFO-0076

## PREAMBLE:

The EIS notes "Prediction of the post-impoundment…environment upstream…was carried out by…numerical modeling…Depth-average mineral suspended sediment concentrations were estimated for average (50th percentile) flow for prediction periods of 1 year, 5 years, 15 years and 30 years after impoundment. Sediment concentrations were also predicted for low (5th percentile) and high (95th percentile flow conditions for…1 year and 5 years after…impoundment. While outside the zone of hydraulic influence, a qualitative assessment was carried out for…sedimentation…in Stephens Lake…"

## QUESTION:

Can the Proponent provide some explanation, or direct reviewers to its location, of why TSS modeling at selected flow percentiles, e.g., 50th percentile or 5th and 95th percentile, or other model settings, provide good estimates of likely effects on the aquatic environment?

## RESPONSE:

As the reviewer noted, effects of the Project on total suspended solids (TSS) were assessed using three flow scenarios ($5^{th}$, $50^{th}$, and $95^{th}$ percentile flows) to capture a range of physical conditions in the Study Area. These flows were selected to provide a description of effects under representative low, median, and high flow scenarios.

The use of a range of physical effects is appropriate when considering how these changes could affect the aquatic environment

Detailed descriptions of the TSS modeling are presented in Appendix 7A in the Physical Environment Supporting volume.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 2.5.2.2.5 Total Suspended Solids/Turbidity; p. 2-66 to 2-68

# DFO-0077

## PREAMBLE:

The EIS notes "Placement and removal of cofferdams/groins during Stage II Diversion will occur over three years (2017, 2018, and 2019) during the open water seasons. Most of these activities are predicted to result in increases in TSS of less than 5 mg/L above background, which would be within the…CCME guidelines for the protection of aquatic life. The exceptions include placement of the South Dam Rock Fill Groin, which is predicted to result in TSS increases of up to 15 mg/L above background, with increases of greater than 5 mg/L for a period of approximately 10 days in early September 2017. An increase in TSS of 7 mg/L for a period one month is also predicted during removal of the Tailrace Summer Level Cofferdam in September/October 2019…"

## QUESTION:

If increases in TSS exceeding the CCME guidelines appear to be unavoidable, can the Proponent provide additional discussion and rationale (or direct reviewers to the location of that information in the EIS) for why the exceedences, in the Nelson River at Keeyask case, are not likely significant adverse environmental effects. For example, can the Proponent indicate that an exceedance of 7 mg/L TSS above background for 30 days in September/October is not likely to be in the sub-lethal or lethal severity of effect range for fish, fish eggs or larvae, benthic macroinvertebrates, or other aquatic organisms. In addition, can the Proponent say that the exceedance when added to the expected background range for that time of year is within the anticipated natural range of TSS in the Nelson River at the Project site, and in one case downstream to the estuary, at that time of year?

## RESPONSE:

The text referred to is presented in the Aquatic Environment Supporting Volume Section 2.5.1.1.3, page 2-43. A discussion of the effects of increases in total suspended solids (TSS) on aquatic biota is provided in the Aquatic Environment Supporting Volume, Section 2.5.2.2.5, p. 2-66 to 2-68. In brief, increases in TSS of this magnitude are expected to be well below acutely toxic levels, but may cause sub-lethal effects in aquatic biota.

With respect to TSS ranges, as discussed in the Physical Environment Supporting Volume, Sedimentation), the TSS concentrations in the project area are generally within the range of 5 to 30 mg/L during the open water season. This range is between 3 and 15

mg/L for Stephens Lake where the monitoring sites will be located for the In-stream Construction Sediment Management Plan and the Physical Environment Monitoring Program. However, several higher TSS concentrations up to 35 mg/L have been recorded in Stephens Lake during the 2005-2010 base line monitoring programs. Therefore, the predicted increase in TSS of 7 mg/L during Stage II river management is within the existing environment range of TSS in the project area. Note that the estimated 7 mg/L increase is a conservative (i.e. high) estimate. See response to DFO-0075 for additional discussion on this estimate.

Since the predicted 7 mg/L increase in TSS during Keeyask Stage II river management will decline as it passes through Kettle, Long Spruce and Limestone forebays, its effect on background TSS would not be measurable as it gets to the estuary.

**REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7E Sedimentation Field Data 2004 to 2007; p. N/A**

# DFO-0078

## PREAMBLE:

The EIS notes "data collected in the open water periods of 2005 to 2007 indicates…suspended sediment concentration generally lies within the range of 5 mg/L to 30 mg/L…from Clark Lake to Gull Rapids…sediment concentrations can vary within their normal range at a given location in a given day…variations…over a short period…can be due to many reasons, including local turbulences in the waterbody, changes in the meteorological environment, and local bank erosion processes…suspended sediment concentrations…in the open water period…2001 to 2004…show similar ranges (2 mg/L to 30 mg/L with an average of 12 mg/L)…A report prepared by Lake Winnipeg, Churchill and Nelson Rivers Study Board in 1975…documents a suspended sediment concentration range of 6 mg/L to 25 mg/L with an average of 15 mg/L based on…measurements in 1972 and 1973. Field studies…on the Burntwood and…Lower Nelson River reach also show a concentration range of 5 mg/L to30 mg/L (Acres…2004…2007b, KGS Acres 2008b…KGS Acres 2008c)…Suspended sediment concentration measurements during…winter…(January to April), of 2008 and 2009 reveal that sediment concentration variations in the winter period are larger than the open water period. A limited data set collected at monitoring locations in Gull Lake show a concentration range of 3 mg/L to 84 mg/L, with an average of 14.6 mg/L…"

## QUESTION:

The Proponent provides some ranges, point estimates, and expected durations of TSS changes. Would it be possible to provide, or direct reviewers to where this information is in the EIS, sample sizes and standard deviations for estimates? Where intervals that are not ranges, would it be possible to specify the level of confidence? E.g., are they 95% confidence intervals for a mean?

## RESPONSE:

All Keeyask field information collected from 2005 to 2007 are included in Section 7, Appendix 7E of the Physical Environment Supporting Volume. The summary includes sample count, minimum, maximum, average and standard deviation for each sampling site. The standard deviation, which is a reflection of variations in concentration, generally varied from 0.3 to 4 mg/L. More than 96% of the total suspended solids concentrations collected from 2005 to 2007 fall within the range of 5 to 30 mg/L.

The existing environment monitoring program followed a data collection protocol that helped in minimizing sampling errors. For example, duplicate samples were taken each time at every sampling location.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 2.5.2.2.5 Total Suspended Solids/Turbidity; p. 2-65

# DFO-0079

## PREAMBLE:

The EIS notes, for mineral, as opposed to organic sediments:... "mineral TSS is generally predicted to decrease in the shallow and deep areas of the reservoir with the Project, most notably under high flows (95th percentile), although small increases (1–4 mg/L) are projected in some areas under some conditions (i.e., different flows and years of operation). The predicted changes in mineral TSS are also relatively similar for the peaking and base loaded modes of operation for median and high flows. In general, the predicted decreases (or occasionally increases) in mineral TSS are less than 5 mg/L under low, median, and high flows in shallow and deep areas for Years 1 and 5 of operation. The major exception would occur under high flows in reaches 7 and 8 (at the downstream end of present day Gull Lake) and most notably reach 9 (the reservoir immediately upstream of the GS) where larger decreases (up to 14 mg/L below background) are expected…"

## QUESTION:

The Proponent predicts TSS decreases. Impacts of TSS decreases appear not to be discussed. While there are no present federal guidelines e.g., in the CCME, has the Proponent considered the potential impacts of TSS decreases?

## RESPONSE:

The paragraph following the quote indicated (from p. 2-65 of the Aquatic Environment Supporting Volume) describes effects of decreases in TSS:

"Mineral TSS would generally remain within the chronic Manitoba PAL water quality objective and the CCME PAL guideline (a change of less than or equal to 5 mg/L relative to background, where background TSS is less than or equal to 25 mg/L). The exceptions would occur in the immediate reservoir (reach 9) and reach 8 (the area north of Caribou Island) under high flow conditions, where decreases may be larger than the Manitoba water quality objective. "

The response to comment DFO-0080 provides additional information on the Manitoba guideline.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 2A Background Information on Selected Water Quality Parameters; p. N/A**
**Section 2.5.2.2.5 Total Suspended Solids/Turbidity; p. 2-65**
**Section 4.2.4.2 Operation Period; p. N/A**

# DFO-0080

## PREAMBLE:

The EIS says "Mineral TSS would generally remain within the chronic Manitoba PAL water quality objective and the CCME PAL guideline (a change of less than or equal to 5 mg/L relative to background, where background TSS is less than or equal to 25 mg/L). The exceptions would occur in the immediate reservoir (reach 9) and reach 8 (the area north of Caribou Island) under high flow conditions, where decreases may be larger than the Manitoba water quality objective…"

## QUESTION:

When discussing TSS decreases the Proponent refers to TSS guidelines as being for changes. In fact, the guidelines talk about increases only – not changes in general – so that they do not really apply to decreases in TSS. Can the Proponent explain in more detail its criteria for discussing changes?

## RESPONSE:

The Manitoba guideline is a change; the federal guideline is an increase. The Manitoba water quality objectives for TSS for the protection of aquatic life refer to both increases and decreases in TSS, relative to background conditions (see Aquatic Environment Supporting Volume, Appendix 2A for a discussion of MWQSOGs and CCME PAL guidelines). Therefore, predicted decreases in TSS were compared to the Manitoba water quality objectives. See Section 2.5.2.2.5 for this discussion (p. 2-65). The potential biological effect of the decrease in TSS during high flows was assessed in Aquatic Environment Supporting Volume, Section 4.2.4.2 (phytoplankton).

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 2.0 Water and Sediment Quality; p. N/A

# DFO-0081

## PREAMBLE:

Water Quality: Project Effects, Mitigation, and Monitoring…Construction Period…Total Suspended Solids, Turbidity, and Water Clarity…" p 2-44 - 2-45 "Cofferdam Dewatering… Water that is trapped or accumulates behind cofferdams will be discharged to the Nelson River. An end- of- pipe criterion of 25 mg/L will be applied such that where met, water behind cofferdams will be directly released to the Nelson River. Where this target is not met, cofferdam water will be pumped to settling ponds and discharged to the Nelson River when the end-of-pipe TSS concentration is less than 25 mg/L (PDSV, Keeyask GS EnvPP). Effects on TSS in the Nelson River are expected to be negligible in the fully mixed condition; small, localized increases in TSS may occur near these point sources…"

## QUESTION:

The Proponent refers to its proposed end-of-pipe allowed TSS of 25 mg/L for several activities. However, according to the CCME, that criteria is only acceptable for short term (e.g., 24 h) TSS increases. Can the Proponent provide additional information on the expected duration of activities for which it proposes the 25 mg/L criteria. For longer term TSS increases (e.g., inputs lasting between 24 h and 30 d), can the Proponent provide prevention measures that will meet the guideline of an increase not greater than 5 mg/L?

## RESPONSE:

The EIS indicated an end-of-pipe criterion of 25 mg/L for TSS for various effluent discharges, as this is a common criterion identified in Licences, including *The Environment Act* Licence No. 2952 for the sewage treatment plant for the Keeyask Infrastructure Project. This threshold is a standard criterion identified in Regulations and Licence Limits, including the Manitoba Water Quality Standards, Objectives and Guidelines (Manitoba Water Stewardship 2011) for Municipal Wastewater Effluents and Regulations the Wastewater Systems Effluent Regulations issued under the *Fisheries Act*. It was also noted in the EIS, that effluent discharges will meet applicable provincial and federal effluent licences, authorizations, and permits. It is noted in the EIS, as indicated in the comment, that effects of effluent discharge on TSS in the fully mixed Nelson River are expected to be negligible but that small localized increases in TSS may occur near the point sources.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. N/A

# DFO-0082

## PREAMBLE:

The EIS notes "An Environmental Protection Program has been developed to mitigate, manage and monitor environmental effects during the Project construction and operation phases. While descriptions of the existing environment are based on measurement and observation, descriptions of effects and mitigation designed to address adverse effects are predictions based on technical scientific studies and analysis, professional judgement and Aboriginal traditional knowledge. Monitoring will determine if these predictions are correct and if mitigation measures are working as expected. If unexpected effects are detected, the program will also define processes for determining appropriate adaptive management programs and practices. The Environmental Protection Program covers the "who, what, when, where and how" of protecting and monitoring the environment. Manitoba Hydro has a contractual responsibility for implementing the program delegated by the Partnership. The Program will consist of three types of plans…1. Environmental Protection Plans, to provide detailed, site-specific environmental protection measures to be implemented by the contractors and construction staff to minimize environmental effects from construction of the generating station and the south access road;… 2. Environmental Management Plans, focused on specific environmental issues, such as sediment management, access management, fish habitat and heritage resources; and…3. Environmental Monitoring Plans, to describe monitoring the effects of construction and operations on the biophysical, physical and socioeconomic environments using both technical science and Aboriginal traditional knowledge. Each plan includes an implementation strategy that, as required, may include contractual arrangements, training, compliance inspections and communication of results. The Keeyask Cree Nations will be directly involved in monitoring implementation by leading the Aboriginal traditional knowledge monitoring program and working side-by-side with scientists as part of the technical science-based monitoring and participating in the Partnership's Monitoring Advisory Committee. Manitoba Hydro will oversee monitoring activity to confirm that work is in accordance with the finalized, regulator approved plans…"

## QUESTION:

The Proponent refers to monitoring and Environmental Protection Plans (EnvPP) for sediment management. Are these described in detail in the EIS? While mitigation measures are described in the EIS that assist in preventing sediment deposition, DFO has been unable to find details of monitoring or action plans (management) for

mitigation. If the detailed information is not shown in the EIS, can the Proponent provide that information separately from the EIS to continue the Environmental Assessment? The Environmental Protection, Environmental Management, and Environmental Monitoring plans are of significant interest to reviewers determining if there is likely to be a significant adverse effect after taking mitigation into account.

## RESPONSE:

We are pleased to submit the following document (attached separately) as part of this filing:

- Preliminary South Access Road Construction Environmental Protection Plans (finalized after license);
- Preliminary Generation Station Construction Environmental Protection Plans (finalized after license);

We are currently developing three documents in support of the Federal Fisheries Act HADD Authorization process and expect to have the following issued by the end of November:

- Draft In-Stream Construction Sediment Management Plan (with relevant physical environment monitoring plans appended);
- Draft Aquatic Effects Monitoring Plan; and
- Draft Fish Habitat Compensation Plan.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.1 Project Effects, Mitigation & Monitoring, Construction Period; p. 7-22

# DFO-0083

## PREAMBLE:

"Water Quality: Project Effects, Mitigation, and Monitoring…Construction Period…Total Suspended Solids, Turbidity, and Water Clarity…" p 2-40 "Cofferdam Placement and Removal…during Stage I and II Diversions have the potential to increase TSS in the Nelson River…results…presented in detail in the PE SV, section 7.4.1…Predicted increases in TSS refer to the fully mixed condition, approximately 1 km downstream of Gull Rapids…"

## QUESTION:

The Proponent notes that it has modeled TSS downstream at 1km from the construction area in the fully mixed zone. Will the Proponent be able to monitor TSS closer to the construction areas? What sort of area might be affected by construction TSS increases greater than those predicted upstream of the fully mixed zone. What are the, at source, sediment loading TSS concentrations likely to be, how extensive might they be in area, and what might their durations be?

## RESPONSE:

Please see response to DFO-0067 regarding the location of the downstream monitoring site.

Areas where total suspended solids (TSS) will be higher than in the fully mixed zone will be localized and will depend on where the sediment originates and how the plume disperses between the source and the completely mixed zone. The largest possible area affected would be the water surface area between the cofferdams and the fully mixed area approximately 1.5 km downstream - the actual area of a plume would be smaller but would be dependent on the source location. The highest concentrations would be localized along shorelines and immediately downstream of instream construction activities at the cofferdams. The estimated daily average sediment concentrations at the sources range from 1 to 43 mg/L.

The duration of these increases at the source depends on the activity taking place, but may last for the duration of the construction activity. The largest increases occur during commissioning of the spillway but they are of relatively short duration. The Preliminary In-stream Construction Sediment Management Plan will be provided to regulators in the first quarter of 2013.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. N/A

# DFO-0084

## PREAMBLE:

Information does not appear to be present in the EIS but is required to determine if monitoring can adequately determine potential problems and appropriate actions taken to mitigate unexpected events.

## QUESTION:

Can the Proponent provide an analysis showing that its monitoring will have sufficient power with high confidence, to detect TSS above the action threshold (regulatory guideline)? For example, how likely is it that the Proponent can detect environmental changes that result in elevated TSS that exceed critical effect sizes such as 5 mg/L above background? Will the number of samples collected during monitoring be sufficient to correctly conclude, with a confidence of say 95% [i.e., a high confidence], that there is a difference of, say, 5 mg/L or more above background?

## RESPONSE:

The In-stream Construction Sediment Management Plan (SMP) will utilize continuous, real time turbidity measurements as a proxy for total suspended solids (TSS) concentrations, which cannot be measured in real time. Turbidity readings will be converted to TSS concentration based on a regression equation relating turbidity to TSS. The regression equation was developed based on turbidity and TSS data collected in the study area between Clark Lake and the entrance to Stephens Lake in open water periods from 2007-2009. The regional regression equation was tested on an independent data set not used to develop the relationship and calculated average TSS was within 1.2 mg/L of measured average TSS. The SMP will be used to measure change in TSS between a monitoring site upstream and a site downstream. It will, therefore, be an assessment of relative difference between the TSS at monitoring sites upstream and downstream of the in-stream construction activities. Note that the relationship will be revised if necessary during construction. Revision would be based on TSS test results for water quality samples obtained during routine maintenance of the SMP loggers. Maintenance will occur approximately every 2 weeks. Overall, it is expected that the regional turbidity-TSS relationship will be able to reliably indicate if TSS increases due to construction exceed SMP action thresholds.

CEAA-0011 provides information about the Partnership's environmental protection program, including the In-stream Construction Sediment Management Plan. The

Partnership intends to provide a preliminary version of that report to regulators in the first quarter of 2013.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 2.5.2.2.5 Total Suspended Solids/Turbidity; p. 2-64

# DFO-0085

## PREAMBLE:

The EIS, in the aquatic effects supporting document section 2 on water and sediment quality, notes: "There are few studies that have reported the acute or chronic toxicity of TSS to fish species represented in the Aquatic Environment Study Area. Lawrence and Scherer (1974) reported that the 96-hour lethal concentration (LC50) for lake whitefish (*Coregonus clupeaformis*) was 16,613 mg/L. McKinnon and Hnytka (1988) found relatively high increases in TSS (instantaneous maximum = 3,524 mg/L and 1-day average concentration = 524 mg/L) caused by winter pipeline construction did not have any direct effect (no downstream emigration and no mortalities) on the fish community of Hodgson Creek, NT. This study is notable as four of the fish species found in Hodgson Creek - northern pike (*Esox lucius*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus catostomus*), and burbot (*Lota lota*) - are also found in the Aquatic Environment Study Area. As indicated in Section 5.4.2, northern pike may spawn in the nearshore areas of the Keeyask reservoir, even during the initial years of operation. Therefore, early life history stages of northern pike may be exposed to elevated concentrations of TSS for several years post-impoundment. No information on the acute or chronic toxicity of TSS to northern pike eggs or larvae could be located. Information for early life history stages of other species represented in the Aquatic Environment Study Area is also sparse and many of the available studies do not differentiate between the effects of suspended particulate materials and sediment deposition. However, the available scientific literature indicates a potential for reduced hatching success in salmonids exposed to elevated TSS concentrations on the order of two months or more, at concentrations ranging from 6.6–157 mg/L (Table 2-17). In addition, northern pike eggs would also be exposed to the combined effects of sedimentation and elevated TSS. Therefore, should northern pike spawn in the nearshore, flooded areas of the reservoir in the initial years of operation where organic TSS will be notably elevated, reduced hatching success of northern pike eggs is likely. Conversely, elevated TSS and turbidity can provide benefits to some fish species and life history stages. Reduced water clarity can reduce the risk of predation by visual predators, which in turn can enhance survival of juvenile fish (e.g., Sweka and Hartman 2003) and may favour planktivorous fish…"

## QUESTION:

The Proponent discusses effects of TSS specific to the individual VEC fish species. However, much of the Proponent's impact assessment appears to rely primarily on general and lethal TSS concentration effects. Can the Proponent provide an expanded

discussion of sub-lethal or chronic impact severity of effect risk assessment for anticipated TSS changes?

## RESPONSE:

The Aquatic Environment Supporting Volume discusses effects of Project-related increases in total suspended solids (TSS) on water quality and compares this to Manitoba Water Quality Standards, Objectives, and Guidelines and Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life and provides a summary of available information regarding potential toxicity to aquatic biota. The MWQSOGs PAL objective is based on the CCME PAL guidelines for TSS. The CCME PAL guidelines for TSS are based upon "a large database that reports effects to biota, many of which are found in North America." Toxicity information presented in the documents that serve as the basis for the CCME PAL guideline (e.g., Newcombe and Jensen 1996) as well as other literature respecting TSS toxicity (e.g., Department of Fisheries and Oceans 2000) and species represented in the Keeyask Study Area, was reviewed and summarized in the Aquatic Environment Supporting Volume (see Section 2.5.2.2.5).

## REFERENCES:

DFO (Department of Fisheries and Oceans Canada). 2000. Effects of sediment on fish and their habitat. DFO Pacific Region Habitat Status Report 2000/01.

Newcombe, C.P., and Jensen, J.O.T. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16: 693-727 pp.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 1A.2.1 Structures in Water - Construction Scheduling p. N/A**

# DFO-0086

## PREAMBLE:

"Keeyask Generation Project Environmental Impact Statement Supporting Volume Aquatic Environment June 2012" (disc 2), p1A-2ff… Restricted activity timing windows…DFO…In northern Manitoba, no in-water or shoreline work is allowed during the 15 April – 30 June, 15 May – 15 July, and 1 September -15 May periods where spring, summer, and fall spawning fish respectively are present, except under site- or project-specific review and with…implementation of protective measures…Based on data from Keeyask field investigations…proposed area-specific timing windows for restricted in-water construction activities are…15 May – 15 July for spring and summer spawning fish and 15 September – 15 May for fall spawning fish…scheduling of construction activities that require working in water have been developed and modified to the extent practicable to avoid or minimize the potential for disturbance to fish in the Keeyask area during spawning, and egg an fry development periods…Adjustments to scheduling…to restrict construction and removal of structures to times of …year when sensitive life stages of fish are least likely to be present are summarized in Table 1A-2…" A summary listing shows these are mostly for cofferdam construction and removal "To the extent possible, work in water has been scheduled to avoid interaction with fish and fish habitat during the spring and fall spawning periods…When avoidance of both spring and fall spawning periods was not possible due to critical construction sequences, avoidance of spring spawning periods was given priority over avoidance of the fall spawning period…Additional mitigation of potential disturbances to fish and fish habitat will be gained by constructing each cofferdam in a sequence that minimizes the exposure of readily-transported fines to flowing water…" A key mitigation is timing of in-water activity to avoid impacts on VEC fish species.

## QUESTION:

- A key mitigation is timing of in-water activity to avoid impacts on VEC fish species. Can the Proponent describe its contingency plans for unavoidable changes in scheduling. e.g., if a TSS episode exceeding the CCME guidelines is relatively benign for adult whitefish migration to spawning areas, is the same episode when delayed due to schedule changes similarly benign for incubating whitefish eggs?
- What sort of information would be available to rapidly assess the potential risk of a schedule change?

- What criteria would the Proponent use to trade-off costs to the project and costs to a Valued Environmental Component (VEC) fish species?

## RESPONSE:

### Part (a)

Manitoba Hydro utilizes detailed schedules that include applicable environmental timing restrictions and the schedules are monitored on a regular basis. Appropriate authorities will be notified of any potential to extend construction beyond timing restrictions.

Contingency planning has been carefully considered in developing the Project. Construction Environmental Protection Plans are being developed to provide instructions to construction workers for the south access road and generation station, including in-stream works. In addition, an In-stream Construction Sediment Management Plan (SMP) is being developed that describes a commitment to monitor in real-time and manage total suspended solids (TSS) inputs into the waterway that may occur as a result of shoreline erosion, in-stream construction, river management, and commissioning of the spillway and the powerhouse. Monitoring plans will also be adjusted so that unanticipated construction activities are monitored. These monitoring plans and the EIS are based on more than 10 years of data to understand important spatial and temporal sensitivities for VEC species.

In the event that a construction activity must occur during a restricted period, information for DFO and MCWS would be prepared outlining the technical reason for the required work during the restricted period, the location, magnitude and duration of predicted increases in TSS, and the proposed additional measures to be implemented to reduce TSS inputs or otherwise mitigate effects, and an assessment of the risk to fish in the area and the population overall. Monitoring of fish movements during construction will assist in determining the extent of fish use of areas that would be affected by increased TSS levels and provide the basis for a site-specific assessment of potential risks to fish based on actual use of habitat during construction. For example, the risk of in-stream construction effects during the lake sturgeon spawning period is less if there are no sturgeon using the habitat to spawn. Similarly, if lake whitefish avoid rapids habitat downstream of construction activities, then TSS inputs pose less of a risk than if substantial spawning is occurring. It is understood that permission from DFO is required when in-stream construction work occurs during restricted periods.

### Part (b)

The In-Stream Construction SMP includes a description of the predicted effects of each in-stream construction activity on TSS and the associated magnitudes, timing and durations. The predicted magnitude and duration of changes to TSS likely would not change if an activity were to be advanced or delayed assuming that flow conditions are similar. The plan also includes mechanisms to monitor and respond to “real time”

situations during construction. Should there be a change to the timing of an in-stream construction activity the Partnership would submit predicted effects on the aquatic habitat (including TSS) to the regulators. As discussed in part (a), monitoring of fish movements during construction could assist in determining the extent of fish use of areas that would be affected by increased TSS levels and these data will be available as construction proceeds.

### Part (c)

As stated in part (a) of this response, in the event that a construction activity must occur during a restricted period, a submission to DFO and MCWS would include the proposed additional measures to be implemented to reduce TSS inputs or otherwise mitigate the project effects. It would also include an assessment of the risk to fish in the area and the population overall. It is understood that permission from DFO is required when in-stream construction work occurs during restricted periods.

**REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; p. N/A**

# DFO-0087

## PREAMBLE:

Previous daily TSS sediment monitoring at the Wuskwatim GS construction site had frequent problems with bio-fouling of sensors.

## QUESTION:

Can the Proponent provide additional information on its anticipated TSS monitoring showing that problems with previous monitoring, e.g., bio-fouling of sensors, has been anticipated and solved?

## RESPONSE:

The In-stream Construction Sediment Management Plan (SMP) to be provided to regulatory agencies in the first quarter of 2013 provides details on monitoring and maintenance that address the issue of bio-fouling.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring and Follow-Up; p. N/A

# DFO-0088

## PREAMBLE:

Details of the development of the turbidity/TSS relationship do not appear to be provided. DFO feels it is necessary to know details of the relationship and plans for ongoing calibration to assess whether monitoring will be adequate for effective adaptive management.

## QUESTION:

Can the Proponent provide additional information on its plans for developing a turbidity/TSS relationship, assuming that is being considered, and details of procedures for calibrating the relationship to changing conditions of sediment characteristics, variation with water depth, seasonal variation, and generally correcting for “drift” from the initial relationship?

## RESPONSE:

Please see response to DFO-0063.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A**

# DFO-0089

## PREAMBLE:

Appendix 1A - Part2

## QUESTION:

How will potential risks associated with Sturgeon stocking and interactions with wild stock be addressed? Loss of genetic integrity, ecologic imbalance and community structure shift?

## RESPONSE:

Potential risks associated with stocking identified by the reviewer are loss of genetic integrity, ecologic imbalance and community structure shift. Loss of genetic integrity will be addressed by stocking lake sturgeon from the same subpopulation so that any subtle genetic differences between populations are preserved. Ecological imbalance could arise if numbers of sturgeon are far greater than appropriate for the environment. Monitoring of young lake sturgeon will be conducted annually to determine whether individuals are growing appropriately and in good condition. If evidence of over-stocking is identified, then stocking numbers will be adjusted. Finally, it is not expected that stocking will result in shifts in the fish community; however, monitoring will be conducted to determine any unanticipated adverse effects.

Lake sturgeon stocks in the Keeyask area presently exist at low abundances/densities. In absence of the generating station and in absence of stocking, lake sturgeon populations are at risk of further abundance decreases which would make recovery even more difficult. Although the loss of genetic integrity is listed as a potential risk associated with stocking, the genetic integrity of remnant lake sturgeon populations is poorly understood. For this reason, Louis Bernatchez at Laval University is being funded to conduct a study that aims to increase the understanding of the lake sturgeon genome. It is hoped that increased genetic resolution will allow researchers to answer important questions related to fish passage, genetic composition of remnant wild stocks and number of female lake sturgeon that contribute to a lake sturgeon cohort.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0090

## PREAMBLE:

Appendix 1A - Part2

## QUESTION:

Assuming sturgeon exhibit natal philopatry for spawning locations, significant genetic structure may be apparent even if there is considerable mixing of groups between spawning events. Will this be accounted for when choosing individual broodstock?

## RESPONSE:

Yes. Currently, it is thought that even with low abundances of lake sturgeon in the Keeyask Study Area, sufficient numbers of spawning lake sturgeon can be captured each year to allow broodstock from the same population/subpopulation to be used for stocking. If attempts to capture broodstock are unsuccessful, using broodstock from the nearest donor population would be considered following discussions with MCWS and DFO. An objective of the Keeyask stocking plan is to preserve local life history adaptations, genetic integrity, and local phenotypic adaptations.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A**

# DFO-0091

## PREAMBLE:

Appendix 1A - Part2

## QUESTION:

Has consideration for the effects of the location of the new hatchery facility on imprinting been made?

## RESPONSE:

The potential for imprinting was one of the factors evaluated as a potential criterion for siting the hatchery; however, based on the information presented below it was subsequently eliminated.

The importance of imprinting in lake sturgeon is unknown but has been discussed as a reason for operating stream-side lake sturgeon hatcheries in tributaries of the Great Lakes. In many of these populations, adult lake sturgeon reside in one of the Great Lakes and move upstream during spring to spawn in one of the Great Lakes tributaries. For these populations it is thought that imprinting during the early lifestages may influence where the sturgeon may spawn once mature. Therefore, stream-side rearing facilities have been used to rear lake sturgeon in their natal waters in the hopes that they will return to the tributaries in which they were reared to spawn as adults. The success of these facilities, and in particular the influence that imprinting may have on recovering lake sturgeon populations, remains unknown.

Evidence from a successful lake sturgeon recovery effort in the St. Louis River (a location where a formerly extirpated population has been recovered using only stocked fish from a different subpopulation, i.e., the Lake Winnebago population) suggests that lake sturgeon can “figure things out” in the absence of imprinting. Lake sturgeon in the St. Louis River are known to have reproduced naturally in 2011.

Given the successful stocking of lake sturgeon from large commercial hatcheries, most notably the Wild Rose Fish Hatchery and Genoa Fish Hatchery in Wisconsin and the Wolf Lake State Fish Hatchery in Michigan, and the absence of evidence that sturgeon imprint on waters where they are hatched, imprinting was eliminated from the criteria in siting the hatchery. However, the use of stream-side rearing facilities located close to where sturgeon would be released is being considered for the final stage of sturgeon rearing. Use of such a facility may increase the retention of sturgeon in waters where they are

stocked, rather than having them move elsewhere, although there is no conclusive evidence that would make this a requirement.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A**

# DFO-0092

## PREAMBLE:

Appendix 1A - Part2

## QUESTION:

Because the chances of capturing a ripe female from which to collect eggs is low, the use of ovaprim is suggested, yet long term effects are unknown. How will this be addressed?

## RESPONSE:

It is acknowledged that the long-term physiological impact of manipulation of the reproductive endocrine axis in lake sturgeon is unknown. Funding is currently being provided for a two year research study at the University of Manitoba to investigate the short- and long-term effects of hormones to induce the final stage of spawning in adult lake sturgeon. Preliminary research results indicate that, following the administration of Ovaprim to induce spawning, the concentration of the hormone in the blood and muscle tissue of the Lake Sturgeon dissipates quickly.

Ovaprim, or a similar hormone, has been used for over 20 years at the Manitou Rapids Fish Hatchery in Rainy River. Adult fish that have been previously injected with Ovaprim (or similar hormone) are returning to the spawning grounds several years later.

Research on hormone use has been conducted on a number of sturgeon species. This research has been mostly culture based, short-term (maximum 6 months) and terminal in nature.

## REFERENCES:

Amiri et al. 2012; Barranikova et al. 2004; Ronyai 2009; Williot et al. 2002; Goncharov et al. 2001.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0093

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

Should the original population be decimated, how will the population within the Gull Reach be maintained?

## RESPONSE:

As discussed in Aquatic Environment Supporting Volume Section 6.3.1, lake sturgeon were historically abundant in much of the lower Nelson River, but numbers have declined to the extent that they are currently assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2006). Presently, the lake sturgeon is under consideration for listing under Schedule 1 of Canada's Species at Risk Act.

Stocking and other mitigation measures have been proposed to recover and maintain sturgeon numbers in this reach (see summary in Aquatic Environment Supporting Volume Section 6.4.2.4).

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0094

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

The recruitment model/unexploited scenario mimics the Wisconsin guideline. There is acknowledgement that these numbers may be too low given the guideline was developed based on rivers smaller than the Nelson. How will final numbers be derived?

## RESPONSE:

The final numbers of lake sturgeon to stock will be derived following discussions with MCWS and DFO.

Following the initial years of stocking, monitoring will provide key data on numbers of fish to stock, age to stock and survival of released fish. Comparisons between pre-Project CPUE data and CPUE data from other populations in the province will be used to determine if adjustments to stocking rates are necessary.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0095

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

Need for a protocol to accrue the maximum benefit from the stocking program. Once genetic integrity has been disrupted how can the situation be reasonably corrected? "Given uncertainties surrounding genetic mixing of stocks, the initial stocking plan will likely attempt to maintain the existing genetic structure and collect spawn from the same subpopulations as will be stocked. However given uncertainties and difficulties associated with spawn collection, a second contingency strategy may be required…spawn will be collected at sites that are genetically the most similar to proposed stocking locations." We require assurance that the genetic differences that exist pre development will persevere. Appropriate analysis will be required to address this.

## RESPONSE:

As discussed in the Aquatic Environment Supporting Volume Appendix 1A Part 2, the proposed stocking strategy aims to maintain the genetic structure of existing stocks. If stocks are deemed to be too low to prevent the use of brood stock from the same subpopulation, then the next most suitable location would be considered in consultation with MCWS and DFO.

DFO states that assurances are required that genetic differences that exist pre-development will persevere, and that appropriate analysis will be required to address this. Louis Bernatchez of Laval University is being funded to develop a tool that will increase the understanding of the lake sturgeon genome. The use of this refined genetic tool is expected to considerably improve our understanding of the genetic structure of remnant populations and reduce the concerns related to the potential effects of stocking on the genetic structure of the population.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0096

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

Disease control in stocked fish – how will this be monitored? Should a problem be identified, how will it be rectified?

## RESPONSE:

Manitoba Hydro, in consultation with officials in Manitoba Conservation and Water Stewardship, is developing Standard Operating Procedures for the new hatchery, which will address the prevention and control of disease. This facility will employ state-of-the-art biosecurity measures. Protocols as to the handling of diseased fish, if they occur, will be developed to comply with regulations from the Canadian Food Inspection Agency and Manitoba Fisheries Branch.

In addition, funding is being provided for a four year research project to help address the disease risk for lake sturgeon in Manitoba. This research includes the characterization of a disease recently observed in lake sturgeon, development of a test for the disease, as well as investigating the prevalence and distribution of the disease in wild populations. To date, this research has identified the pathogen and is developing a test for the disease. This research will improve the management of disease in hatchery reared lake sturgeon.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0097

## PREAMBLE:

Appendix 1A - Part2

## QUESTION:

Concern over the acquisition of sufficient broodstock to avoid genetic variability. There is acknowledgement that collecting spawning individuals will be unlikely. Concern over reliance on the use of gametes from just a few individuals (EIS suggests 2 females per year) and the subsequent release of closely related offspring. Decrease in hetrozygosity/genetic drift/allele loss and thereby lower genetic diversity. Please provide detailed report(s) that examined these challenges.

## RESPONSE:

DFO's concern over the number of brood stock to use to avoid loss of genetic diversity are acknowledged; however, it is probable that lake sturgeon stocks are so low in the Keeyask Study Area that a loss in genetic diversity may already be occurring in this remnant population. The Michigan guidelines for stocking lake sturgeon in the Great Lakes suggest that over a 25 year period, gametes should be collected from a minimum of 250 different females and 250-1250 different males (Elliot et al. 2005). At Keeyask, these targets would be impossible to reach. The population is sufficiently low that even the capture of two females per year (as suggested by the DFO review) may be difficult to attain. The objective of the stocking plan is to release four families per year, two females crossed with two males. Over a 25 year period that would equate to stocking out gametes from 50 females and 100 males.

Results from Schueller and Hayes (2011) demonstrate that both minimum viable population (MVP) size and extinction risk can be influenced by demographic stochasticity and inbreeding depression. This study was designed to determine MVP and how inbreeding may affect MVP. More specifically, the study was focused on how MVP and inbreeding is expected to accrue in remnant populations. Remnant populations of lake sturgeon would be those populations where there is limited to no natural recruitment. The lake sturgeon populations in the Keeyask area are naturally recruiting; however, recruitment is highly variable among years. Population viability analysis (PVA) is a standard tool for examining the relationship between extinction risk and population size, but often does not take into account genetic consequences. This study used a

standard modeling approach using individual-based model (IBM) to evaluate inbreeding depression (genetic consequences) in two ways:

- individuals with inbreeding coefficients above a threshold experienced inbreeding depression; and
- individuals experienced inbreeding depression at a rate related to their inbreeding coefficient (gradual).

Three mechanisms relating inbreeding to fitness were explored:

- young-of-the-year (YOY) viability;
- post-YOY viability; and
- number of progeny.

This study used a 5% chance of extinction over 250 years as the criterion to determine MVP. The estimated MVP without inbreeding effects was 80 individuals. For some scenarios incorporating inbreeding, MVP did not change, while others had MVP values up to 1800. Table 2 in Schueller and Hayes (2011) demonstrates that for YOY viability and Number of Progeny that gradually manifest do not affect MVP, but that a gradual manifestation of post-YOY viability is the critical influence on MVP.

The stocking strategy presented in the EIS follows guidelines for a stocking program from the Great Lakes, which was designed with the involvement and input of many experts on lake sturgeon genetics in North America and, therefore, not only represents the state of knowledge, but the approach that should be followed. While Schueller and Hayes (2011) examine the derived parameters that are of direct interest to concerns raised by DFO, there are no reports that directly examine the challenges described by DFO. To address the concerns that DFO raises requires new genetic tools and a better understanding of lake sturgeon genetics. The industry standard genetic tools that are available for lake sturgeon do not allow for the assessment of effective dispersal within a single watershed let alone a management unit, such as the Keeyask area. Effective dispersal is a tool to allow the understanding of natural gene flow among populations or geographically distinct areas.

To address these concerns and knowledge gaps, Manitoba Hydro is funding a study conducted by Louis Bernatchez at Université Laval that will increase the understanding of the current lake sturgeon population genetics for DU3. This “cutting edge” research aims to develop tools that may be able to provide an understanding of the current level of effective dispersal and allow the assessment of age cohorts to determine whether the current level reproduction is the result of population wide successful spawning, or a few large females contributing during ‘perfect storm’ years when conditions are ideal. Results of the study will be used to support the genetic analysis that is one component of the monitoring planned to assess the effectiveness of the stocking program.

The level of genetic diversity that currently exists within the adult lake sturgeon population of the Nelson River is healthy and there is no indication of any inbreeding at present. The Manitoba Hydro study will also be looking at the population genetics of the juvenile populations to assess the genetic diversity as well to increase the state of knowledge of lake sturgeon population genetics and demographics.

## REFERENCES:

Elliott, R.F., E. Baker, B. Eggold, and M Holtgren. 2005. Lake Michigan Lake sturgeon rehabilitation plan-conservation genetics, and rehabilitation stocking. Oral presentation. Proceedings of the second Great Lakes Lake Sturgeon Coordination Meeting. November 9-10, 2004. Sault Ste Marie, Michigan.

Schueller, A.M. and D.B. Hayes. 2011. Minimum viable population size for lake sturgeon (Acipenser fulvescens) using an individual-based model of demographics and genetics. Canadian Journal of Fisheries and Aquatic Sciences 68: 62-73.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0098

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

Given predictions of accumulated sedimentation/peat accumulation and subsequent influences in water chemistry (including decreasing oxygen and increasing mercury levels) is stocking the forebay with sturgeon a rational option?

## RESPONSE:

Habitat will be present in the reservoir post-project for each life stage of lake sturgeon, although some habitat types will not be abundant. Although the reservoir will have areas where sediments accumulate and water chemistry changes, large areas of the reservoir will not be affected by changes to total suspended solids (TSS) or dissolved oxygen (DO )levels. Also, lake sturgeon are not high on the food chain and as such mercury levels are expected to remain generally low. Stocking lake sturgeon into the Keeyask Reservoir is a rational option to recover populations.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0099

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

Stocking will continue as long as required to achieve and maintain the stated DFO (2010) RPA for DU3. (pg 18) Long term program expected for a generation (25 years) or in perpetuity if needed. Is the proponent prepared to stock lake sturgeon as long as required (i.e. beyond 25 years?).

## RESPONSE:

As stated in the stocking strategy (Aquatic Environment Supporting Volume Appendix 1A), stocking will continue until self-sustaining populations are established. It is recognized that this may extend beyond 25 years.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A**

# DFO-0100

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

Given the challenges of detecting changes in sturgeon (growth, age, etc.) over the short term, how will success/failure be determined?

## RESPONSE:

Hatchery-reared fish released as a part of the stocking program will be tagged, or otherwise identified (e.g., by genetic sample), so that they can be distinguished from wild fish. The success/failure of the stocking program will be determined through a monitoring program using gill net mesh sizes that target YOY and sub-adult lake sturgeon. Monitoring will be conducted annually in deep-water habitats (which are known to be preferred by YOY and sub-adult lake sturgeon) in the Nelson and Burntwood Rivers, and the ratio of wild to hatchery-reared fish captured will be recorded. Detecting changes in growth rate in young sturgeon (<10– 14 years), which monitoring is designed to target, is not expected to be difficult. However, detecting these changes in older fish is considered difficult due to ageing inaccuracies in fish > 15 years.

Until recently (2008), attempts to capture YOY lake sturgeon in these areas were unsuccessful, so minimal baseline information exists. More recent information suggests that YOY capture success may be highly influenced by the overall year-class strength, as fish from the 2008 year-class continue to make up a large proportion of the current lake sturgeon catch in the area. As YOY lake sturgeon capture rates in other years have been low to non-existent, the stocking plan will be considered successful if hatchery-reared lake sturgeon are captured in meaningful numbers during monitoring.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; p. N/A

# DFO-0101

## PREAMBLE:

Appendix 1A - Part 2

## QUESTION:

Given the challenges of detecting changes in a phased approach to passage, have possible retrofit options been identified? - Have other forms of d/s passage been identified?

## RESPONSE:

Considerable effort and cost has gone into optimizing the turbine design to reduce fish mortality so that the powerhouse and spillway can be used to provide downstream passage. The design of the trashracks was examined to confirm that spacing is appropriate to allow fish of the appropriate size to pass and avoid impingement of larger individuals. It was determined that the risk of impingement for adults of all large-bodied species was relatively low. Smaller fish will pass through the trashracks and turbines; and because reducing trashrack spacing would increase the likelihood of impingement for smaller fish, this modification was not pursued. Therefore, fish exclusion devices or downstream fish passage mechanisms will not be installed as part of the generating station construction.

The Partnership will continue to monitor fish moving downstream once the generating station is constructed. Based on the results of this monitoring, an examination of fish movements may be extended to the trashracks as fish enter the generating station to assist in assessing the need for further downstream fish passage or exclusion measures. The Partnership will continue to monitor developments in technology to address this issue and will investigate the concept of downstream fish passage program(s) for Keeyask that could be implemented if monitoring demonstrates to regulatory agencies clear benefits and the necessity for such programs, based on discussions with regulators.

Also, please see DFO-0048.

## REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; p. 6-13

# DFO-0102

## QUESTION:

The EIS indicates that the turbine has been designed to maximize fish survival compared to other Manitoba Hydro generating stations. Please provide a table to compare turbines of similar design and on similar systems.

## RESPONSE:

Vertical fixed blade propellers, in general, have higher fish survival rates than other turbine designs, such as Kaplan or Francis. The rate of mortality and injury to fish is less for fixed blade vertical shaft turbines that have fewer blades, a larger diameter, and slower rotational speed. Based on these features, the rate of mortality and injury to fish is expected to be lower for the turbines at Keeyask relative to the turbines at the Kelsey and Wuskwatim generating stations (see summary table below). As discussed in Aquatic Environment Supporting Volume Appendix 1A Part 1 Attachment 2, the design specifications for the Keeyask turbines included additional features associated with reduced harm to fish (e.g., thicker leading edges on the turbine blade).

| Station | Turbine Type | # Blades | Diameter | Rotational Rate |
|---|---|---|---|---|
| Kelsey GS | Vertical fixed blade propeller | 5 | 5.84 | 102.9 RPM |
| Keeyask GS | Vertical fixed blade propeller | 5 | 8.35 m | 75 RPM |
| Wuskwatim GS | Vertical fixed blade propeller | 5 | 6.7 m | 94.8 RPM |

## REFERENCE: REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; p. 6-13

# DFO-0103

## QUESTION:

The EIS indicates 90% survival for fish up to 500mm. Can this be further broken down into species, sex, maturity and length for the VEC fish species within the Keeyask Study area. An analysis/graphs of survival rates and injury rates should be provided.

## RESPONSE:

As presented in Aquatic Environment Supporting Volume Appendix 1A, Part 1, Attachment 1, this information is based on the Franke formula, which combines results from many studies. It is not possible to break down by species, sex, etc.

The Franke formula does differentiate among fish of different lengths, as it is based on the probability that a fish will be struck by a turbine blade. The blade strike correlation factor (0.1 and 0.2) is used to account for variability in strike potential resulting in mortal injuries and also to relate the output to empirical data available to the Franke study. The value of the correlation factor in the range of 0.1 to 0.2 was determined by Franke et al. (1997) from Kaplan survival tests. Three passage locations (near the hub, mid blade, and tip) were considered in the calculation of survival estimates, and estimates were calculated for five representative fish lengths.

| **Correlation Factor** | | **0.1** | | | **0.2** | | |
|---|---|---|---|---|---|---|---|
| **Passage Location** | | **Hub** | **Mid** | **Tip** | **Hub** | **Mid** | **Tip** |
| **Fish Length (mm)** | **100** | 99.5 | 99.4 | 98.4 | 99 | 98.9 | 96.8 |
| | **205** | 99 | 98.9 | 96.8 | 97.9 | 97.7 | 93.7 |
| | **305** | 98.4 | 98.3 | 95.2 | 96.9 | 96.6 | 90.5 |
| | **510** | 97.4 | 97.41 | 92.1 | 94.8 | 94.3 | 84.2 |
| | **710** | 96.4 | 96 | 88.9 | 92.7 | 92 | 77.8 |

## REFERENCES:

Franke, G.F., Webb, D.R., Fisher, R.K. Jr., Mathur, D., Hopping, P.N., March, P.A., Headrick, M.R., Laczo, I.T., Ventikos, Y. and F. Sotiropoulos. 1997. Development of Environmentally Advanced Hydropower Turbine System Design Concepts. Idaho National Engineering and Environmental Laboratory. 161 p. and appendix

## REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; p. 6-13

# DFO-0104

## QUESTION:

Several recommendations to minimize mortality that can be incorporated into hydro facilities include: using trashracks with reduced bar spacing while preventing further impingement, using temporary overlays with the existing trashracks to reduce clear spacing during migration periods, use of partial depth curtain wall over existing trash rack, installation of an inclined or skewed bar rack system upstream of the intake, barrier or stop nets set upstream in the forebay, and use of partial depth guide walls or an angled louver system upstream of the intakes coupled with a bypass system. Will the powerhouse be designed to incorporate some of these features if monitoring indicates that fish mortality is higher than predicted? Additional biological data and studies will be required post construction to better assess the requirements and potential mitigation for both potential downstream passage and protection. Also, these studies should determine the overall number of fish expected to pass through the turbines.

## RESPONSE:

Based on the results of studies to date and discussions with DFO and MCWS it has been determined that some form of fish exclusion device or downstream fish passage mechanism will not be installed as part of the generating station construction. Considerable effort and cost has gone into optimizing the turbine design to reduce fish mortality so that the powerhouse and spillway can be used to provide downstream passage. The design of the trashracks was examined to confirm that spacing is appropriate to allow fish of the appropriate size to pass and avoid impingement of larger individuals (see Aquatic Environment Supporting Volume Appendix 1A, Part 1, Attachment 2). It was determined that the risk of impingement for adults of all large-bodied species was relatively low. Smaller fish would pass through the trashracks and turbines and it was determined that reducing trashrack spacing would increase the likelihood of impingement for smaller fish and so this modification was not pursued. Considerable effort and cost has gone into optimizing the turbine design to reduce fish mortality.

The Partnership will continue to monitor fish moving downstream once the generating station is constructed. Based on the results of this monitoring, an examination of fish movements may be extended to the trash racks as fish enter the generating station to assist in assessing the need for further downstream fish passage or exclusion measures. The Partnership will continue to monitor developments in technology to address this issue and will investigate the concept of downstream fish passage program(s) for

Keeyask that could be implemented if, in discussion with the Partnership, monitoring demonstrates to regulatory agencies clear benefits and the necessity for such programs, based on discussions with regulators.

The Aquatic Effects Monitoring Plan will provide a description of fish movement monitoring studies during Project operation. The schedule for preparation of the Aquatic Environment Monitoring Plan (AEMP) is provided in DFO-0015.

## REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; p. 6-13

# DFO-0105

## QUESTION:

Survival rates can be maximized for entrained fish if operation of the turbines is at maximum efficiency. How will Keeyask be operated to minimize mortality?

## RESPONSE:

Turbines are typically operated at maximum efficiency but at times operational requirements do not allow for operation at maximum efficiency.

## REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; p. 6-13

# DFO-0106

## QUESTION:

What are acceptable mortality rates based on the fish community and population in the Keeyask study area?

## RESPONSE:

Mortality of fish during passage past the turbines and spillway would reduce the number of fish entering Stephens Lake. Given the relative size of Gull and Stephens lakes, emigration of juvenile and adult fish from Gull Lake to Stephens Lake is not thought to provide a significant input to the Stephens Lake population and no material impact of turbine/spillway mortality to the fish community is expected. (For additional information, please see Aquatic Environment Supporting Volume Sections 5.4.2.3.5 and 6.4.2.3.2).

Construction of the Keeyask Generating Station will also reduce the drift of larval fish from Gull to Stephens lakes. The input of larval lake sturgeon from upstream of Gull Rapids may be the source of young lake sturgeon in Stephens Lake, given the extremely low numbers of spawning fish observed in the last decade (see Aquatic Environment Supporting Volume Section 6.4.2.3.2). However, this reduction in larval drift is due to the presence of the reservoir and would not be affected by the turbines.

## REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; p. 6-13

# DFO-0107

## QUESTION:

A detailed monitoring plan should be developed to assess mortality of fish passing through the station and spillway. How will this impact the fish community?

## RESPONSE:

Please see DFO-0015 for a discussion of the development of a detailed monitoring plan.

Please see DFO-0106 for a discussion of effects of turbine and spillway mortality to the fish community in Stephens Lake.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 5.4.1.1.6 Assessing Environmental Sensitivity of Borrow and Quarry Rock Material; p. 5-24

# EC-0001

## PREAMBLE:

This section states the following: 'In total, 25 granular and 16 rock samples from the Keeyask GS area were selected for laboratory testing. Samples were shipped to Maxxam Analytics in Burnaby, BC, for testing in spring 2010 (granular borrow samples, specific and bulk rock samples) and winter 2010-2011 (specific, and composite rock samples). The analysis requested for the granular materials Included soluble metals using MEND guidelines for water-extractable metals (MEND 2000). The requested analyses on the rock samples Included total sulphur, sulphate, neutralization potential and metal content using standard Maxxam methods and quality assurances and quality control procedures (Sobek et al., 1978, MEND 1991).'

## QUESTION:

EC notes that results of the rock assessment are not shown. In addition, as indicated by the Proponent, the requested analysis on the rock samples included total sulphur, sulphate, neutralization potential and metal content, but this list does not include acid potential. EC requests that the Proponent provide the result of the static and kinetic tests.

## RESPONSE:

Acid Potential is a synonym of Maximum Potential Acidity (MPA). MPA is calculated from the total sulphur concentration; based on the assumption that all measured sulphur is present in the form of sulphide - which was the case for the majority of the Keeyask samples analysed. Accordingly, Acid Potential was calculated and used in the assessment.

The results of the static rock assessment are shown in Tables 1 and 2 below. This information formed the basis for the discussion in the Physical Environment Supporting Volume. Two sets of rock samples were tested, as shown in Table 1. The first dataset was for targeted sampling of rock cores where only the segment with an indication of sulphides was tested. The second set of samples included targeted analysis of only sections with sulphides and analysis of composite samples that included the portion with sulphides as well as surrounding host rock. The composite samples are representative of the mixed rock as it would actually be used for construction purposes. The assessment was based on a weight of evidence approach for the prediction of acid

generation potential associated with the Keeyask rock (as summarized in the Physical Environment Supporting Volume Section 5), which found:

- Paste pH is above 7.7.
- Total, average and median Net Neutralization Potential (NNP) values are positive.
- Average and median Neutralization Potential Ratio (NPR) values for specific samples combined from two datasets are above 2.
- Average and median NPR for composite samples is above 2.

Some material was found to be capable of producing acid in localized pockets of rock (less than $1m^3$), but it was concluded that any generated acid will likely be neutralized by the surrounding rock mass. On this basis, the resulting leachate from the excavated large rock mass is not expected to be acidic.

Kinetic tests are conducted if there is significant risk for the production of acid and/or metal-rich leachate. Because the assessment of the Keeyask rock samples concluded that the overall risk of acidic drainage is low, kinetic testing was not deemed to be required.

**Table 1: ABA Test Results and descriptive statistics for Keeyask Rock Samples.**

| S. No. | Sample ID | Paste pH | Total Sulphur (Wt.%) | Sulphate Sulphur (Wt.%) | Sulphide Sulphur* (Wt.%) | Maximum Potential Acidity** (Kg CaCO3/Tonne) | Neutralization Potential*** (Kg CaCO3/Tonne) | Net Neutralization Potential*** (Kg CaCO3/Tonne) | Neutralization Potential Ratio (NPR)**** (dimensionless; no unit) | Fizz Rating |
|---|---|---|---|---|---|---|---|---|---|---|
| | **First dataset, specific samples only (first campaign), n=9** | | | | | | | **NNP** | **NPR** | |
| 1 | GR04-01 (amphibolite) | 9.4 | 0.10 | <0.01 | 0.10 | 3.1 | 15.8 | 13 | 5 | None |
| 2 | GR04-04 (granodiorite) | 7.7 | 0.56 | 0.01 | 0.55 | 17.2 | 10.9 | -6 | 0.6 | None |
| 3 | 03-008 (Iron formation in gneiss) | 8.2 | 0.71 | 0.01 | 0.70 | 21.9 | 15.2 | -7 | 0.7 | None |
| 4 | 03-011 (amphibolite) | 9.4 | 0.29 | <0.01 | 0.29 | 9.1 | 261.3 | 252 | 29 | Strong |
| 5 | 03-015 (amphibolite) | 9.6 | 0.04 | <0.01 | 0.04 | 1.3 | 27.0 | 26 | 22 | Slight |
| 6 | G-0013 (Gneiss) | 8.2 | 2.16 | <0.01 | 2.16 | 67.5 | 27.6 | -40 | 0.4 | Moderate |
| 7 | G-0018 (Gneiss) | 8.0 | 0.35 | 0.01 | 0.34 | 10.6 | 8.1 | -3 | 0.8 | None |
| 8 | G-0025 (Gneiss) | 9.4 | <0.02 | <0.01 | <0.02 | <0.6 | 6.5 | 6 | 11 | None |
| 9 | G-0050 (Gneiss) | 9.0 | 0.21 | <0.01 | 0.21 | 6.6 | 14.1 | 7 | 2.1 | Slight |
| | **Second dataset, specific samples only (second campaign), n=4** | | | | | | | | | |
| 1 | 03-006 Specific (7.72-11.84, Gneiss ) | 8.8 | 0.46 | 0.01 | 0.45 | 14.1 | 13.2 | -0.9 | 0.9 | None |
| 2 | 03-025 Specific (2.99-4.54, Gneiss with granite bands) | 9.7 | 0.16 | <0.01 | 0.16 | 5.0 | 11.2 | 6.2 | 2.2 | None |
| 3 | G-0466 Specific (5.05-5.84, Gneiss with granite stringers) | 9.7 | 0.56 | <0.01 | 0.56 | 17.5 | 10.7 | -6.8 | 0.6 | None |
| 4 | G-0466 Specific (9.54-10.20, Gneiss with sulfide clots) | 9.8 | 0.18 | <0.01 | 0.18 | 5.6 | 69.4 | 63.8 | 12.3 | Moderate |
| | **Second dataset composite samples only (second campaign), n=8** | | | | | | | | | |
| 1 | 03-006 Composite (7.72-18, Gneiss 90% and Granite 10%) | 9.4 | 0.36 | <0.01 | 0.36 | 11.3 | 33.2 | 22.0 | 3.0 | Slight |
| 2 | 03-025 Composite (2.46-16.85, Gneiss 50% and Granite 50%) | 9.6 | 0.19 | <0.01 | 0.19 | 5.9 | 9.9 | 4.0 | **1.7** | None |
| 3 | G-0466 Composite (4.89-10.61, Gneiss 83% and Granite 17% ) | 9.8 | 0.28 | <0.01 | 0.28 | 8.8 | 13.7 | 5.0 | **1.6** | None |
| 4 | 03-007/008 Composite (20.9 m total, gneiss 62%, granite 33.2%, Fe formation 3.5%, pegmatite 1.3%) | 9.5 | 0.18 | 0.04 | 0.14 | 4.4 | 14.5 | 10.1 | 3.3 | None |
| 5 | 03-010 Composite (4.89-29.34. Gneiss 87.3% and Granite 12.7%) | 9.8 | 0.21 | 0.04 | 0.17 | 5.3 | 15.3 | 10.0 | 2.9 | None |
| 6 | 03-012 Composite (3.22-8.18, Amphibolite 74% and Granite 26%) | 9.5 | 0.13 | 0.05 | 0.06 | 1.9 | 14.3 | 12.4 | 7.5 | None |
| 7 | 03-015 Composite (7.66-26.25 m. Amphibolite ~87% and Granite 13%) | 9.7 | 0.13 | 0.01 | 0.12 | 3.8 | 17.8 | 14.1 | 4.7 | None |
| 8 | 03-016 Composite, (4.36-36.65 m. Gneiss 52% , Granite 43% and Fe formation 5%) | 9.7 | 0.27 | 0.01 | 0.15 | 4.7 | 12.0 | 7.3 | 2.6 | None |
| | **STATISTICS** | | | | | | | | | |
| | **First dataset, specific samples only (first campaign), n=9** | | | | | | | | | |
| | 10% percentile | 7.9 | 0.1 | 0.01 | 0.08 | 2.6 | 7.8 | **-13.3** | **0.6** | - |
| | Median | 9.0 | 0.3 | 0.01 | 0.32 | 9.8 | 15.2 | 6.5 | 2.1 | - |
| | 90% percentile | 9.4 | 1.1 | 0.01 | 1.14 | 35.6 | 74.4 | 71.0 | 23.0 | - |
| | Average | 8.8 | 0.6 | 0.01 | 0.55 | 17.1 | 42.9 | **27.7** | 7.9 | - |
| | Standard deviation | 0.7 | 0.7 | 0 | 0.69 | 21.5 | 82.2 | 86.1 | 10.5 | - |
| | **Second dataset, specific samples only (second campaign), n=4** | | | | | | | | | |
| | 10% percentile | 9.0 | 0.2 | 0.01 | 0.17 | 5.2 | 10.8 | **-5.0** | **0.7** | - |
| | Median | 9.7 | 0.3 | 0.01 | 0.32 | 9.8 | 12.2 | 2.7 | **1.6** | - |
| | 90% percentile | 9.8 | 0.5 | 0.01 | 0.53 | 16.5 | 52.6 | 46.5 | 9.3 | - |
| | Average | 7.6 | 0.3 | 0.06 | 0.29 | 8.5 | 20.9 | 12.5 | 3.2 | - |
| | Standard deviation | 4.2 | 0.2 | 0.06 | 0.20 | 7.1 | 27.6 | 29.1 | 5.1 | - |
| | **Combined first and second datasets, specific samples only, n=13** | | | | | | | | | |
| | 10% percentile | 8.0 | 0.1 | 0.01 | 0.11 | 3.3 | 8.6 | **-6.8** | **0.6** | - |
| | Median | 9.4 | 0.3 | 0.01 | 0.32 | 9.8 | 14.1 | 6.2 | 2.1 | - |
| | 90% percentile | 9.7 | 0.7 | 0.01 | 0.69 | 21.4 | 61.1 | 56.2 | 19.7 | - |
| | Average | 9.0 | 0.5 | 0.01 | 0.48 | 14.9 | 37.8 | 24.0 | 6.7 | - |
| | Standard deviation | 0.7 | 0.6 | 0 | 0.57 | 17.7 | 69.1 | 72.4 | 9.2 | - |
| | **Second dataset, composite samples only (#3), n=8** | | | | | | | | | |
| | 10% percentile | 9.5 | 0.1 | 0.01 | 0.10 | 3.2 | 11.4 | 4.7 | **1.6** | |
| | Median | 9.7 | 0.2 | 0.01 | 0.16 | 5.0 | 14.4 | 10.1 | 2.9 | - |
| | 90% percentile | 9.8 | 0.3 | 0.01 | 0.30 | 9.5 | 22.4 | 16.5 | 5.5 | |
| | Average | 9.6 | 0.2 | 0.01 | 0.18 | 5.8 | 16.3 | 10.6 | 3.4 | - |
| | Standard deviation | 0.1 | 0.1 | 0 | 0.09 | 3.0 | 7.2 | 5.8 | 1.9 | - |

**Notes:**

*Sulphide sulphur is based on difference between total sulphur and sulphate sulphur.

**MPA (Maximum Potential Acidity) is based on sulphide sulphur .

*** NP (Net Neutralization Potential) determined by Std. Sobek NP method (Sobek et al. 1978, EPA 600 Method, Cantest SOP No. 7110) .

**** NNP (Net Neutralization Potential) is based on difference between Neutralization Potential (NP) and MPA.

Values with negative NNP and NPR<2 are highlighted and bolded, respectively

**Table 2: Trace Metals Using Aqua Regia Digestion with ICP-MS Finish for Keeyask Rock Samples.**

| S. No. | Sample ID | Ag ppm | Al % | As ppm | Au* ppb | B ppm | Ba ppm | Bi ppm | Ca % | Cd ppm | Co ppm | Cr ppm | Cu ppm | Fe % | Ga ppm | Hg ppm | K % | La ppm | Mg % | Mn ppm | Mo ppm | Na % | Ni ppm | P % | Pb ppm | S % | Sb ppm | Sc ppm | Se ppm | Sr ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm | Zn ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **First dataset, specific samples only (first campaing), n=9** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | GR04-01 (amphibolite) | <0.1 | 1.25 | <0.5 | <0.5 | <20 | 21 | <0.1 | 0.84 | <0.1 | 20.1 | 45 | 85.3 | 3.05 | 4 | <0.01 | 0.35 | 4 | 0.73 | 585 | 3.2 | 0.075 | 28.3 | 0.054 | 2.1 | na | 0.1 | 3.3 | <0.5 | 13 | na | 0.9 | 0.115 | 0.3 | 0.3 | 45 | 0.2 | 42 |
| 2 | GR04-04 (granodiorite) | <0.1 | 3.16 | <0.5 | 1.7 | <20 | 111 | <0.1 | 0.31 | <0.1 | 25.2 | 206 | 58.7 | 6.54 | 9 | <0.01 | 1.04 | 14 | 1.94 | 749 | 3.3 | 0.011 | 96.4 | 0.035 | 4.6 | na | <0.1 | 6.4 | <0.5 | 14 | na | 7.4 | 0.208 | 0.5 | 1.8 | 104 | 0.1 | 98 |
| 3 | 03-008 (Iron formation in gneiss) | <0.1 | 1.68 | <0.5 | 1.5 | <20 | 66 | 0.2 | 0.51 | <0.1 | 8.4 | 86 | 56.3 | 11.47 | 7 | <0.01 | 0.51 | 19 | 0.67 | 304 | 4.9 | 0.008 | 31 | 0.144 | 2.4 | na | <0.1 | 3.7 | <0.5 | 11 | na | 6.5 | 0.088 | 0.5 | 3.2 | 31 | 1 | 28 |
| 4 | 03-011 (amphibolite) | 0.2 | 3.91 | <0.5 | <0.5 | <20 | 153 | 0.6 | 1.48 | 0.3 | 62.6 | 547 | 248.4 | 8.06 | 14 | 0.01 | 1.89 | 24 | 2.65 | 1822 | 3.3 | 0.018 | 451 | 0.037 | 21.6 | na | <0.1 | 18.5 | <0.5 | 5 | na | 13.2 | 0.438 | 1.8 | 5.7 | 178 | 0.3 | 185 |
| 5 | 03-015 (amphibolite) | <0.1 | 1.64 | <0.5 | <0.5 | <20 | 22 | 0.2 | 1.08 | <0.1 | 15.5 | 93 | 64.8 | 3.09 | 8 | <0.01 | 0.68 | 11 | 1.12 | 434 | 3 | 0.097 | 44.7 | 0.037 | 5.9 | na | <0.1 | 8.1 | <0.5 | 9 | na | 9.4 | 0.203 | 0.5 | 3 | 80 | 0.3 | 71 |
| 6 | G-0013 (Gneiss) | 0.2 | 0.85 | <0.5 | 7.1 | <20 | 9 | 11.4 | 0.38 | 0.1 | 35.6 | 102 | 141.8 | 4.01 | 3 | <0.01 | 0.3 | 6 | 0.32 | 503 | 22.9 | 0.028 | 138 | 0.004 | 14.2 | na | <0.1 | 3.9 | 1.5 | 3 | na | 10.7 | 0.041 | 0.7 | 75.1 | 28 | 0.2 | 42 |
| 7 | G-0018 (Gneiss) | <0.1 | 3.79 | 0.7 | 0.9 | <20 | 220 | 0.6 | 0.11 | <0.1 | 36 | 251 | 85.9 | 6.25 | 17 | <0.01 | 2.45 | 33 | 2.33 | 595 | 2.9 | 0.019 | 130.5 | 0.027 | 8.8 | na | <0.1 | 10.9 | <0.5 | 3 | na | 17.1 | 0.396 | 1.5 | 4.7 | 152 | 0.3 | 141 |
| 8 | G-0025 (Gneiss) | <0.1 | 0.44 | <0.5 | 0.9 | <20 | 12 | <0.1 | 0.23 | <0.1 | 3 | 52 | 4.5 | 0.95 | 3 | <0.01 | 0.09 | 31 | 0.23 | 114 | 3.6 | 0.02 | 4.7 | 0.017 | 6.1 | na | <0.1 | 0.6 | <0.5 | 8 | na | 25.7 | 0.049 | <0.1 | 1 | 9 | <0.1 | 22 |
| 9 | G-0050 (Gneiss) | <0.1 | 2.14 | <0.5 | 0.8 | <20 | 44 | 0.1 | 0.32 | <0.1 | 21.5 | 172 | 57.5 | 3.86 | 9 | <0.01 | 0.29 | 14 | 1.57 | 399 | 3.4 | 0.021 | 73.5 | 0.025 | 5.8 | na | <0.1 | 6.5 | <0.5 | 7 | na | 9 | 0.185 | 0.2 | 1.8 | 76 | <0.1 | 68 |
| | **Second dataset, specific samples only (second campaing), n=4** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 03-006 Specific (7.72-11.84, Gneiss ) | 0.1 | 2.58 | 6.2 | <0.5 | <20 | 140 | 0.2 | 0.45 | 3 | 23.9 | 178 | 53.4 | 5.02 | 11 | <0.01 | 1.17 | 17 | 1.63 | 534 | 4.4 | 0.017 | 74.4 | 0.038 | 10 | 0.56 | 0.1 | 8.3 | <0.5 | 11 | <0.2 | 7.8 | 0.219 | 0.8 | 1.8 | 97 | 0.1 | 837 |
| 2 | 03-025 Specific (2.99-4.54, Gneiss with granite bands) | <0.1 | 1.89 | 2.1 | 0.7 | <20 | 144 | <0.1 | 0.29 | <0.1 | 14.3 | 174 | 31.5 | 3.72 | 7 | <0.01 | 0.98 | 20 | 1.09 | 310 | 6.9 | 0.058 | 54.1 | 0.021 | 15.9 | 0.19 | 0.2 | 4.1 | <0.5 | 7 | <0.2 | 13.8 | 0.204 | 0.4 | 1.9 | 54 | <0.1 | 59 |
| 3 | G-0466 Specific (5.05-5.84, Gneiss with granite stringers) | 0.1 | 2.08 | 1.7 | 1 | <20 | 256 | <0.1 | 0.41 | 0.1 | 27 | 213 | 89.9 | 3.73 | 7 | <0.01 | 1.3 | 19 | 1.28 | 287 | 5.1 | 0.076 | 79.8 | 0.053 | 6.2 | 0.53 | <0.1 | 9.2 | <0.5 | 22 | <0.2 | 6.7 | 0.259 | 0.5 | 1.5 | 109 | 0.2 | 71 |
| 4 | G-0466 Specific (9.54-10.20, Gneiss with sulfide clots) | <0.1 | 3.21 | 34 | 2 | <20 | 320 | <0.1 | 0.87 | <0.1 | 31.8 | 203 | 56.8 | 5.38 | 16 | <0.01 | 2 | 50 | 2.19 | 725 | 4.8 | 0.05 | 95.5 | 0.026 | 12.5 | 0.18 | 0.1 | 11 | <0.5 | 13 | <0.2 | 30.9 | 0.377 | 0.8 | 2.5 | 150 | 0.2 | 107 |
| | **Second dataset composite samples only (second campaing), n=3** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 03-006 Composite (7.72-18, Gneiss 90% and Granite 10%) | 0.1 | 2.44 | 5.6 | <0.5 | <20 | 139 | 0.2 | 0.82 | 1.1 | 22.9 | 187 | 52.3 | 4.43 | 10 | <0.01 | 1.17 | 28 | 1.57 | 498 | 5.6 | 0.035 | 66.9 | 0.043 | 20.5 | 0.34 | 0.3 | 7.7 | 0.6 | 16 | <0.2 | 14.7 | 0.23 | 0.6 | 1.8 | 83 | 0.1 | 351 |
| 2 | 03-025 Composite (2.46-16.85, Gneiss 50% and Granite 50%) | <0.1 | 1.77 | 4 | <0.5 | <20 | 132 | <0.1 | 0.22 | <0.1 | 14.6 | 184 | 36.3 | 3.34 | 7 | <0.01 | 1.12 | 20 | 1.11 | 226 | 8.1 | 0.05 | 55.9 | 0.011 | 19.9 | 0.18 | 1.1 | 4.4 | <0.5 | 7 | <0.2 | 16.4 | 0.216 | 0.4 | 1.5 | 60 | 0.1 | 66 |
| 3 | G-0466 Composite (4.89-10.61, Gneiss 83% and Granite 17% ) | <0.1 | 2.63 | 8.7 | 1.5 | <20 | 270 | <0.1 | 0.37 | <0.1 | 25.5 | 199 | 54.2 | 4.66 | 11 | <0.01 | 1.76 | 26 | 1.76 | 501 | 4.3 | 0.052 | 77.8 | 0.043 | 11.3 | 0.28 | <0.1 | 10.1 | 0.6 | 12 | <0.2 | 13.6 | 0.294 | 0.7 | 1.4 | 119 | 0.1 | 85 |
| 4 | 03-007/008 Composite (20.9 m total, gneiss 62%, granite 33.2%, Fe formation 3.5%, pegmatite 1.3%) | <0.1 | 2.61 | 10.8 | 2.3 | <20 | 111 | <0.1 | 0.27 | <0.1 | 17.7 | 176 | 33.7 | 6.12 | 13 | <0.01 | 1.26 | 36 | 1.42 | 477 | 3.1 | 0.025 | 71.1 | 0.025 | 12.9 | 0.2 | <0.1 | 8.2 | <0.5 | 5 | <0.2 | 27.5 | 0.216 | 0.8 | 5.2 | 73 | 0.3 | 82 |
| 5 | 03-010 Composite (4.89-29.34, Gneiss 87.3% and Granite 12.7%) | 0.1 | 2.7 | 1.3 | <0.5 | <20 | 205 | 0.2 | 0.3 | <0.1 | 21.8 | 221 | 50.3 | 5.11 | 11 | <0.01 | 1.45 | 24 | 1.66 | 562 | 1.6 | 0.035 | 82.4 | 0.019 | 18.5 | 0.25 | <0.1 | 9.3 | <0.5 | 6 | <0.2 | 20.2 | 0.246 | 0.8 | 4.9 | 89 | 0.2 | 75 |
| 6 | 03-012 Composite (3.22-8.18, Amphibolite 74% and Granite 26%) | <0.1 | 2.37 | 1.5 | <0.5 | <20 | 140 | <0.1 | 0.29 | 0.2 | 15.2 | 164 | 33.4 | 5.07 | 10 | <0.01 | 1.16 | 28 | 1.26 | 446 | 2.1 | 0.024 | 60.3 | 0.025 | 14.7 | 0.22 | <0.1 | 6.9 | <0.5 | 8 | <0.2 | 20.1 | 0.174 | 0.7 | 2.3 | 65 | 0.2 | 66 |
| 7 | 03-015 Composite (7.66-26.25 m. Amphibolite ~87% and Granite 13%) | <0.1 | 1.57 | 0.5 | <0.5 | <20 | 83 | <0.1 | 0.67 | <0.1 | 20.1 | 80 | 91.5 | 3.8 | 7 | <0.01 | 0.7 | 8 | 0.98 | 346 | 0.6 | 0.071 | 41.7 | 0.049 | 6.6 | 0.13 | <0.1 | 6.6 | <0.5 | 5 | <0.2 | 7.8 | 0.205 | 0.5 | 4.6 | 93 | 0.2 | 78 |
| 8 | 03-016 Composite, (4.36-36.65 m. Gneiss 52% , Granite 43% and Fe formation 5%) | 0.1 | 1.19 | <0.5 | <0.5 | <20 | 69 | 0.8 | 0.21 | 0.1 | 14 | 147 | 87.6 | 2.84 | 6 | <0.01 | 0.71 | 11 | 0.67 | 330 | 32.9 | 0.035 | 55.9 | 0.014 | 13.3 | 0.34 | <0.1 | 5.9 | <0.5 | 4 | 0.3 | 11.3 | 0.137 | 0.5 | 34.5 | 58 | 0.3 | 72 |
| | *Average*, Combined #1 and #2 datasets, n=21* | **76** | 2.19 | 3.8 | 1.1 | 10.0 | 127 | **0.72** | 0.5 | **0.27** | **22.7** | **175** | **70.2** | 4.8 | 9.05 | 0.01 | 1.07 | 21 | 1.34 | **512** | **6.19** | 0.04 | **86.4** | 0.04 | 11.1 | 0.28 | 0.13 | 7.31 | **0.34** | 9.0 | 0.12 | **13.8** | 0.21 | 0.6 | **7.6** | 83 | 0.22 | **126** |
| | *Average concentrations in the Upper Crust (Rudnick and Gao, 2004)* | 53 | - | 4.8 | 1.5 | - | 628 | 0.16 | - | 0.09 | 17.3 | 92 | 28 | - | 17.5 | 0.05 | - | 31 | - | 368 | 1.1 | - | 47 | - | 17 | - | 0.4 | 14 | 0.09 | 320 | - | 10.5 | 0.3 | 0.9 | 2.7 | 97 | 1.9 | 67 |

Values exceeding the crustal concentration are in bold.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 5.4.1.1.6 Assessing Environmental Sensitivity of Borrow and Quarry Rock Material; p. 5-24

# EC-0002

## PREAMBLE:

In this section, the Proponent states that: 'With respect to the quarry rock, there are a number of different indicators for the generation of acidic drainage and therefore a weight-of-evidence approach is typically applied. Using this approach, the assessment of the Keeyask rock samples concluded that the risk of acidic drainage is low.'

## QUESTION:

EC requests that the Proponent:

- Clarify what the following statement implies: "assessment of the Keeyask rock samples concluded that the risk of acidic drainage is low". Since no results of the rock assessment are provided, EC is unsure if this statement implies that the rocks are non acid generating (NAG) or that the neutralizing potential/acid potential ratio (NP/AP) is greater than 3 or uncertain (between 1 and 2).
- Confirm that any borrow materials or quarry rocks that would be used for construction as well as road construction do not show the potential to generate acid.

## RESPONSE:

With regard to the quarry rock, please refer to the response provided to EC-0001 for the rock assessment results, which supports the overall conclusion that there is a low potential for acidic leachate generation.

The borrow material was subjected to Shake Flask Extraction tests, which showed that all 25 water extractions associated with the granular materials were neutral (lowest pH was 6.1) with sulphur concentrations below detection limits (<1 mg/L). It was on this basis that the judgment was made that sulphide oxidation and acid generation in borrow materials are expected to be negligible.

## REFERENCE: Volume: Response to EIS Guidelines; Section 4.3.1.1 Powerhouse Complex; p. 4-7

# EC-0003

## PREAMBLE:

This section outlines that the powerhouse unit will contain electrical and mechanical equipment, including ventilation systems, domestic and fire water systems, cranes, water and wastewater treatment systems, compressed air, and oil storage facilities.

## QUESTION:

EC would like to make the Proponent aware of the new Wastewater System Effluent Regulations that may apply to the wastewater treatment component of the powerhouse depending of the volume of influent (100 $m^3$/d) the system is designed to treat. EC requests that the Proponent provide estimates on proposed wastewater influent volumes (including volumes associated with combined grey water, storm water and other wastewater steams) in order to determine whether this facility would be captured under the new wastewater regulations.

## RESPONSE:

The Partnership is aware of the new Wastewater Systems Effluent Regulations (SOR /2012 - 139), registered on June 6, 2012. This regulation applies to wastewater systems designed to collect an average of 100 $m^3$/day or more of influent (Article 2(1a)).

It is anticipated that 46 staff will be required to operate and support the Project, of which nine will be located in Gillam (see Project Description Supporting Volume Section 4.4 Operational Workforce). At an average wastewater generation of 275 L per capita per day, a conservative assumption based on experience at the Wuskwatim project work camp, the influent is estimated to be approximately 10 $m^3$/day and the new Wastewater System Effluent Regulations would not apply.

## REFERENCE: Volume: Response to EIS Guidelines; Section 6.3.8.2 Operation Effects and Mitigation; p. 6-216

# EC-0004

## PREAMBLE:

This section outlines the following: 'Total organic material released into the reservoir is predicted to be highest in the large bays on the north and south sides of the new reservoir… These effects are considered large in magnitude, medium in geographic extent, medium term in duration and continuous.'

## QUESTION:

There is little detail provided regarding mitigation measures which may be implemented to reduce elevated levels of organic materials in the reservoir, in this section as well as Chapter 8 (Monitoring and follow-up). EC requests that the Proponent provide details regarding specific mitigation measures which will be considered and implemented to reduce elevated concentrations of organic materials in the surface water at each phase of the project. This may include but is not limited to an outline of various tools, techniques and materials.

## RESPONSE:

Effects of the flooding and disintegration of peat on water quality are discussed in Aquatic Environment Supporting Volume Section 2.5.2.2 and summarized in Section 2.5.3.2. In general, concentrations of TSS, metals, and nutrients will increase and pH will decrease in off-current flooded areas for the first 10-15 years following impoundment, with effects being greatest in the first few years. Dissolved oxygen levels will decline under some conditions, in particular in winter under ice cover. No marked effects to the water quality in the mainstem of the Nelson River are predicted as a result of flooding/disintegration of peatlands.

There are no practical and cost effective measures to reduce elevated concentrations of organic suspended sediment in the off-current flooded areas. A potential mitigation measure would be to remove the peat prior to reservoir impoundment; however, this option is not practical. Since there are not marked effects on water quality in the mainstem of the Nelson River, mitigation measures to reduce the impacts on organic suspended solids in the mainstem of the Nelson River are not planned.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section 2.5.1.1.8 Concrete Batch Plant Effluent and Aggregate Wash Water; p. 2-44

# EC-0005

## PREAMBLE:

This section states the following: 'Wastewater effluent, including concrete processing wastewater, will not be directly released to a waterbody unless it has been treated to meet applicable provincial and federal effluent licences, authorizations and permits.'

## QUESTION:

EC requests that the Proponent clarify if domestic wastewater and concrete processing wastewater will be combined into the same stream.

## RESPONSE:

Domestic wastewater and concrete processing wastewater will not be combined into the same stream.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section 2.5.1.1.8 Concrete Batch Plant Effluent and Aggregate Wash Water; p. 2-44

# EC-0006

## PREAMBLE:

This section proceeds to outline the following: 'Wastewaters from concrete processing (i.e., concrete batch plant effluent) will be initially discharged to a two-cell settling pond to reduce TSS prior to discharge to the lower Nelson River and apply end-of-pipe discharge criterion of less than 25 mg/L for TSS… TSS currently ranges (on average) between 15 and 18 mg/L in the Keeyask area and discharge of the concrete batch plant effluent or aggregate wash water is predicted to cause a negligible change in TSS in the Nelson River.'

## QUESTION:

The main concern discussed regarding concrete wash water is elevated levels of TSS. Consideration should be given to the potentially deleterious effects that concrete wash water could have on the aquatic environment due to its strong alkalinity. Other contaminants associated with concrete wash water (such as chromium) will not be completely removed simply through settling ponds. EC requests that the Proponent:

- Provide a detailed outline of mitigation measures to be followed for surface runoff and wastewater control.
- Develop and provide alternative and more rigorous mitigation measures for the treatment of concrete wash water if shown to be warranted by testing of discharge quality.

## RESPONSE:

Nearly all effluent from the concrete batch plant will be water used to wash concrete aggregate. The aggregate wash water does not come into contact with cement or concrete. The wash water will contain the fine particles and dust that naturally occurs on the aggregate in-situ. The aggregate wash water will not be highly alkaline or contain other contaminants such as chromium. Measures to improve the water quality of aggregate wash water in order to meet water quality objectives other than total suspended solids (TSS) are not expected to be required.

Concrete wash water, the relatively small amounts of water used to wash out concrete trucks and the concrete batch mixer, will be contained on-site and treated to meet turbidity and pH requirements prior to discharge. Turbidity will be treated by settlement or filtration; pH will be treated by use of acid, dry ice, carbon dioxide gas or other

methods. The contractor may elect to use a washout treatment unit, which typically uses carbon dioxide for treatment or may use other methods of treatment.

The contractors will be responsible for developing drainage management plans. Specifications for these plans are outlined in the Construction Environmental Protection Plans for this project.

Project Description Supporting Volume Section 3.1 outlines how wastewater will be treated during the construction phase of the Project. Section 4.6.7 outlines how wastewater will be treated during the operating phase of the Project.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 2.0 Water and Sediment Quality, Table 2-11 Construction-related activities, potential effects to water quality, and proposed mitigation measures; p. 2-135**

# EC-0007

## PREAMBLE:

Table 2-11 outlines that water treatment plant backwash will be treated if required, such that TSS will be less than 25 mg/L prior to discharge to the receiving environment.

## QUESTION:

EC requests the Proponent provide a full characterization of discharges to ensure they are not deleterious; noting that TSS should not be the only discharge parameter to be assessed against water quality objectives.

## RESPONSE:

The water treatment plant will be licensed by Manitoba Conservation and Water Stewardship and will be operated according to its Manitoba *Environment Act* licence. It is the Partnership's understanding that potentially harmful substances will be evaluated by Manitoba Conservation and Water Stewardship during the licensing process.

## REFERENCE: Volume: Response to EIS Guidelines; Section 6.3.7.2 Operation Effects and Mitigation; and Table 6-19 Summary of Mitigation and Residual Effects on Valued Environmental Components for the Aquatic Environment; p. 6-209, 6-211,6-294

# EC-0008

## PREAMBLE:

Section 6.3.7.1 states that: 'Cofferdam designs, construction methodology and sequencing have been developed to minimize erosion and sediment inputs during construction. For example, fine cofferdam material exposed to erosion (waves, flow) would be covered with rock to prevent erosion. The residual construction effects associated with shoreline and erosion processes are expected to be small in magnitude, medium in geographic extent, short-term and sporadic during the construction period.' Similarly Section 6.3.7.2 states that: 'Shoreline erosion will expand the reservoir by an additional 7 to 8 km² (2.7 to 3.0 mi²) during the first 30 years of operation due to mineral bank erosion and peatland disintegration… The effects of the Project on shoreline erosion are considered to be large in magnitude, medium in geographic extent, and long-term in duration.' Table 6-19 outlines mitigation measures to reduce TSS and erosion during construction and operation. Construction Mitigation includes: Measures to control sediment releases; and Management measures to maintain inputs at levels that are not harmful to aquatic life. Operation Mitigation includes: No mitigation required.

## QUESTION:

EC requests that the Proponent provide additional information on the mitigation measures to be carried out to minimize shoreline erosion, reduce soil loss and adverse impacts to water quality and the river bed during this project.

## RESPONSE:

A preliminary In-stream Construction Sediment Management Plan (SMP) will be provided to regulatory agencies in the first quarter of 2013 (see also response to CEAA-0011). The SMP includes an Adaptive Action Plan that will be implemented when target levels for total suspended solids are reached. The SMP also includes a summary of the in-stream construction activities, their potential effects and the associated mitigation measures that could be implemented to avoid or reduce sediment in the river.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.3 Effects & Mitigation Physical Environment; 6.3.8 Sedimentation; Section 6.3.8.1 Construction Effects and Mitigation; p. 6-214

# EC-0009

## PREAMBLE:

This section outlines the following: 'As noted in the Shoreline Erosion section (Section 6.3.7.1), cofferdam designs, construction methodology and sequencing have been developed to minimize the introduction of sediment into the water. For example, cofferdam removal would be done “in the dry” as much as reasonably practical to prevent sediment entering the water. '

## QUESTION:

The uses of cofferdam designs and construction methodology (‘in the dry’) are good examples of general approaches to mitigating against shoreline erosion however there is still little detail provided on a full range of design and construction techniques and tools which could be considered throughout construction, operation and decommissioning. EC requests that the Proponent provide more detail regarding specific mitigation measures for each phase of the project (construction, operation and also decommissioning), including but not limited to an outline of various tools, techniques and materials which will be used to reduce erosion and a detailed description of how each will indeed mitigate against erosion.

## RESPONSE:

A preliminary In-stream Construction Sediment Management Plan (SMP) will be provided to regulatory agencies in the first quarter of 2013 (also see response to CEAA-0011). The SMP includes an Adaptive Action Plan that will be implemented when target levels for total suspended solids are reached. The SMP also includes a summary of the in-stream construction activities, their potential effects and the associated mitigation measures that could be implemented to reduce erosion in order to avoid or reduce sediment in the river.

No further mitigation is planned for erosion during the operations phase.

## REFERENCE: Volume: Response to EIS Guidelines; Section 6.3.8.1 Construction Effects and Mitigation & Chapter 8, Table 8-3 Monitoring and Follow-up Plans for the Aquatic Environment; p. 6-214 & 8-13

# EC-0010

## PREAMBLE:

Section 6.3.8.1 outlines the following: 'A Sediment Management Plan will be in place during construction and will describe where monitoring is to be done and what actions might be taken if suspended sediment increases beyond specified thresholds… Monitoring of suspended solids and turbidity will be done at several locations upstream and downstream of the Project as part of physical environment monitoring plan (see Chapter 8). Monitoring under the Sediment Management Plan would only be in place during construction and is separate from the physical environment monitoring.' Table 8-3 also describes the monitoring regime for managing sediment and maintaining water quality.

## QUESTION:

The information provided in chapters 6 and 8 does not specifically outline where sampling and monitoring will take place along the Nelson River and what actions might be taken if suspended sediment increases beyond specified thresholds. EC requests that the Proponent:

- Provide more details in the Sediment Management Plan which includes, but is not limited to, proposed sampling locations (illustrated on a site plan, relative to proposed infrastructure), number of sampling locations, sampling and monitoring frequency, sampling parameters, type of samples to be collected, time of year sampling will take, and sampling methodology, detailed erosion and sedimentation prevention strategies, measures that will be used for reservoir preparation, best practices, and identify linkages to adaptive management, as required for a comprehensive Sampling Management Plan.
- Identify mitigation measure to be taken in the event of water quality exceedances. These details should be provided for each phase of the project (construction, operation and decommissioning).

## RESPONSE:

### Part A:

The Preliminary In-Stream Construction Sediment Management Plan (SMP), which is to be provided to regulatory agencies in the first quarter of 2013, will describe monitoring to take place to determine if in-stream construction activity causes suspended sediment

to increase beyond target levels. It also describes primary and secondary mitigation strategies.

Reservoir preparation is described in the Response to EIS Guidelines Chapter 4, Section 4.6.3. The description summarizes the Reservoir Clearing Plan that forms part of the Joint Keeyask Development Agreement (Schedule 11-1), and is also provided in Chapter 4 Appendix 4A. The plan is also described in the Physical Environment Supporting Volume Section 6, Debris (Section 6.3.11.1 Construction Effects and Mitigation). Section 4.6.3 of the Response to EIS Guidelines indicates that "standing woody material, which includes dead and living trees and shrubs 1.5 m tall or taller, as well as all fallen trees 1.5 m or more in length with a diameter of 15 cm or greater at its largest point, will be cleared." The Reservoir Clearing Plan should be referenced for a more complete description.

**Part B:**

Mitigation measures in response to increased Total Suspended Solids (TSS) due to in-stream construction will be noted in the SMP. CEAA-0011 provides information about the Partnership's environmental protection program, including the SMP. The Partnership intends to provide a preliminary version of that report to regulators in the first quarter of 2013.

During operation there will be an overall decline in mineral TSS, therefore no mitigation is required. Organic TSS will increase in the first year after impoundment in back bays, primarily due to peat resurfacing rather than breakdown of peat shorelines. Peat resurfacing is substantially lower in subsequent years. Predicted additional organic TSS is less than 5 mg/L in all areas of the reservoir in year two after impoundment and decreases to 1 mg/L or less by year five (Physical Environment  Supporting Volume Section 7.4.2.3). See response to EC-0004 for measures to mitigate peat.

A decommissioning plan has not been prepared for the Keeyask Project. As noted in the Project Description (Response to EIS Guidelines Chapter 4 Section 4.8 Decommissioning), "A hydroelectric generating station may operate almost in perpetuity. If decommissioning is required at some future date, it will be undertaken according to the legislative requirements, existing agreements and industry standards prevalent at that time." The project life is so long that any plans for decommissioning activities and associated environmental mitigation at this time would be out of date well before the activity takes place.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.2.3 Peat Sedimentation - Upstream of Project; p. 7-37

# EC-0011

## PREAMBLE:

Erosion of peatlands will result in the transportation and sedimentation of peat materials in the reservoir. The Proponent has identified peat transport zones and estimated volumes of material that would be mobilized over timelines up to 30 years. The EIS predicts some 1.3 million tones of peat within the reservoir, of which 10,000 to 13,000 tonnes are expected to travel downstream after year 1 if no peat management measures are implemented.

## QUESTION:

EC requests that the Proponent identify the peat management measures that will be undertaken; how peat inputs, behaviour and effects will be monitored over the operation of the project; and what and when adaptive management actions will be used as a contingency should effects be detected.

## RESPONSE:

Note: this question is similar to DFO-0059, DFO-0071 and EC-0004.

A Physical Environment Monitoring Plan (PEMP) is being developed that includes a number of components pertaining to sediment monitoring for both mineral and organic sediments and floating peat mats. The PEMP will include erosion monitoring at select locations in the reservoir and periodic mapping of the reservoir shoreline location (e.g., from aerial imagery). The monitoring will help identify the rate of reservoir expansion, where peatland disintegration and shoreline erosion are occurring, and where floating/mobile peat is accumulating in the reservoir. CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary PEMP. The Partnership intends to provide a preliminary version of that report to regulators in the second quarter of 2013.

Suspended sediment and deposition monitoring will also be undertaken, as further described in the response to DFO-0059. The response to DFO-0059 also provides discussion regarding the 10,000-13,000 tonnes (about 1% of the referenced 1.3 million tonnes) of peat transported downstream referenced in the above preamble.

The Aquatic Environment Monitoring Plan (AEMP) is also being developed and will include a number of components pertaining to monitoring the effects of sediment on the aquatic environment. See DFO-0015 for additional information.

The Waterways Management Program (JKDA, Schedule 11-2; also provided in Response to EIS Guidelines, Chapter 4, Appendix 4B) includes management of peat debris that represents a hazard to navigation in both the Keeyask reservoir and downstream. Please see response to EC-0004 for further discussion regarding mitigation measures related to organic sediment.

**REFERENCE: Volume: Physical Environment Supporting Volume; Section: 6.4.2.1.5 Peat Resurfacing and Floating Peat Mat Mobility, Section 7.4.2.3 Peat Sedimentation - Upstream of Project , Section 9.2.1.2 Approach to Predicting Project Effects; p. 6-56, 7-35, 9-6**

# EC-0012

## PREAMBLE:

As peatland is flooded, floating peat mats will rise up with the rising water, and may be mobile within the reservoir. Organic sedimentation is expected to occur beyond the modeled 30 year horizon, but at reduced rates. The peat mats are predicted to sink to the bottom in some cases, and become overlain with silt. Predictions have been made respecting the effects on dissolved oxygen levels, due to decomposition of the organic material. Other changes to water quality may be associated with the addition of the peat materials.

## QUESTION:

EC requests that the Proponent:

- Describe the potential for further changes to the water chemistry in the reservoir, such as a drop in pH, concomitant increase in metals, increased color due to organic matter;
- Confirm if "worst case" volumes of peat addition have been taken into account with respect to estimating mercury methylation;
- Provide estimates of depth of lakebed to be covered.

## RESPONSE:

Effects of peatland disintegration and flooding (as well as other potential pathways of effects during the operation period) on water quality are described in detail in the Aquatic Environment Supporting Volume, Section 2.5.2.2. This assessment included a detailed analysis of effects on metals, pH, colour, etc. associated with the organic materials.

Mercury methylation rates were not estimated and the potential effect of peat addition on mercury methylation rates was not assessed for the estimate of expected maximum mercury concentrations in fish and the duration of elevated concentration. Maximum fish mercury levels were estimated from empirical models. One of the two models used (Johnston et al. 1991) is based on the relationship between percentage reservoir flooding and fish mercury concentrations for 21 reservoirs and lakes from northern Manitoba. A full description of the assessment approach and the model parameters is provided in the Aquatic Environment Supporting Volume, Appendix 7E. The duration of

elevated fish mercury concentrations in the Keeyask reservoir and Stephens Lake was also based on published empirical data for almost 20 reservoirs in northern Manitoba and Québec.

Please see response to DFO-0072 for effects to aquatic habitat, including areas of organic substrate in the long term (30 years post-impoundment). Please refer to responses to NRCan-0018 and NRCan-0019a for the relationships between peat disintegration, mercury methylation, and mercury concentrations in water and fish.

## Reference:

Johnston, T.A., R.A. Bodaly, and J.A. Mathias. 1991. Predicting fish mercury levels from physical characteristics of boreal reservoirs. Canadian Journal of Fisheries and Aquatic Sciences 48: 1468-1475.

**REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.6 Environmental Monitoring and Follow-Up and January 24th Monitoring Presentations; p.7-43**

# EC-0013

## PREAMBLE:

Real time monitoring of TSS will be done using turbidity as a surrogate. This is a commonly accepted practice, as it provides immediate data for management response. However, the relationship between TSS and turbidity must be determined on a site-specific basis, and be calibrated and validated as the project proceeds.

## QUESTION:

EC requests that the Proponent revise the sediment management plan to include a section that details monitoring of turbidity and TSS, including development of the regression model, calibration with field data, and ongoing validation and QA/QC.

## RESPONSE:

The preliminary In-stream Construction Sediment Management Plan (SMP) will describe monitoring that will take place to measure if in-stream construction activity causes suspended sediment to increase beyond target levels. One section will describe the turbidity monitoring (methods, locations) and maintenance of the monitoring equipment, including collection of discrete water samples for total suspended solids (TSS) measurement.

Another section of the SMP will identify the regression equation to be used. As currently drafted, it notes, “During in-stream work, samples of water at the monitoring stations will be periodically collected and analysed for TSS to confirm or adjust the Tu (turbidity)-TSS relationship, as required.” The turbidity and TSS relationship is a regional relationship developed using data collected in the study area during 2007-2009 at sites from Clark Lake to Stephens Lake (also see response to DFO-0084).

The SMP is intended to serve as a guidance document for the onsite Environmental Officers in order to implement the monitoring program. It provides guidance on such things as where monitoring will be done and steps to be taken in response to TSS increases that exceed specified thresholds. Details on the technical analysis performed to develop the Tu-TSS relationship are beyond the scope of the SMP since the Environmental Officers do not require this information to implement the plan.

The Tu-TSS relationship will be validated using TSS test results for water quality samples obtained during routine maintenance of the SMP loggers. Maintenance will occur approximately every 2 weeks. The relationship will be revised if necessary during

construction and would be based on the samples collected as part of the routine maintenance activities.

CEAA-0011 provides information about the Partnership's environmental protection program, including the SMP. The Partnership intends to provide a preliminary version of that report to regulators in the first quarter of 2013.

## REFERENCE: Volume: N/A; Section: Proponent's Presentation January 24th, Slide 15; p. N/A

# EC-0014

## PREAMBLE:

Background TSS is estimated to average 10-20 mg/L.

## QUESTION:

EC requests that the Proponent describe the dataset and method used to determine the background value of 20 mg/L.

## RESPONSE:

The question refers to the assumed background value in Chart 7.4-1 in Section 7 of the Physical Environment Supporting Volume. Physical Environment Supporting Volume Section 7.3.1.2, describes the data set used to develop existing environment sediment conditions downstream of Gull Rapids.

As noted in the response to question DFO-0064, the assumed background of 20 mg/L in the chart of results was chosen for illustrative purposes to demonstrate how much of an increase occurs from an assumed background for the different construction activities. The assumed background of 20 mg/L is close to the existing environment average Total Suspended Solids (TSS) of about 14 mg/L at a site downstream of Gull Rapids (Physical Environment Supporting Volume, Section 7.3.2.1, Table 7.3-2).

## REFERENCE: Volume: Response to EIS Guidelines; Section: Table 8-3 Monitoring and Follow-Up Plans for the Aquatic Environment; p. 8-14

# EC-0015

## PREAMBLE:

Monitoring is described in general terms in Table 8-3. In addition, presentations made by the Proponent described proposed construction phase monitoring. In presentations on the proposed monitoring (April 11, 2012), it was proposed that there would be 3 sites for construction monitoring with thresholds set for mitigation actions to be taken. The sites include an upstream location (Site 1), downstream location (Site 2) and site near the outflow of Stephens Lake (Site 3). Turbidity will be monitored as a proxy for total suspended solids (TSS) and be compared to thresholds: increases at Site 2 of 25 mg/L above Site 1 for 1 hour would trigger investigation; increases of 200 mg/L above Site 1 would trigger mitigative action, and increases at Site 3 of 25 mg/L above Site 1 would trigger action.

## QUESTION:

Concerns with the proposed monitoring have been identified: The proposed sites allow for a considerable area of Stephens Lake to experience elevated TSS before triggering action. Monitoring Site 2 is sited well below the construction activity, and should be closer to the area of disturbance. Changes to Site 3 as proposed would mean that most or all of Stephens Lake had elevated TSS and turbidity. EC requests that the Proponent provide further clarification of the proposed monitoring. EC requests that the Proponent develop a monitoring plan that identifies the effects associated with construction and operation of the proposed facility and planned mitigation. The plan should describe the sites to be monitored, timing, how comparisons to baseline will be drawn, identify thresholds that will trigger action, and provide details of how the field monitoring will be done, including quality assurance/quality control measures.

## RESPONSE:

Please refer to response to question DFO-0067 for more information on the location of monitoring site 2 (site SMP-2).

CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary In-stream Construction Sediment Management Plan (SMP). The Partnership intends to provide a preliminary version of that report to regulators in the first quarter of 2013.

The SMP describes the monitoring that will take place to measure effects of in-stream construction activity on total suspended solids (TSS). It presents mitigation strategies to reduce the effects of construction on TSS. The SMP describes how the monitoring will be done, including routine maintenance and discrete sampling that will be used to check equipment and verify the relationship between turbidity and TSS. The SMP identifies the sites that will be monitored, which include site 1 (SMP-1) immediately upstream of construction and site 2 (SMP-2) about 1.5 km downstream of the in-stream construction. The location of the third site (SMP-3) was moved in response to comments from regulators. The revised location is approximately 9 km downstream of the Project site in Stephens Lake.

A Physical Environment Monitoring Plan (PEMP) is also being developed that will include a number of components pertaining to sediment monitoring during construction and operation. CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary PEMP. The Partnership intends to provide a preliminary version of that report to regulators in the second quarter of 2013.

**REFERENCE: Volume: Project Description Supporting Volume; Section: 2.5.1.1 Measures in Joint Keeyask Development Agreement and Adverse Effects Agreement, R-EIS Guidelines 6.2.3.3.6 Mercury, Palatability and Cysts in Fish 8.2 Overview of Monitoring Activities; p. 2-37, 6-76, 8-9**

# EC-0016

## PREAMBLE:

The Proponent acknowledges that there will be increases in mercury associated with the reservoir impoundment, and states that there is no mitigation available. Levels are predicted to rise for a period of time before stabilizing then declining, over the order of three decades. Maximum concentrations do not appear to be provided.

## QUESTION:

EC requests that the Proponent conduct an assessment of downstream effects associated with mercury methylation including: - identifying pathways for mercury throughout the food web, and incorporating lessons learned from the other hydroelectric projects; - baseline mercury data collection in water, sediments and biota; - revise modeling taking into account additional pathways, and particularly mercury accumulation in the benthos to predict the fate of mercury in the downstream environment; and - identification of any additional mitigation or adaptive management measures.

## RESPONSE:

Downstream effect of reservoir creation on fish mercury concentration are discussed briefly in Section 6.4.7.1.2 of the Response to EIS Guidelines and in more detail in Aquatic Environment Supporting Volume Section 7.2.4.2.2, including potential pathways and experiences from other hydroelectric projects. The assessment of downstream effects is based on an empirical model that takes into account baseline mercury concentrations in fish and best scientific judgment accounting for the specific conditions of the Project.

There are several statements that indicate a misunderstanding between Environment Canada and the Partnership regarding mitigation measures and estimates of mercury concentration.

A description of baseline mercury concentrations in surface water is provided in the Aquatic Environment Supporting Volume, Sections 2.4.1 and 2.4.2 and Appendix 2J. A description of baseline mercury concentrations in sediments is provided in the Aquatic Environment Supporting Volume Sections 2.6.3.1 and 2.6.3.2.

The potential pathways of effect that could impact human health were a key focus of the assessment and are discussed in Section 6.6.5.3 of the Response to EIS Guidelines and in Part 1; Section 5.4.2.3 of Socio-Economic Supporting Volume. These sections also outline the mitigation measures and adaptive management approach to be implemented by the Partnership throughout project development and operation.

A detailed discussion of mercury in fish is provided in Section 6.4.7.1 of the Response to the EIS Guidelines.

Note that estimates of maximum fish mercury concentrations are provided in detail in Section 6.4.7.1.2 of the Response to EIS Guidelines.

## REFERENCE: Volume: Response to EIS Guidelines; Section: Table 8-3 Monitoring and Follow-Up Plans for the Aquatic Environment; p. 8-14

# EC-0017

## PREAMBLE:

The proposed monitoring includes sampling of fish for gill histology if peak sediment inputs exceed target levels. EC suggests that non-lethal techniques be investigated for use in evaluating the effects of elevated TSS on fishes; detection of effects associated with exceeding TSS thresholds may also be approached in a tiered fashion.

## QUESTION:

EC requests that the Proponent provide details on monitoring that would be done in response to threshold exceedance, and the rationale for what is proposed. If levels in water approach thresholds for action, EC requests that the Proponent investigate effects on sediments and benthos should there be extended exposure to and settling out of particulate matter. DFO should be consulted on the advisability of sampling fishes.

## RESPONSE:

A preliminary Aquatic Effects Monitoring Plan (AEMP) will be provided to regulators for review in the second quarter of 2013. During construction, there will be annual monitoring of benthic invertebrates. Sampling will be conducted upstream and downstream of construction activities and would provide a means for monitoring effects associated with increases in Total Suspended Solids (TSS) as well as other pathways of potential effect. As sedentary organisms, benthic invertebrates are believed to be an appropriate and sensitive indicator for monitoring the effects of increased TSS. This monitoring will occur regardless of the recorded increases in TSS, i.e., no threshold is required.

Based on predicted increases in TSS (typically less than 25 mg/L in the fully mixed zone of the river), no tissue sampling of fish is planned since the magnitude and duration of TSS increases is not likely to cause a detectable effect.

**REFERENCE: Volume: Response to EIS Guidelines; Section: 6.5 Effects and Mitigation Terrestrial Environment; 6.5.7 Birds; p. 6-362**

# EC-0018

## PREAMBLE:

The Proponent has not included a discussion or impact assessment regarding these risks associated with lighting and collision; could find no reference to these in the EIS.

## QUESTION:

EC requests that the Proponent provide information regarding any design and mitigation measures that have been incorporated to minimize the adverse effects of lighting. EC also requests further information regarding the communication tower, and any other features planned for the project site that may create a specific collision hazard for migratory birds, as well as on the proponent's proposed mitigation measures to minimize the risk of collisions.

## RESPONSE:

The Partnership assumes that the above question is being raised regarding the concerns of birds flying into a lighted tower. Communications towers in the U.S. kill 6.8 million birds annually (Stoffels, 2012). These towers are often much taller than the approximately 40m tall permanent communications tower at Keeyask. The 6.8 million is a large number, but nothing near the one billion birds that die annually from flying into buildings (Stoffels, 2012).

It is known that certain types of lighting attract birds more readily than other types. A recent study in northern Michigan revealed that steady-burning red lights are the most likely to attract birds and cause bird fatalities (Patterson, 2012). The FAA in the U.S. has adopted a new tower lighting guideline to reduce the number of bird collisions (Petro, 2012). These new guidelines allow the use of flashing red lights in place of the steady burning red lights.

Towers along waterbodies can be an added risk for migrating birds as birds often use waterbodies to navigate along on their migration route. This is not likely to be the case at Keeyask as the reservoir will be at right angles to the migration path and the birds are expected to fly directly across the water. In some years, large numbers of birds stopover at Keeyask during migration. These are usually waterfowl that frequent areas away from Gull Rapids, so they will not likely be near the generating station.

The issue with birds flying into buildings is usually associated with the large, well lit skyscrapers in cities. The buildings of the Keeyask Generating Station should not constitute a risk to migrating birds.

The currently planned permanent communications tower will be a self supporting 30m or 40m steel tower located on top of the powerhouse building, with an approximate total height of 100m and is unlikely to require lighting as the structure is far away from any regulated flight path; however, station management typically installs minimum lighting for better poor weather visibility for private and contract air craft.

## REFERENCES:

Stoffels 2012. Stoffels, Bob. For the Birds – in OSP online magazine accessed at: http://www.ospmag.com/issue/article/092012-Stoffels

Patterson, 2012. Patterson Jr., James W. Evaluation of New Obstruction Lighting Techniques to Reduce Avian Fatalities. Federal Aviation Administration

Petro 2012. Petro, Lee. FAA Adopts New Tower Lighting Guidelines. Radio – the Radio Technology Leader. Accessed online at: http://radiomagonline.com/fcc/faa_adopts_new_tower_lighting_guidelines_0626/

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.5.7.7.3 Colonial Waterbirds; p. 6-362

# EC-0019

## QUESTION:

In this section the Proponent has proposed the following mitigation in response to the loss of gull and tern breeding habitat: "Deployment of artificial gull and tern nesting platforms (e.g., reef rafts), breeding habitat enhancements to existing islands (e.g., predator fencing or placement of suitable surface substrate), and/or development of an artificial island, or a combination of these measures, will be implemented to off-set the loss of gull and tern nesting habitat at Gull Rapids and areas upstream."

EC requests that the Proponent provide additional information regarding each mitigation measure (i.e., for artificial nesting platforms, island enhancements, or development of artificial islands), including information regarding the design, placement, development and implementation of each measure. EC also requests that the Proponent identify the decision-making process by and situations in which they would choose to a) deploy an artificial nesting platform, b) enhance an existing island, c) develop an artificial island, or d) implement a combination of these measures. Annually during the first three years of operation or until mitigation measures are deemed to be successful.

## RESPONSE:

Details about the mitigation measures to offset the loss of gull and tern nesting habitat at Gull Rapids and areas upstream are limited at this time. A detailed plan with design, placement, development and implementation for this project will be developed at a later date and reviewed with regulators. Conceptual information has been developed regarding each potential mitigation measure (i.e., for artificial nesting platforms, island enhancements, or development of artificial islands), as described below. Additionally the Terrestrial Environment Monitoring Plan (Response to EIS Guidelines, Chapter 8, Table 8-4 Monitoring and Follow-Up Plans for the Terrestrial Environment) includes monitoring of colonial waterbirds to determine effectiveness of mitigation measures implemented. If initial mitigation measures are not functioning as planned, for colonial waterbirds modifications and/or additional measures will be considered.

**Artificial Nesting Platforms**: These floating platforms are most often deployed to encourage nesting by terns and have been utilized successfully in Toronto Harbour, the UK and Wisconsin, among other areas (Brennan 2009; BTCV 2009; Jarvie and Blokpoel 1996, Lampman et.al 1996). This mitigation measure involves the construction of platforms, deployed in calm backwater bays in the Keeyask reservoir, within a few

kilometres upstream of the generating site to permit tern foraging directly downstream of the generating station.

**Nesting Island (or Peninsula) Enhancements**: These enhancements are to be installed in areas where the existing nesting reefs occur at Gull Rapids. Since the area below Gull Rapids is currently inaccessible and cannot be surveyed/assessed, it is unknown what the exact configuration of the land below the generating station will be post construction. Once the conditions below the Generating Station axis have stabilized, areas will be identified to implement the enhancement measures. The areas to be enhanced will either be islands or peninsulas that can be isolated with the use of predator fencing. The purpose is to keep land-based predators out of the nesting areas.

**Artificial Nesting Island:** If monitoring confirms that it is warranted and feasible a constructed island will be developed in the new reservoir in relatively close proximity to the Generating Station. It would be constructed in an area of relatively shallow water (i.e., on a high point of land) prior to filling the reservoir. Construction of the island would involve the placement of granular material suitable for nesting habitat, likely as a cap over clay or impervious fill, with the sides of the island being heavily rip-rapped to protect against ice damage. Construction of an artificial island would be a more expensive alternative to the previous two options.

## References:

Brennan, 2009: Floating Island Created for Nesting Birds in Anaheim; Living Green in Orange County, June 24, 2009.

British Trust for Conservation, 2009: BTCV Handbook – Waterways & Wetlands; Chapter 11 Islands & Rafts.

Jarvie, Blokpoel, 1996. Reefrafts for Common Terns and Fish – Guidelines for Design, Construction and Operation.

Lampman K., Taylor M. & Blokpoel H. (1996) Caspian terns (*Sterna caspia*) breed successfully on a nesting raft. Colonial Waterbirds, 19, 135-138.

RSPB (The Royal Society for the Protection of Birds),2012 Artificial islands http://www.rspb.org.uk/ourwork/conservation/advice/islands/index.aspx

**REFERENCE: Volume: Response to EIS Guidelines; Section: Table 6-14 Keeyask Road Transport Activities Table 6-15 Emission Estimates for Keeyask Site Clearing Compared to Emission Estimates for Manitoba Road Transport (2006) Table 6-16 Emission Estimates for Keeyask Dam and Generation Facilities Construction Co; p. 6-196, 6-197, 6-198**

# EC-0020

## PREAMBLE:

The emissions estimates are compared to the total Manitoba road transport emissions. Comparing all of Manitoba to the emissions generated at the Project site don't appear to match in scale.

## QUESTION:

EC requests that the Proponent provide an explanation as to why a provincial scale was used for comparison with this project.

## RESPONSE:

Baseline air quality data for the study area are not available, and review of Manitoba Conservation's historical data holdings in publicly available Manitoba Ambient Air Quality Annual Reports does not provide applicable baseline air quality monitoring locations that would be useful for application in specific air quality assessment. The closest provincial air quality monitoring station is located in Thompson, Manitoba. The City of Thompson possesses industrial activity that does not take place within the Keeyask Study Area, rendering Thompson as inappropriate for use as surrogate baseline air quality data for application in an assessment of air quality in a remote and low population density location.

To place the estimated emission loadings for the Keeyask Generation Project road transportation and site clearing into some context of magnitude, an illustrative comparison of estimated Keeyask Project loadings was made. Keeyask Project atmospheric loadings were compared with emission loadings that already occur, as generated by the Road Transport Sector in Manitoba.

In the Physical Environment Supporting Volume (Section 3.4.1.1.4, Construction of Keeyask Dam and Generation Facilities) an additional comparison is made for context, listing annual Keeyask construction emission loadings compared to annual diesel bus emission loadings within the City of Winnipeg for a single year. This represents a smaller geographic region than a provincial scale for comparison with Keeyask Local Study Area construction activities, and is an accepted annual loading within the City of Winnipeg

resulting from operation of diesel buses within city limits. It is demonstrated that estimated Keeyask construction annual loadings will remain well below annual loadings to the local airshed in Winnipeg resulting from continuous use of diesel buses in Winnipeg in a given year.

Given the context of the Project's road transport activities, it is expected that these will not result in significant emissions of air contaminants that might negatively affect the local population in the vicinity of the project site and the Keeyask Project's materials transport routes.

Contractors operating within the Keeyask Study Area will be required to take reasonable steps to minimize air emissions from project activities as per the Construction Environmental Protection Plans to be provided to regulators in the first quarter of 2013.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Table 3.4-2 Emission Estimates for Keeyask Site Clearing Compared to Emission Estimates for Winnipeg Bus Diesel Use (2006); p. 3-9 and 3-11

# EC-0021

## PREAMBLE:

This section states that: 'The maximum potential daily loading due to Keeyask road transport for each reported air contaminant is "small in comparison" to daily emission loadings derived from total emissions reported to NPRI (2009) for all road transport activities in Manitoba.' Also, by using table 3.4-2, EC calculated that the estimated total SOx, NOx & PM emissions from the project are 13.3%, 1.6% and 1.4% respectively of the total Manitoba road transport emissions.

## QUESTION:

EC requests that the Proponent provide further clarification on the criteria being used to determine the definition of a 'small' in this context.

## RESPONSE:

Section 3.4.1.1.2 (Physical Environment Supporting Volume) provides detail that includes a number of assumptions intended to generate conservative (i.e. higher than actual expected) emissions estimates. These assumptions include conservatism built into aspects such as:

- Emissions estimates are based upon summer peak daily trip values (highest possible trip values in a given construction year)
- All vehicular traffic is assumed to be heavy duty commercial vehicles/trucks (HDCV class greater than 4.5 tonnes)
- Applying city fuel efficiency rates for HDVC vehicle class, rather than highway driving fuel efficiencies as reported by Transport Canada.
- Maximum Peak Daily Emissions are assumed to occur daily over a 365 day per year schedule
- Keeyask emissions were assumed to be in the Keeyask Local Study Area. In reality the emissions will be distributed across a much wider area that would include supply routes outside the Local Study Area (e.g., road transport from Winnipeg to the site).

In actual operation of these vehicles during the construction phase, we expect the emissions generated by construction activity to be less than the conservative estimate as reported. Consequently, we predict the categorization of the impact to air quality

generated by Keeyask road transport to be “small” in the category of geographical extent, low in magnitude, short term in duration and intermittent in frequency.

**REFERENCE: Volume: Physical Environment Supporting Volume; Section: 3.4 Project Effects, Mitigation and Monitoring; 3.4.1 Construction Period; 3.4.1.1 Air Quality Effects During Construction; 3.4.1.1.4 Construction of Keeyask Dam and Generation Facilities; Table 3.4-4 Emission Estimates for Keeyask Dam and Generation Facilities Construction Compared to Emission Estimates for Winnipeg Bus Diesel Use (2006); p. 3-11 and 3-12**

# EC-0022

## PREAMBLE:

This section further states that: 'Annual emissions associated with dam and facility construction are estimated to be highest for NOx at 382 tonnes per year; however, this is still less than 1% of the annual NOx loading estimate for road transport within the entire province.' This is true for the number of tonnes, but both PM10 and SOx emissions have a higher percentage when compared to the 2009 emissions for MB road transport of 1.0% and 9.2% respectively.

## QUESTION:

EC requests that the Proponent provide clarification as to why they did not develop mitigation measures for SOx emissions.

## RESPONSE:

SOx emissions related to Keeyask construction are generated from heavy-duty diesel vehicles, heavy-duty gasoline trucks, light-duty diesel trucks, light-duty gasoline trucks, light-duty gasoline vehicles and off-road diesel consumption. At present, there are no practicable alternative vehicles that would substitute for this fleet of conventional construction vehicle technology. Consequently, mitigation of SOx emissions associated with these sources is limited to operational measures such as reasonable steps to minimize excessive construction-related emissions. Contractors will be encouraged to take reasonable measures to minimize construction-related emissions (including SOx). The Generating Station Construction Environmental Protection Plan (to be provided to regulatory agencies in the first quarter of 2013; also see CEAA-0011) includes recommendations for proper maintenance of engines for efficient operation and avoidance of excessive emissions, as well as recommended practice to reduce idling of diesel and gasoline equipment to minimum practicable levels.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 3.4 Project Effects, Mitigation and Monitoring; 3.4.1 Construction Period; 3.4.1.2 Summary of Air Quality Effects During Construction; p. 3-12

# EC-0023

## PREAMBLE:

This section states that: 'Acceptable dust-control measures will be used on the roadway, as necessary, to limit the amount of airborne dust.'

## QUESTION:

EC requests that the Proponent provide the criteria that will used to determine when the dust-control measures will be implemented and whether or not they be included in the EnvPP.

## RESPONSE:

On-site safety staff will determine when dust control measures on the roadway are required in order to maintain safe conditions for workers, vehicles and equipment movement on the construction site. The South Access Road Construction Environmental Protection Plan will include measures on dust control.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Table 3.4-5 Summary of Air Quality and Noise Residual Effects; p. 3-19

# EC-0024

## PREAMBLE:

This table lists the magnitude of air quality impacts during construction as 'moderate', but in the preceding sections of text the magnitude is determined to be small.

## QUESTION:

There appears to be contradicting statements throughout this section on the magnitude of air quality impacts during construction of the Project. EC requests that the Proponent provide clarification on the prediction of air quality impacts during the construction phase.

## RESPONSE:

In Sections 3.4.1.1 through 3.4.1.2 of the Physical Environment Supporting Volume discussion of emission loadings generated by the Keeyask Project's construction phases are presented in terms of estimates for Maximum Peak Daily Emissions (tonnes/day). As no background air quality data exist for the Local Study Area, these loadings are placed into a context that relates the magnitude of Keeyask Project construction-related emissions to existing and commonly accepted atmospheric loadings. This includes commonly accepted loads resulting from industrial activities such as the road transport sector and also the loading associated with operation of diesel-powered buses within the City of Winnipeg for a specific year.

In Sections 3.4.1.1 through 3.4.1.2, the atmospheric loadings due to construction activities pertain to the following construction efforts:

- Emission loads due to construction of access roads (access roads other than the North Access Road, which was a component of the KIP submission)
- Emission loads due to transport of equipment, materials and personnel in support of Keeyask Project construction
- Site Clearing Activities
- Construction of Keeyask Dam and Generation Facilities.

Table 3.4-5 of the Physical Environment Supporting Volume, consists of a summary of Air Quality and Noise Residual Effects. For potential impacts to air quality related to activities conducted in the construction phase of the Project, a rating was assigned to consider the four construction-activity categories in an aggregated fashion. For example,

for the “Magnitude” column seen in the table below, effects are reported across the specified Construction Activity Categories with a rating ranging from “ low” to “moderate”. The highest impact rating for “Magnitude” was reported in the Physical Environment Supporting Volume Table 3.4-5 as “Moderate”.

A new table provided below (not presented in the Physical Environment Supporting Volume and presented specifically for this IR), details the specific Construction Activity Category ratings in the first four rows, and these ratings were used to assign an overall air quality effect as reported in the final row of the table below and also in Physical Environment Supporting Volume Table 3.4-5. Definitions for these ratings are provided in Section 5.5 of the Keeyask Response to EIS Guidelines document.

| Construction Activity Category | Magnitude | Geographical Extent | Duration | Frequency |
|---|---|---|---|---|
| Road Construction | LOW | SMALL | SHORT TERM | CONTINUOUS |
| Material, Equip & Personnel Transport | LOW | SMALL | SHORT TERM | INTERMITTENT |
| Site Clearing | MODERATE | MEDIUM | SHORT TERM | INTERMITTENT |
| Construction of Dam and Generation Facilities | MODERATE | SMALL | SHORT TERM | CONTINUOUS |
| AIR QUALITY EFFECT RATING AS REPORTED IN Physical Environment (SV1 Section 3.4 Table 3.4-5) for Overall Construction | MODERATE | MEDIUM | SHORT TERM | CONTINUOUS |

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 3.4 Project Effects, Mitigation and Monitoring; 3.4.6 Environmental Monitoring and Follow Up; p. 3-20

# EC-0025

## PREAMBLE:

This section states that: 'Project effects on noise and air quality related to construction are considered to be moderate in magnitude and medium in their spatial extent from construction sites, and therefore, confined to localized areas within the study area. Consequently, noise and air monitoring programs are not planned for the Project.'

## QUESTION:

EC requests that the Proponent revise their EIS to include temporary air monitoring programs during the construction phase of the Project.

## RESPONSE:

Air quality monitoring has not been proposed because: i) there are no concentrated emission sources that are likely to cause exceedances of the ambient air quality objectives and guidelines for Manitoba in the assessment area, and ii) the nearest residential communities are located 30 km or more away from most construction activities and air quality exceedances would not be expected at such large distances. Emissions from the Project are generally from sources that are distributed over a wide area and located several kilometres from receptors at the construction camp. Emissions that do occur are likely to be well dispersed over distances of several kilometres from the emission sources.

Project emissions were characterized for three main activities resulting in the greatest emissions: transport of equipment, material and personnel; clearing; and construction of the dam and generation facilities. Emissions from road transport were characterized for the peak estimated traffic day using conservative (high) estimates of emissions. It includes transport required along roads from as far as Winnipeg. Transport emissions are not anticipated to substantially affect air quality at the site since they are mobile along roads and highways located 10s to 100s of kilometres from the site, and more than 90% of total trip kilometres occur at distances of 20 km or more from the site (Physical Environment Supporting Volume, Section 3, Table 3.4-1). Site clearing activities will occur over a large area, the largest components being reservoir clearing (approx. 36 $km^2$), and roads and road corridors (approx 7 $km^2$). Additional clearing will occur at quarries, borrow areas and for other infrastructure, and total clearing will exceed 50 $km^2$. Clearing activities generally occur at distances of 3 km or more from the camp. Construction of the powerhouse, spillway and dams across the river occurs

approximately 3-5 km south of the camp. While it is anticipated emissions would disperse to low levels over the distance between this construction area and the camp, typical winds would also tend to transport emissions away from the camp. Dust emissions, primarily due to vehicle traffic on roads, will be managed through speed limits at the site and appropriate dust suppression measures as described in the South Access Road Construction Environmental Protection Plan (to be provided to regulatory agencies in the first quarter of 2013; see also CEAA-2011).

## REFERENCE: Volume: Socio-Economic Environment Supporting Volume; Section: Appendix 5C: Human Health Risk Assessment (HHRA); p. 5C-1; and Terrestrial Environment Supporting Volume; Section: 8.0 Wildlife and Mercury; p. 8-1

# HC-0001

## PREAMBLE:

Critical review of the HHRA: The baseline mercury levels in moose and snowshoe hare were not obtained from data collected in the Keeyask region but rather from data collected outside of Manitoba. The use of off-site data increases the degree of uncertainty in the conclusions presented in the HHRA regarding human exposures to this contaminant. The HHRA recommends monitoring mercury levels in wild game so data that is representative of the impacted region is obtained.

## QUESTION:

HC supports the recommendation in the HHRA that the monitoring of wild game be undertaken. This information would serve to validate some of the assumptions used in the HHRA (e.g., off-site data for moose and snowshoe hare) and also beneficially serve as baseline data for future Keeyask HHRAs and the assessment of risk related to other hydro generation projects planned within in the region (e.g., Conawapa).

## RESPONSE:

The Partnership acknowledges the comment from Health Canada as to the benefits of monitoring mercury levels in wild game. As per Table 8-4: Monitoring and Follow-Up Plans for the Terrestrial Environment, Mercury in Wildlife p.8-26 in the Response to EIS Guidelines, there are plans to undertake a voluntary monitoring program that includes monitoring mercury levels in wild game.

**REFERENCE: Volume: Socio-Economic Environment Supporting Volume; Section: Appendix 5C: Human Health Risk Assessment; p. 5C-1; Section: 5.4.2.3 Mercury & Human Health; p. 5-214 to 5-224; and Volume: Aquatic Environment Supporting Volume; Section: Table 7-1; p. 7-53**

# HC-0002

## PREAMBLE:

Mercury and human health – proposed mitigation measures: Based on the results of the HHRA, fish consumption recommendations were developed. HC agrees with the need for such recommendations and in general, would also concur with the recommendations themselves.

However, HC notes that with respect to recommendations of "unrestricted eating" for all fish with less than 0.2 ppm mercury, the current edition of the Guidelines for Consumption of Recreationally Angled Fish in Manitoba (2007) recommends that women of childbearing age and children under 12 years, limit their consumption of fish with less than 0.2 ppm mercury to 8 meals per month.

The HHRA recommends that fish consumption advisories be communicated to local First Nations and communities. Also, based on fish monitoring data, additional human health risk assessments be undertaken every 5 years after peak mercury levels have been reached to determine if consumption advisories need to be changed.

## QUESTION:

HC advises adopting Manitoba's guidelines recommendation limiting consumption for women of childbearing age and children under 12 years with respect to fish with less than 0.2 ppm mercury to provide added protection of health for these sensitive receptors. HC would consider this approach reasonable but would advise that if monitoring results show that mercury levels in fish are higher than the predicted maximum levels in the HHRA, prior to reaching their actual maximum levels, fish consumption advisories should be re-visited to ensure that they remain protective of human health.

## RESPONSE:

The Partnership reviewed and considered the Guidelines for Consumption of Recreationally Angled Fish in Manitoba (2007); however, recommendations in the final, peer-reviewed Human Health Risk Assessment (HHRA) were developed and tailored to specific communities and corresponding consumption patterns. They include specific consumption guidelines for specific lakes expected to be affected by the Project, and

based on specific data regarding those lakes. Albeit a complex issue, this is why the recommended consumption guidelines differ slightly from the Provincial recreational fishing guidelines. Nevertheless, given the complexity of this issue, the Partnership will continue to work with Health Canada and provincial health regulators to seek common understanding and will consider further input from Health Canada and provincial health regulators that is forthcoming. The draft HHRA was included in the July 2012 EIS filing and the final HHRA will be included in Supplemental Filing 1, to be filed in the first quarter of 2013.

The HHRA adopted the 0.2 ppm fish mercury threshold for unrestricted subsistence consumption of fish for all members of the population for the following reasons:

- Although there is no formal acceptable value for mercury concentrations [Hg] in fish, it is the Partnership's understanding that it would be very unusual for Health Canada to issue consumption advisories for First Nations populations when fish have mercury concentrations below 0.2 ppm.
- The toxicological potency estimate for mercury used in the fish consumption recommendations includes a substantive safety factor. In addition, consumption recommendations include various conservative assumptions (*e.g.,* assumed year-round consumption).
- The Keeyask HHRA uses actual data on mercury concentrations in fish for specific local fish species, e.g. Lake Whitefish from all sampled Keeyask Area waterbodies, which currently have a mean mercury concentration of less than 0.1 ppm.
- The approach also considered a potential impact of substantive restrictions on fish consumption, that local resource users could be frightened away from eating fish altogether. In fact, literature examined for the analysis (e.g., Shimshack and Ward, 2010) pointed out that people can be easily discouraged from eating fish with substantive restrictions; furthermore, some literature points out the benefits of expectant mothers eating fish in the healthy brain development of the foetus[1].
- The Partnership engaged Dr. Laurie Chan, an international expert in the field of mercury and health to provide an external review of the HHRA. He endorsed the methodology and recommendations and also stressed the nutritional benefits of fish. He was concerned that caution should be taken not to discourage use of fish, or impose unnecessary restriction, due to the conservative nature of the risk assessment paradigm.

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[1] Also see Oken E, Kleinman KP, Berland WE, Simon SR, Rich-Edwards JW, Gillman MW. 2003. Decline in fish consumption among pregnant women after a national mercury advisory. Obstet Gynecol 102(2):346–51. Full article is available at no charge at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1989666/

For these reasons, the Keeyask HHRA consumption recommendations to Keeyask Cree Nations domestic resource users are thought to provide ample protection to human health and no additional recommendations are considered necessary for Lake Whitefish because current mercury levels in these fish are extremely low (see bullet iii). Given the need to balance promoting a healthy (fish) diet and communicating safe consumption of fish, it is possible that such an advisory to restrict Lake Whitefish consumption to eight meals per month could do more harm than good. The Partnership is willing to participate in future discussions with Health Canada and provincial health regulators to establish appropriate recommendations that communicate safe consumption guidelines and the healthy benefits of a fish diet.

The Proponent acknowledges the importance of an adaptive management approach with an ongoing monitoring program. As noted in the Response to EIS Guidelines, Chapter 8 (Monitoring), the Partnership has committed to annual monitoring of key fish species for mercury levels, communicating results to local communities and to undertaking additional HHRAs every five years post-impoundment (starting in 2022). A periodic survey of consumption of country foods in the KCNs communities will also be undertaken (see Table 8-3 and 8-5 in Chapter 8 of the Response to EIS Guidelines). If monitoring results show that mercury levels in fish are higher than the predicted maximum levels in the HHRA, the Partnership will work with provincial and federal health regulatory agencies to prepare appropriate consumption advisories.

## Reference:

Shimshack JP, Ward MB. 2010. Mercury advisories and household health trade-offs. J Health Econ. 2010 Sep; 29(5):674-85.

## REFERENCE: Volume: Socio-Economic Supporting Volume; Section: 5.3.3 Mercury and Human Health; p. 5-104 to 5-120

# HC–0003

## PREAMBLE:

Mercury and human health: The EIS indicates that communication products to address adverse health impacts will be developed.

## QUESTION:

It should be noted that the determination and implementation of risk management strategies for country foods in the project area fall under the responsibilities of provincial and/or municipal authorities.

However, HC considers accurate communication strategies a very important tool in the reduction of risk to Aboriginal health with regards to country foods. HC would be willing to review proposed risk management approaches and communication products to provide its opinion.

## RESPONSE:

The Partnership agrees with the comments from Health Canada, and notes that the communication products have recently been provided to Health Canada for its review and input in paper and electronic format.

Working with federal and provincial health authorities, these communication products will be updated on an as needed basis depending on the results of monitoring following the development of the Keeyask Generating Station.

## REFERENCE: Volume: Socio-Economic Supporting Volume; Section: 5.3.3.2 Keeyask Cree Nation; p. 5-107

# HC-0004

## PREAMBLE:

Gull eggs and plants: The HHRA does not assess plants or gulls eggs (identified by FN as important food source of concern during the workshop held to determine what they eat).

Gull eggs and plants would not be expected to represent significant contributors to mercury exposure and therefore the final conclusions with respect to potential health risks are not expected to change based on this additional data. However, as local population who consume country foods have specifically identified these foods as important food sources, gull eggs and wild plants should be included in order to confirm the expectations that these foods are acceptable to continue.

This information would also beneficially serve as baseline data for future Keeyask HHRAs and in the assessment of risk related to other hydro generation projects planned within the region (e.g., Conawapa).

## QUESTION:

HC encourages the proponent to participate in the voluntary monitoring plans for gull eggs and plants to provide more comprehensive information on the potential adverse effects to these country foods.

## RESPONSE:

The Partnership has indicated that the collection of samples of wild game, waterfowl and plants on a voluntary basis for mercury testing will be undertaken post-impoundment on an annual basis or until mercury levels return to baseline conditions (see Response to EIS Guidelines, Chapter 8 Monitoring, Table 8-5). Further explanation is provided in Section 5.3.3.2 of the Socio-Economic Supporting Volume (pg. 5-116) on the voluntary sampling protocol in place for collection of plant samples for Labrador tea, blueberries and Seneca root for independent mercury testing.

Since consumption of gull eggs is not common today (Keeyask Cree Nations members of the Mercury and Human Health Technical Working Group indicated that their use has declined over time), a decision was made not to include them in the voluntary sampling program.

**REFERENCE: Volume: Socio-Economic Supporting Volume; Section: Appendix 5C – HHRA, Subsection 3.3 Concentration of Mercury in Waterfowl; p. 5C-28; Volume: Response to EIS Guidelines; Section 8.3.3.1 -Wildlife and Mercury: Waterbirds; p. 8-10**

# HC-0005

## PREAMBLE:

Mercury in Ducks: In the HHRA mercury levels in whitefish were used to represent mercury levels in waterbirds. The proponent shows data collected from hydroelectric projects areas in Quebec to support this approach. The intent is to demonstrate that according to data from the Quebec projects, mercury levels in waterbirds can be estimated by the levels of mercury in fish with similar diets and similar feeding habits (TE SV-2, Section 8.0 – Wildlife and Mercury, Table 8-4). Waterbirds that were identified as food sources in the Keeyask region are herbivorous/benthivorous and would have similar dietary patterns to whitefish.

1 is sorted alphabetically by group; Table 2 is sorted alphabetically by issue.

The HHRA recommends mitigation measures including monitoring mercury in waterfowl and waterbirds.

## QUESTION:

HC suggests that the future monitoring data should be assessed to determine whether consumption of waterbirds and waterfowl poses a health risk and implement mitigation measures if an unacceptable risk has been identified.

## RESPONSE:

Two planned monitoring programs will provide information related to mercury levels in waterbirds and waterfowl to determine whether consumption of waterbirds and waterfowl pose a health risk. If an unacceptable risk is identified under future conditions, mitigation measures will be implemented by the Partnership.

As noted in HC-0004, the collection of samples of waterfowl will be undertaken on a voluntary basis for mercury testing post-impoundment on an annual basis or until mercury levels return to baseline conditions (see also Response to EIS Guidelines document, Chapter 8 Monitoring, Table 8-5).

In addition, monitoring of selected fish species (noted as whitefish [among other species] in Section 7.2.4.4 of the Aquatic Environment Supporting Volume) in the Keeyask reservoir and Stephens Lake will be undertaken to verify predicted increases in mercury levels in fish – this is then is used to predict levels in waterbirds and waterfowl

(see also Table 8-3 of Response to EIS Guidelines). Fish mercury concentrations will be monitored regularly starting in 2013. Once the full supply level of the reservoir is reached, concentrations will be measured annually until maximum concentrations are reached, and every three years thereafter until concentrations are stable. For a more detailed description of the monitoring of fish mercury concentrations see the Aquatic Effects Monitoring Program (see Aquatic Environment Supporting Volume page 7-22 to 7-23).

As noted in HC-0002, the Response to EIS Guidelines, Chapter 8 (Monitoring) also expresses a commitment of the Partnership to undertake additional Human Health Risk Assessments every five (5) years post-impoundment. An assessment of the safety of eating waterfowl would be part of that process.

**REFERENCE: Volume: Socio-economic Environment Supporting Volume; Section: Appendix 5C – HHRA, Section 5.1.2 Post Impoundment Scenario; p. 5C-51; and Cree Nation Partners - Keeyask Environmental Evaluation; Section: 9.2 TCN Adverse Effects Agreement; p. 49**

# HC-0006

## PREAMBLE:

Mercury concentrations in fish from AEA offset lakes: The HHRA states "…measured mercury concentrations in fish from offset lakes (specifically identified by one of the Keeyask Cree Nations) have indicated that certain fish from the various background lakes in the study area may have mercury concentrations that warrant consumption recommendations (tissue concentrations of mercury above 0.2 ug/g)." HC notes that in Table 7L-1, data report maximum mercury levels of 0.85, 0.71, and 0.61 ppm for walleye collected from Pelletier, Recluse, and Waskaiowaka Lakes from 2004-2006. Fish from these lakes are intended to provide traditional food source as indicated in the Adverse Effects Agreement Healthy Food Fish Program, in order to replace fish that may no longer be safe to consume as a result of increased methyl-mercury levels caused by the Keeyask Project.

## QUESTION:

HC advises that the proponent monitor mercury concentration in fish from the offset lakes to mitigate potential risks to human health arising from use of off-set lakes as a country foods source as a result of the project. Communication products may be required for use of these lakes (e.g., consumption recommendations for sensitive subgroups of the population).

## RESPONSE:

The Keeyask Adverse Effects Agreements with Tataskweyak Cree Nation, War Lake First Nation and York Factory First Nation include provision for a program to address the potential for increased mercury concentrations in fish by replacing the domestic supply of fish currently taken from on-system lakes and rivers that have the potential to be affected by Keeyask. The Keeyask Adverse Effects Agreement with Fox Lake Cree Nation includes provision for an Alternative Resource Use Program, which may be used to harvest fish species in alternate resource areas within the Fox Lake Resource Management Areas.

Each of the Keeyask Cree Nations is responsible for implementing the relevant programs for their community and for identifying possible off-system lakes to provide this replacement fish supply. To assist with this process, the Partnership has undertaken

mercury sampling of fish in offset lakes already identified by Tataskweyak Cree Nation and War Lake First Nation - the only communities thus far to identify offset lakes for this purpose. These results will be used by Tataskweyak Cree Nation and War Lake First Nation to design and implement appropriate domestic food fish off-setting programs for their communities. As new or different lakes are identified by the Keeyask Cree Nations for the purposes of these programs for which no mercury data are available, additional mercury sampling and analysis may be undertaken by the Partnership at that time. As well, monitoring of mercury levels in the catch associated with these programs may be undertaken by the Partnership on an as needed basis so that the programs can be adjusted if needed.

It should be noted that offset lakes are not formally included in the Aquatic Effects Monitoring Plan for Keeyask because there are no effects to these lakes as a result of developing the project.

Results of mercury sampling to date have already been used to develop sample communication products (i.e., a map of the offset lakes with consumption recommendations) for use by these communities. It is anticipated that these products will be updated as new information becomes available.

NOTE: As a point of clarification, the mercury levels noted in the preamble to the question are maximum concentrations in individual fish. These differ from mean standardized concentrations which are generally used to compare fish mercury concentrations between lakes or to guidelines and standards.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 7.2.4 Project Effects: Mitigation and Monitoring; p. 7-16

# HC-0007

## PREAMBLE:

Project Effects, Mitigation and Monitoring: HC understands that the proponent has proposed to monitor mercury in fish tissue on an annual basis until maximum concentrations are reached, and every 3 years thereafter until concentrations are stable. HC does not have any objections to this approach; however, the EIS does not provided a clear determinant of what constitutes “maximum concentration” and “stable”. Mercury levels in fish are expected to steadily increase over a number of years, reach a maximum, and decline steadily thereafter but may fluctuate slightly over the course of this time. The number of years in which a decrease in mercury levels is observed to conclude that a maximum concentration has been reached, does not appear to have been determined. The EIS includes an outline of monitoring planned for the mercury in fish tissue. However, the detailed monitoring program that will be provided in the Aquatic Effects Monitoring Plan (AEMP) is not yet provided and is related to regulatory licensing with DFO and Manitoba Conservation.

## QUESTION:

HC advises that the proponent provide a clear determinant in the EIS of what will constitute a “maximum concentration” and “stable” condition at which point fish tissue monitoring will be reduced to a frequency of every third year. When the AEMP is available for review, HC is able to provide advice regarding potential effects and review of additional HHRAs to ensure fish consumption advisories remain protective of human health.

## RESPONSE:

A preliminary draft of the Aquatic Effects Monitoring Plan (AEMP) will be provided to regulators for review in the second quarter of 2013 (also see response to CEAA-0011). The AEMP will indicate that maximum post-Project mercury concentrations will be considered attained for a species if standardized means are not statistically different for three consecutive years, or if means are significantly lower in a year following two consecutive years of similar concentrations. Stable post-Project mercury concentrations at the end of the declining phase will be considered attained for a species if standardized means are not statistically different for three consecutive sampling periods.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: KCN-EVRPTs; Section 5.3.3.1 Mercury in Manitoba in the Past; Section 5.3.3.2 Keeyask Cree Nations; Page No.: 5-106 to 5-107**

# HC-0008

## PREAMBLE:

Existing / Past Health Impacts from Mercury: There are three hydroelectric generating stations planned for the Nelson River (Wuskwatim [currently under construction], Keeyask and Conawapa). This area has been impacted by past hydroelectric developments. The EIS states "Based on their experiences with previous hydroelectric development and through the Federal Ecological Monitoring Program (FEMP), the issue of mercury and human health became a primary concern for the KCNs in relation to the Keeyask Project."

HC conducted biomonitoring (blood and hair) sampling for mercury from 1976 until 1990 from local people within this region. For the most part, people from this area tested within acceptable range, but approximately 2% tested in "greater risk" range (Wheatly and Paradis, 1995)).

HC notes that many environmental assessments involving hydro projects, where mercury levels are known to increase in biota, have considered hair mercury analysis of local populations in order to determine if any potential increased dietary exposure may pose a risk.

It is important to note that the FEMP was a result of Claim 18 in 1981, under the Northern Flood Agreement (NFA), which alleged that Canada, Manitoba, and Manitoba Hydro had not met a responsibility of the NFA "to implement a long-term coordinated ecological monitoring and research program that would allow evaluation of impacts on communities" that signed the NFA and belonged to the Northern Flood Committee. Reference: Wheatly B., and Paradis S., Exposure of Canadian Aboriginal Peoples to Methylmercury. Water, Air, Soil Pol 1995; 80: 3-11.

## QUESTION:

HC suggests that the proponent consider the merit of conducting such analysis on the basis of whether it can adequately be confirmed that any increase in mercury exposure from the diet, based on empirical measurements in fish, would not have a significant impact on human health and report the results in the HHRA.

In the event where hair mercury analyses are conducted, HC is prepared to review the data and provide an opinion on the potential for adverse impacts with respect to human health.

## RESPONSE:

Manitoba Hydro and the Keeyask Cree Nations (KCNs) considered the merits of blood and hair sampling and arrived at the conclusion that it was not appropriate to require a blood and hair sampling program in the in-vicinity KCNs communities for the following reasons:

- Mitigation measures (e.g., programs to replace country food from unaffected locations and consumption advisories) will be in place to reduce the risk that mercury in fish could affect the health of the KCNs;
- Monitoring of fish mercury concentrations, the pathway that has the greatest potential to affect human health, will be undertaken and will provide information to guide action with respect to consumption advisories; and
- KCNs participants in the Mercury and Human Health Technical Working Group, which guided the mercury analysis during the environmental assessment process, were concerned about the anxiety created with hair and blood testing (e.g., to establish baseline conditions beyond the testing that was undertaken by FEMP in the 1980s and 1990s). The KCNs have each indicated that they may pursue community-led, voluntary testing with the assistance of the federal government, but to date have not yet pursued this option.

NOTE: As a matter of clarification, the citations attributed to Wheatley & Paradis (1995) cannot be found in the referenced paper. This publication does not appear to mention the NFA or to cover the “risk” of mercury exposure. As well, the smallest geographical unit identified in Wheatley & Paradis (1995) is Manitoba and no mercury concentrations in humans specific to the NFA communities are presented.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 10.4 The Precautionary Approach; p. 10-3

# HC-0009

## PREAMBLE:

This section [S. 10.4] states "The concept of using a precautionary approach has been an implicit foundation in the planning and design of the Project, using both technical science and aboriginal traditional knowledge (ATK)."

## QUESTION:

HC would like to inform the proponent of a biomonitoring initiative underway in Saskatchewan that may be considered to manage risk of traditional uses of land and potential impacts to human health resulting from the Project.

http://www.health.gov.sk.ca/biomonitoring-common-questions

Should biomonitoring be undertaken by the proponent, as justified by previous biomonitoring results, it would be a means of identifying whether communication products are effective i.e., if consumption guidelines are being followed, or if populations are in the range of exposure that would pose unacceptable risk.

## RESPONSE:

The Partnership has reviewed the Alberta and Saskatchewan biomonitoring program from the identified web link above. This program is being conducted by the provincial health authorities, and not an industry proponent, is not linked to a specific project or industry and the collection of blood samples is part of routine prenatal blood tests undertaken by community health practitioners. Further, the blood samples are grouped together and analysed for the level of a number of environmental chemicals (of which mercury is one). Results will only be available by geography. The study "will not provide information regarding the source of the exposure, the length of the exposure, how long the substances have been in the body or if there are health effects related to that exposure. It would give an indication of the potential risk." (*Environmental Health Monitoring in Northern Saskatchewan: Biomonitoring Project – Common Questions;* http://www.health.gov.sk.ca/biomonitoring-common-questions)

The scope of such a biomonitoring program would be well beyond that required to examine mercury in terms of its effects on human health. Furthermore, application of this model would seem to require substantive changes (*e.g.,* reporting restrictions) to be of assistance in tracking mercury at the community level. If such a program was instituted in northern Manitoba, it would be best and most appropriate for it to be led

35 and implemented by the Regional Health Authority (similar to the Alberta and
36 Saskatchewan programs) as part of routine health care and on a strictly voluntary basis.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.3.2.1 Main Camp and Work Areas; p. 4-9

# MBWildlands-0001

## PREAMBLE:

Section "4.6.3 Reservoir Clearing" states: "Selected locations will not be cleared if they are deemed to provide environmentally sensitive habitat."

## QUESTION:

If these non-cleared areas of "environmentally sensitive habitat" are inside the reservoir area, will they not eventually be flooded?

## RESPONSE:

The sentence should have read "Selected locations will not be cleared if they are deemed to provide environmentally sensitive habitat after flooding." Yes, these areas will be flooded.

Examples of these environmentally sensitive habitat areas would be shallow flooded areas close to the reservoir shoreline (back bays, creek mouths, etc.) where conditions could allow trees and shrubs to remain standing for several years. These trees and shrubs would reduce wave energy and shoreline erosion and thereby provide more stable conditions for the establishment of shoreline vegetation along the reservoir shoreline (see Section 2.1.4.1 (c) of the Reservoir Clearing Plan, which is included as Appendix 4A in the Response to EIS Guidelines and Project Description Supporting Volume Section 3.6). Leaving a few individual trees or clumps of trees tends to increase shoreline diversity and structure and promote increased wildlife use. Benefits would also extend to the aquatic environment, where retaining some standing trees and large woody debris can increase the complexity of aquatic habitat, including increased cover habitat for fish, and increased substrate for the growth of algae, invertebrates and other food organisms.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.7.3 Vegetation and Debris Management; p. 4-49A

# MBWildlands-0002

## PREAMBLE:

"4.7.3 Vegetation and Debris Management" states: "…some shoreline areas will disintegrate after initial flooding, adding approximately 7 to 8 $km^2$ to the reservoir area in the first 30 years after it is created.

## QUESTION:

Of the total reservoir area, both initially and subsequently as the reservoir expands over decades, what percentage of flooded area will be peatlands/muskeg vs. what percentage will be forested lands, etc.?

## RESPONSE:

The land cover composition of the initially flooded and 30 year reservoir expansion area is provided in Table 2-14 of the Terrestrial Environment Supporting Volume and is reproduced below. A detailed characterization of the habitat composition of these areas is provided in Appendix 2 Table 2C-20 of the Terrestrial Environment Supporting Volume.

| Land Cover Type | Initial Flooding | Reservoir Expansion |
|---|---|---|
| Broadleaf treed on all ecosites | 1.5 | 1.8 |
| Needleleaf treed on mineral or thin peatland | 34.5 | 41.0 |
| Tall shrub on mineral or thin peatland | 0.5 | 0.4 |
| Low vegetation on mineral or thin peatland | 2.1 | 1.5 |
| Needleleaf treed on other peatlands | 37.5 | 42.1 |
| Tall shrub on other peatlands | 0.9 | 1.3 |
| Low vegetation on other peatlands | 9.0 | 5.0 |
| Shrub/ low vegetation on riparian peatland | 8.6 | 3.9 |
| Nelson River shore zone | 5.2 | 3.2 |

| Land Cover Type | Initial Flooding | Reservoir Expansion |
|---|---|---|
| Off-system shore zone | 0.2 | 0.0 |
| All | 100 | 100 |
| Note: Totals may not add to 100% due to rounding. | | |

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.2.5 Resource Use Monitoring; p. 8-34

# MCWS-LB-0001

## QUESTION:

Section 8.2.5 on page 8-34 states that harvesting activities conducted by domestic resource users authorized to harvest within the Project site will be monitored at the North and South access gates. Elsewhere it states that the public will be restricted from the site, workers will be prohibited from possessing firearms on the site, hunting by workers will be prohibiting in the project site etc. The first line seems to imply that domestic hunting will be permitted in the project site. If so will this be open to all Treaty Indians, only those living near the Project area or I am misreading the line entirely?

## RESPONSE:

Public access to the Project site, including the south and north access roads, will be restricted while the Project is being constructed. Domestic resource use within the Project site will be permitted for authorized Aboriginal users only. Section 2.4 of the Keeyask Construction Access Management Plan (to be provided to regulatory agencies in the first quarter of 2013; also see CEAA-0011) describes specific measures to ensure safe, coordinated access for authorized users during construction and how these users will be selected. Authorized users such as trapline holders, their helpers and traditional resource users will be selected by a process involving KCN representatives and authorized by the Project Manager or delegate. This measure is intended to ensure continuity of existing domestic use (and commercial trapping) and at the same time, limit access to unauthorized individuals to protect natural resources in the area. Although domestic resource use is permitted for authorized Aboriginal users, no access is permitted to the construction site, work areas or the main construction camp site for domestic use. The objective of this condition is to maintain safe working conditions and to protect the health, life and well being of each and every individual.

The Partnership recognizes that those who access Crown lands on either side of the access roads via means other than the access roads (e.g., existing trails in the area) may be legally entitled to do so. The Partnership can only implement restrictions within the area of the road and road right-of-way (ROW).

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.2.5 Resource Use Monitoring; p. 8-34

# MCWS-LB-0002

## QUESTION:

This page also states that the CNP has developed moose and fish harvest sustainability plans to address the long-term sustainability of these species in the Split lake RMA in cooperation with the Split Lake Resource Management Board. Have these plans been developed? The NE region agrees that plans like this should be developed with the RMB; however are not aware of any completed plans as stated in the EIS.

## RESPONSE:

Draft versions of the Fish Harvest Sustainability Plans for each of the Cree Nation Partners (CNP) and the Moose Harvest Sustainability Plan are currently being developed by the CNP and will be presented to the Split Lake Resource Management Board for review and discussion once they are ready. The responses to MCWS-LB-0009 and MCWS-WB-0001 outline how the CNP envision the Split Lake Resource Management Board will be involved in the review and implementation of these plans.

## REFERENCE: Volume: Socio-Economic Environment, Resource Use and Heritage Resources Supporting Volume; Section: 1.5 Commercial Forestry; p. 1-85

# MCWS-LB-0003

## QUESTION:

There was no mention of how timber will be disposed of. Is the plan to utilize any of the timber (firewood or otherwise) or will it burned? Will the stumps (root systems) be left in place to slow erosion or will they be removed to reduce debris in the forebay? The EIS calculates "Project Forest Damage Appraisal and Valuation (Table 1-10) based on impacts and timber dues to be paid for timber removal within the Forest Management Unit 86, but not for timber removal outside the FMU in the non-commercial timber zone. As a major portion of this project exists outside FMU 86, Manitoba Conservation and Water Stewardship holds the option to assess Forest Damage Appraisal and Valuation on this portion of the project footprint. Bruce Holmes, NE Region Forestry Manager has raised the same concerns.

## RESPONSE:

Mechanical clearing will take place by shear blading during the winter when the ground is frozen. Using this method, the cleared material will be deposited in windrows or piles, left to dry, and then burned the following winter. As much as possible, materials will be burned in areas selected to minimize the risk of peat fires. The machinery will enable stumps to be sheared off at ground level, along with any other vegetation in the area. Most of the loose and dead woody debris along with hummocks of sphagnum moss will be removed, thereby minimizing the amount of organic debris left in the reservoir when it is flooded.

Hand clearing will be undertaken in areas that are designated environmentally sensitive sites (e.g. sacred, cultural or heritage sites; areas within 10 m of the existing normal high-water mark on the Nelson River and within 5 m of tributary banks); and areas not accessible to heavy equipment. These areas will be cleared by people using chain saws, brush cutters and appropriate hand tools. The preliminary extent of clearing methods are shown in Map 3-7 of the Response to EIS Guidelines. The amount of timber salvaged for firewood or building materials is not known and will depend on the economic feasibility of timber salvage. (For further details see Project Description Supporting Volume, Section 3.6, p. 3-28 & 3-29).

Appendix 4A of the Response to EIS Guidelines includes the Joint Keeyask Development Agreement Schedule 11-1: Reservoir Clearing Plan. The objectives of the Reservoir Clearing Plan are as follows:

- minimize impacts of reservoir creation and operation on the fishery by minimizing the effects of standing trees and shrubs on fishing in selected areas within the reservoir;
- minimize the impacts of reservoir creation and operation on human access to shore locations by creating shore access locations through selective clearing of trees and shrubs;
- minimize hazards to boating safety and fishing resulting from large floating debris by minimizing the source of such debris; and
- minimize aesthetically offensive landscapes.

The reservoir clearing plan states that where mechanical clearing occurs, stumps will be sheared off at ground level resulting in the removal of tree stumps but not the root systems. Where hand clearing occurs, stumps and root systems of trees and shrubs that are 15 cm (6”) high will remain.

The Forest Damage Appraisal & Valuation (FDA&V) was calculated on the affected standing timber volume on productive forestland within FMU 86 only.

Although not specifically stated within the document, the Forest Damage Appraisal and Valuation (FDA&V) was written to target the forested land base within the Commercial Forest Zone (CFZ). As stated in the FDA&V timber dues, gross merchantable volume, mean annual increment and age classes vary from Forest Management Unit (FMU) to Forest Management Unit and Forest Section to Forest Section. These are required to perform the FDA&V calculation but none of these exist for the Non-Commercial Forest Zone (NCFZ). In addition, no forest inventory exists for the NCFZ which is also a requirement for the calculation.

The FDA&V states that “…the intent is to encourage the planning and orderly removal of timber products during any forest operation.” Consistent with the stated intent, Manitoba Hydro is examining the feasibility of salvaging timber of sufficient size and concentrations within the project footprint area for either local use or delivery to further markets.

There is limited potential for utilization of the primarily young forest stands within the project footprint and the few small concentrations of potentially useable material that are sporadically distributed across the footprint.

The Crown also seeks to recover cost (e.g., forest renewal, forest protection) and value (timber dues) from the timber resources that are incurred in the managed CFZ. These same forest management costs are not incurred in the NCFZ where no forest renewal activities have taken place and fire protection is limited to infrastructure values. Also, dues should not be applied to wood volume from very young forest stands that have no foreseeable future value and will likely burn again (high frequency fire area with limited

protection) before they reach any size. It therefore does not make sense to apply the FDA&V process to the NCFZ.

The FDA&V further states that in cases "… where due to inaccessibility or remoteness, the marketing of merchantable timber might be difficult. In this event, salvage or other dues rates might be applied instead of full stumpage rates." This should be a consideration for that portion of the project footprint within FMU 86 as the above certainly applies.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 8.2.5 Resource Use Monitoring; p. 8-34

# MCWS-LB-0004

## QUESTION:

The EIS focuses almost entirely on monitoring and mitigation during construction and points out that it is Conservation and Water Stewardship's responsibility to monitor harvest when the GS goes into operation and the new Highway 280 access is opened to the public. That may be true however: harvest of wildlife, particularly moose will be of greater impact when the road is opened to the public and there should still be some responsibility for the developer to provide monitoring to accurately determine what that impact is. Little mitigation and no monitoring is planned for moose (8.2.5 page 8-34). Moose is an important big game species to the KCN. To me this seems like a perfect opportunity to monitor the effects of a development like this on moose. A preconstruction survey, a survey at the conclusion of construction and a survey 5 years post construction will provide important information on effects to moose at various critical stages. I believe the EIS underestimates the impacts of harvesting by domestic and recreational harvesters once access is open to the public. Alternate Access Programs will not significantly reduce domestic harvest in the project area and the area will reach an equilibrium similar to the surrounding road accessible area in a short time. Please provide additional information regarding the monitoring of wildlife once access is open to the public.

## RESPONSE:

Moose and caribou populations will be monitored as part of the Terrestrial Environment Monitoring Plan. The plan will be provided to regulatory agencies in the second quarter of 2013 (also see CEAA-0011). Other species to be monitored include ruffed grouse, beaver, mallard and Canada goose (see Section 8.2.3 of the Response to EIS Guidelines). Moose and caribou monitoring objectives and activities are described below.

Monitoring of moose populations is planned in the Split Lake Resource Management Area (SLRMA), which includes the new PR 280 route. One of the three moose monitoring objectives in Table 8-4 of Chapter 8 of the Response to EIS Guidelines is to "address uncertainties with respect to the redistribution of harvest effort affecting the viability of moose in the Split Lake Resource Management Area". The monitoring activities planned include but are not limited to:

- Monitoring vital measures of the moose population including a population estimate, age, sex, productivity, mortality, and recruitment using sample counts and records;

- Monitoring will focus on the Keeyask Generating Station Local and Regional Study areas (study area boundaries are described in the "Response to EIS Guidelines") but may also extend into other areas within the Split Lake Resource Management Area; and
- Using special moose management units, harvest strategies and population models to project the future population and adjust protocols as needed. The moose harvest sustainability plan will be administered by TCN.

Regular moose monitoring is planned during the construction phase and monitoring may continue for up to 30 years into the operation phase, depending on results. More detailed information on methods and frequency of monitoring will be provided in the Terrestrial Environment Monitoring Plan.

The potential for changing caribou hunting patterns in the vicinity of the new PR 280 route is expected to be limited for the following reasons:

- The Project and the new PR 280 highway segments are located in Game Hunting Area 9 where resident and non-resident licensed hunting is not permitted (see Socio-Economy Supporting Volume, Chapter Resource Use, Section 1.7.3.2). Therefore, recreational hunting pressures are not expected to change in association with improved road access.
- Domestic caribou hunting patterns are not predicted to change due to offsetting program activities given differences in the timing between these programs and domestic hunting activities (the TCN offsetting programs, for example, typically are run in spring and fall while the domestic caribou hunt occurs in winter). Effects of the offsetting programs on caribou are, therefore, expected to be neutral (see Terrestrial Environment Supporting Volume, Section 7.4.6.2.2).
- Domestic hunting pressures have been low in areas of the Project vicinity which have current access (see Terrestrial Environment Supporting Volume section 7.4.6.2.2), therefore, effects arising from improved access are expected to be of small magnitude. Occasionally, higher harvests of coastal and barren-ground caribou may occur when increased numbers of caribou periodically move into the area. Overall, the effects arising from improved access are expected to be of small magnitude.

The Partnership will work with Manitoba Conservation and Water Stewardship to monitor caribou populations in the lower Nelson River area for the Keeyask Generation Project and will coordinate these activities with monitoring for other Manitoba Hydro projects in the region (i.e., Keeyask Transmission Project, Bipole III and Keewatinoow). Regular caribou monitoring will be designed to address uncertainties with respect to cumulative effects on the viability of caribou populations in the lower Nelson River region. This monitoring is expected to occur annually during construction and continue

for up to 30 years of operation, depending on results. More detailed information on methods and frequency of monitoring will be provided in the Terrestrial Environment Monitoring Plan, which will be submitted in the second quarter of 2013.

## REFERENCE: Volume: Response to the EIS Guidelines; Section: 6.7.3.2.1 Construction Effects and Mitigation; p. 6-538

# MCWS-LB-0005

## QUESTION:

The EIS refers to the Access Management Plan. (see AMP) is referenced many times such as in section 6.7.3.2.1 page 6-538. Does the AMP exist or is still to be developed?

## RESPONSE:

The preliminary Construction Access Management Plan will be provided to regulatory agencies in the first quarter of 2013 (also see CEAA-0011). This plan will outline access management measures to be implemented along the South Access Road during the course of project construction. A comparable Access Management Plan has already been developed for the North Access Road, which was licensed as part of the Keeyask Infrastructure Project, and will remain in place during construction of the Keeyask Generating Station.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.7.5 Maintenance of Roads and Stream Crossings; p. 4-50

# MCWS-LB-0006

## QUESTION:

A reference to the proposed status could not be found for PR 280 east from its junction with the North Access road once the new route to Gillam is opened. Will the old 280 that runs north of Stephens Lake be decommissioned? This should be determined as it will have a significant impact on overall harvesting levels and it'd closing may offset any increased harvest created by the new access.

## RESPONSE:

The Response to EIS Guidelines; Section 4.7.5 (p. 4-50) states that once the Project goes into operation, the north and south access roads will be connected by a permanent river crossing over the Project's north dam, powerhouse, central dam, spillway and south dam. Manitoba Infrastructure & Transportation (MIT) has indicated it will assume the responsibility to maintain these roads as part of the provincial transportation system. Once the Partnership has completed construction of the new permanent road from PR 280 to Gillam via the Keeyask generating station, MIT intends on abandoning the north eastern section of PR 280. The portion to be abandoned runs from approximately Kilometre 174 of PR 280 (the Keeyask Junction) to PR 290.

An assessment of the effects of abandoning the north eastern section of PR 280 has been considered as summarized in following sections.

### Terrestrial Ecosystems and Habitat

The closure of part of the current PR 280 was considered in the terrestrial ecosystems and habitat assessments. Public access into an area can lead to increased human-caused fires, invasive plant spread, and resource harvesting. The increased access to areas adjacent to the north and south access roads will be somewhat offset by reduced access to areas along PR 280 between the junctions of the north access road and PR 290 when MIT closes this section of PR 280.

See Terrestrial Environment Supporting Volume Sections:

- 2.4.4.2.2 – intactness;
- 2.5.4.2.1 – fire regime;
- 2.6.4.2.2 – terrestrial habitat; and
- 2.7.4.2.1 – priority habitat.

The conclusions from the terrestrial habitat and ecosystems assessments are also applicable to priority plants, to the extent that the distributions and abundances of these species are related to particular habitat types and access-related resource harvesting.

### Birds

The switching of traffic flow from the northern portion of PR 280 and onto the north and south access roads was considered in the assessment of hunting pressure on various bird species. In particular, the determination that hunting pressure would increase considered that access to the decommissioned PR 280 would still be possible (at minimum by all-terrain vehicles and snow machine traffic) and hunting in this area would be additional/incremental to hunting along the new PR 280 (north and south access roads). This would result in harvest continuing in the traditional area (north PR 280) and expanding into a new area (north/south access roads). This determination discussed in the Terrestrial Environment Supporting Volume Sections:

- 6.4.1.1 - Canada goose;
- 6.4.2.2.2 - ruffed grouse;
- 6.4.2.4 - willow ptarmigan; and
- 6.4.3.1.1 – waterfowl.

Additionally, an assessment was carried out for decommissioning the northern portion of PR280 and its effects on songbirds and woodpeckers from vehicle collisions. It was determined that the impacts would be shifting from the northern portion of PR 280 to the north and south access roads.

This determination is discussed in the Terrestrial Environment Supporting Volume Sections: 6.4.3.2.1 - Songbirds and 6.4.3.2.2 Woodpeckers.

### Mammals

The closure of part of the current PR 280 was considered in the mammals' effects assessment. Potential effects of the north and south access roads on mammal VECs including caribou and moose are mortality due to wildlife-vehicle collisions, sensory disturbance due to traffic, and increased access for resource users. A corresponding decrease in local traffic along the current PR 280 route could offset some of the effects of the new provincial road. A scenario detailing the extent of road decommissioning was not described, and the extent that resource harvesting would be reduced in that area is unclear. If the road is not decommissioned over substantial portions of its length, it will likely be accessible to all-terrain vehicles and snow machines and could result in the on-going harvest of moose and caribou in the area. A plan to decommission the road over large areas will further reduce these effects, but may not completely prevent access to the area by resource users.

The total landscape fragmentation was assessed including both the new portion (north and south access roads) and the currently existing PR280 (decommissioned), as part of the intact caribou habitat analysis for the region.

More detailed information can be found in the Response to EIS Guidelines Sections:

- 6.5.8.1.3 - caribou;
- 6.5.8.2.3 – moose; and
- 6.5.8.5.3 – fur bearers.

And the Terrestrial Environment Supporting Volume Sections:

- 7.4.1.2.2 - small mammals;
- 7.4.1.2.3 - small mammals;
- 7.4.2.2.4 – aquatic furbearers;
- 7.4.3.2.2– terrestrial furbearers;
- 7.4.3.2.4 - terrestrial furbearers;
- 7.4.4.2.2 - large carnivores;
- 7.4.4.2.4 - large carnivores;
- 7.4.6.1.1 – beaver;
- 7.4.6.1.2 – beaver;
- 7.4.6.3.2 – moose;
- 7.7.7.1.2 – wolverine;
- 7.4.7.2.2 – regionally rare species; and
- 7.4.8.2.3 – caribou.

## Resource Use and the Socio-Economic Environment

Due to the uncertainties regarding the timing and extent of decommissioning, we were not able to predict the extent that resource harvesting would be reduced in that area. It should also be noted that Section 4.4.2.5 (pg 4-126) Socio-Economic Supporting Volume stated, “FLCN has expressed concern that community Members living in Fox Lake (Bird) will face increased travel distances to reach Thompson if the northern portion of PR 280 (around Stephens Lake) is decommissioned”. Assuming an average travel speed of 70 km/hr, the time to travel the additional 8 km to Bird is 10 minutes.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.4.6.2.1 Construction Effects and Mitigation; p. 6-274

# MCWS-LB-0007

## QUESTION:

Section 6.4.6.2 - The list of Construction Effects is thorough. The EIS states that "there is no potential for an increase in fish mortality due to harvesting by Aboriginal members of the workforce. Due to restrictions within the construction site and the prohibition on bringing personal boats on the site, workers will not be able to access the areas where sturgeon will be vulnerable to harvest." Is this meant to include Aboriginal people who are not members of the work force? The EIS is not clear on whether or not road access to the Gull Lake/Keeyask area will be restricted to only members of the work force and that Aboriginal harvesters will not be allowed to access the site by road for the purpose of harvesting.

## RESPONSE:

The statement quoted is not meant to include Aboriginal people who are not members of the workforce. In general, Aboriginal people who are not members of the workforce will not be provided road access to the Project site. The exception is a limited number of Aboriginal resource users who will be authorized access by road. Authorized users such as trapline holders, their helpers and traditional resource users will be selected by a process involving KCN representatives and authorized by the Project Manager or delegate (see Section 2.4 of the Keeyask Construction Access Management Plan to be filed with regulatory agencies in the first quarter of 2013). Authorized users are expected to be able to continue their domestic activities in areas safe to do so (the Keeyask Construction Access Management Plan specifies areas of the Project site that will be restricted for safety reasons).

For authorized Aboriginal resource users, access to waterbodies for the purposes of fishing will remain limited during construction for the following reasons:

- Access to boat launching facilities: Boat launching facilities upstream and downstream of the Generating Station (shown on Map 2-10 of the Project Description Supporting Volume) will be accessible to the public for emergency purposes only (see Section 2.4 of the Keeyask Construction Access Management Plan to be filed in the first quarter of 2013). These boat launches are required to support the construction of the Project and are not available during the construction phase for any purpose other than emergencies. New access by boat launch is not being created.

- Access by water: Upstream waterway users on Gull Lake will not be permitted to travel on the waterway downstream of the ice boom. Downstream of Gull Rapids a series of buoys and warning signs on both shores of the Nelson River will be in place to limit access to Gull Rapids. Boaters on Stephens Lake will not be permitted to travel upstream of this boundary. Restricted areas for boat traffic are shown on Map 2-18 of the Project Description Supporting Volume. Waterway access will be restricted directly upstream and downstream of the Project.

The Partnership recognizes that those who access Crown lands on either side of the access roads rights-of-way via means other than the access roads (e.g., existing trails in the area) may be legally entitled to do so. The Partnership can only implement restrictions within the Project site. Access to other areas of Gull Lake and Stephens Lake will remain unchanged from present conditions.

## REFERENCE: Volume: Socio-Economic Environment, Resource Use and Heritage Resources; Section: 1.8 Lodges, Outfitters and Other Tourism; p. N/A

# MCWS-LB-0008

## QUESTION:

Adverse Affects Agreements - The Cree Nation Partners Keeyask Environmental Evaluation describes the Offsetting Programs under the Adverse Affects Agreements. The objective of the Healthy Food Fish Program is to "provide opportunities for Members to continue to fish and to provide a supply wholesome fish to Members in order to replace fish that may no longer be safe to consume as a result of increased methyl-mercury levels caused by the Keeyask Project."

Two of the lakes identified in Map 6 are allocated to an existing commercial use. Dunlop's Fly-in Lodge and Outposts is licenced to operate a 24 bed fishing lodge on Waskaiowaka Lake and a 6 bed outcamp on Pelletier Lake. The Supporting Volume on Socio-Economic Environment, Resource Use and Heritage Resources, Part 2 Resource Use, Section 1.8.3.2 Lodges describes this lodge and outcamp. Section 1.8.4.1 describes the potential impacts on the lodge's operations. In each case the EIS notes that "No mitigation is planned". Section 1.8.4.3 Residual Effects continues to describe the likely effects on this commercial operation and again indicates that "No mitigation is planned."

Since the Healthy Fish Program is clearly identified as only being necessary because of the impacts of the project and because the resulting program is predicted to have impacts on the lodge operation, it is not reasonable to conclude that "No mitigation is planned" is an acceptable position for the EIS to take. An impact on this operation arising from the project is anticipated in the EIS. It should be comparatively simple to devise mitigation strategies that cover the range of impact that may actually occur. The proponent should be required to develop and implement measures to mitigate these impacts. Please provide additional information on mitigation as it relates to impacts on lodge operations.

a) The EIS does not mention whether or not the lodge owner has even been advised of the Healthy Food Program.

## RESPONSE:

The Healthy Food Fish Program is a component of Tataskweyak Cree Nation's (TCN) Adverse Effects Agreement which addresses effects on TCN members' Treaty and Aboriginal rights resulting from the construction and operation of the Keeyask Project.

TCN's partner in Keeyask, War Lake First Nation, has a similar program in its Adverse Effects Agreement. Operating together, TCN and WLFN are known as the Cree Nation Partners (CNP). The rights of Aboriginals to access wildlife resources in their traditional territory are well established and, in the case of the TCN, are confirmed by the following:

- Occupancy and use of traditional territory, including the Split Lake Resource Management Area (SLRMA), since time immemorial;
- Signed an adhesion to Treaty 5 in 1908;
- The Natural Resources Transfer Agreement of 1930 – Canada transferred to the Province of Manitoba certain rights over Crown land, including natural resources, with specific recognition and affirmation of off-Reserve Aboriginal harvesting rights;
- The Registered Trapline System of the 1940's;
- Signed the 1977 Northern Flood Agreement (NFA) with Canada, Manitoba and Manitoba Hydro – residents of affected reserves would be granted "first priority to all wildlife resources within their Trapline Zones, and in the rivers and lakes which were traditionally available to them as a source of food supply, income in-kind, and income";
- S.35 of the *Constitution Act* (1982) – recognizes and affirms existing Aboriginal and Treaty rights and obligates governments to respect them; and
- Signed the NFA Implementation Agreement (1992 Agreement) between TCN, Canada, Manitoba and Manitoba Hydro – established the Split Lake Resource Management Board in order for TCN to jointly manage the resources in the SLRMA with the Province. It also established TCN reserve land on Waskaiowaka Lake.

For a more complete history of CNP's occupation and use of the area, please refer to the Cree Nation Partners Keeyask Environmental Evaluation Report (Chapter 4 and Appendix 2).

## Part A

While studies have been undertaken to ascertain the sustainability of fish harvests at the lakes identified for the Healthy Fish Food Program, the EIS also notes the potential for a reduction of 'trophy fish' to occur (section 6.7.4.3 of the Response to the EIS Guidelines). Fish catches will be monitored to determine if this actually occurs and, if so, to what extent. This key distinction resulted in the determination to develop adaptive mitigation strategies to address potential adverse effects. In the past, resolution of concerns has been mutually resolved by the parties involved and responsible, and it's anticipated this can continue into the future.

The commercial lodges and outfitters noted in the question operate under licences issued by the Province of Manitoba. These licences are subject to Treaty and Aboriginal rights.

## Part B

The Partnership has been in contact with local lodge owners and outfitters in the area. Five lodge owners and four outfitters were interviewed in 2009 to understand the nature of existing and future hunting and sports fishing activities in the region and to identify concerns associated with the Project. The executive director of the Manitoba Lodge and Outfitters Association (MLOA), a business organization representing the resource-based tourism industry, was consulted, and he also attended a workshop as part of the Public Involvement Program. While the purpose of these interviews and meetings was not explicitly to inform the lodge owners and outfitters about the details of offsetting programs, information about the programs has been available through the Public Involvement Program, the Project website (www.keeyask.com) and, to a general extent, through residents in the area. For more information on the Public Involvement Program, please refer to the Public Involvement Supporting Volume of the Keeyask EIS.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.7 Effects & Mitigation-Resource Use; p. N/A

# MCWS-LB-0009

## QUESTION:

Fish Suitability Plan - The Evaluation also notes that TCN, with Hydro, is developing a Fish Sustainability Plan to ensure the long-term conservation of our fish population. The plan is also referenced in Section 6.7 of the Response to EIS Guidelines. While the Fish Sustainability Plan should be a valuable tool for ensuring the sustainability of fishing activities under this program, it should be noted that under 1992 Agreement between Canada, Manitoba Split Lake Cree Nation and Manitoba Hydro on the implementation of the Northern Flood Agreement the Split Lake Resource Management Board has the mandate for Resource Planning in the Split Lake Resource Management Area. The Response to EIS Guidelines states The AEAs provide for coordination with and annual reports to the Resource Management Boards with respect the management and administration of the AEA offsetting programs. The Fish Sustainability Plan should be developed and implemented through the Resource Management Board, not developed independently and then presented to them as finished product, unless the RMB decides that is the way it wants to implement its Resource Planning mandate. Please provide additional information on The Fish Suitability Plan as it relates to the mandate of the Resource Management Board

## RESPONSE:

The CNP (Cree Nation Partners) are preparing the Fish Harvest Sustainability Plans to guide sustainable implementation of the Healthy Food Fish Program (TCN) and the Community Fish Program (WLFN), both of which are parts of the Tataskweyak Cree Nation (TCN) and War Lake First Nation (WLFN) Adverse Effects Agreements. The objective of these programs is to provide opportunities for Members to continue to fish and to provide a supply of wholesome food fish to Members from a number of lakes in the Split Lake Resource Management Area in order to replace fish which may no longer be available to Members as a result of increased methyl-mercury levels in fish following impoundment of the Keeyask Reservoir.

The CNP proposes that implementation of the Fish Harvest Sustainability Plan will occur in close cooperation with the Split Lake Resource Management Board (SLRMB) and that any adjustments to future fishing activities will be done in consultation with the Board. CNP envisions a close working relationship between managers of the CNP Offsetting Programs and the Split Lake Resource Management Board. Should the Board choose, the Fish Harvest Sustainability Plans could be developed into Resource Management Plans under the 1992 NFA Comprehensive Implementation Agreement.

## REFERENCE: Volume: Response to EIS Guidelines; Section: N/A; Page No.: N/A

# MCWS-LB-0010

## QUESTION:

Should be noted that although a Draft Fish Sustainability Plan has been presented to the Split Lake Resource Management Board, it does not appear certain that this plan represents the way that fish will be harvested or the mechanism by which they will be managed. The First Nations have many options available to them on how to best implement their Offsetting Programs and it should be recognized that the means presented in the Draft Plan may not be the way that they choose to proceed. Again, the Resource Management Board should be identified as having more of a role in the development and implementation of this plan. There should be more recognition that the Offsetting Program may change over time as the First Nation adjusts it to meet the emerging needs of its people, and that the Sustainability Plan will also need to adjust to reflect the changes in the Program.

## RESPONSE:

Any future changes to the programs will be made in consultation with the Split Lake Resource Management Board. Please see responses to MCWS-LB-0009 and MCWS-WB-0001.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.0 Alternative Means, Design, Mitigation, Table 6-2 and Table 6-3; p. 6-58 and 6-60

# MCWS-LB-0011

## QUESTION:

Supporting Volume on Aquatic Environment - Section 6 Alternative Means, Design, Mitigation provides a readable summary of design considerations and the rational for the choices made. Table 6.2, Summary Table – Aquatic Environment – Alternative Means and Mitigation Measures – Upstream of Generating Station and Table 6.3 – Downstream of Generating Station, both provide an excellent summary of measures considered and adopted. The description of Potential Effects, options, considerations and recommendations is sufficiently detailed to provide confidence that effects and their mitigation options have been identified. Section 6.13.1 Aquatic Environment concludes with the statement On-going discussions with MCWS and DFO may identify modifications to the design of recommended measures or determine additional mitigation measures that will be implemented as part of the Project. The review of the proposed ongoing monitoring and the process for making decisions on the need for and suitability of the proposed and additional mitigation options should be described with attention to the structure by which Conservation and Water Stewardship will interact with CNP and Manitoba Hydro. Please provide additional detail with respect to the proposed ongoing monitoring and mitigation process as it relates to the interaction of the Province and CNP.

## RESPONSE:

The Project will include an Aquatic Effects Monitoring Plan (AEMP), to be filed with regulatory agencies in the second quarter of 2013. As part of the AEMP, monitoring of the fish habitat compensation measures will be conducted to:

- Determine the effectiveness of the habitat compensation works and determine if works need to be modified and/or additional ones added as per the Project's Authorization under the *Fisheries Act*;
- Confirm the effectiveness of the stocking program on lake sturgeon populations and modify as appropriate; and
- Confirm whether the post-Project effects are as predicted in the environmental assessment, and if not, determine what other mitigation or compensation measures may be required.

The adaptive management approach will involve an ongoing process of engagement between Keeyask Hydropower Limited Partnership (KHLP), DFO and MCWS. Some specific elements in the process will be the following:

- Annual monitoring reports by the KHLP;
- Annual meetings between KHLP, DFO and MCWS to review and discuss annual monitoring results, and stewardship and monitoring plans for the upcoming year; and
- A formal review of the fish habitat compensation four years post-impoundment to determine whether installed works are functioning as intended and whether additional mitigation or compensation is required. A second review 10 years post-impoundment would determine whether reservoir conditions are evolving as anticipated, or whether other works are required.

## REFERENCE: Volume: Response to EIS Guidelines; Section: N/A; p. N/A

# MCWS-WB-0001

## QUESTION:

Throughout the document, it indicates that the CNP (Cree Nation Partnership) will develop a moose harvest sustainability plan, and later it indicates it has been developed. Has this harvest plan been developed? It also references the responsibility of the province to regulate licensed hunter harvest levels and that moose harvest within the local study area will be recorded at access gates. Will community harvest levels throughout the regional study area be monitored through ATK monitoring and identified in the moose harvest sustainability plan? It is understood that there are sensitivities around recording community harvest levels but without a good understanding of harvest levels from all resource users, it is difficult to ensure population persistence within the northern Resource Management Areas. What exactly is meant by "ATK monitoring?

## RESPONSE:

The natural world sustains the KCNs communities and each has a responsibility, since time immemorial, to care for it. They act as responsible stewards of their natural world and will implement environmental provisions of their Adverse Effects Agreements in a sustainable manner.

The Moose Harvest Sustainability Plan is currently being developed by the Cree Nation Partners and, once ready, will be presented to the Split Lake Resource Management Board (SLRMB) for review and discussion. The Moose Harvest Sustainability Plan is being developed to provide relevant guidance for program managers responsible for running the Tataskweyak and War Lake Access Programs, and for use by the SLRMB in providing management advice to the province. The Access Programs provide community members with substitute opportunities to pursue traditional activities within the Split Lake Resource Management Area in areas not affected by the Keeyask Project.

Community harvest levels for the CNP will be gathered as part of the reporting process outlined for the Access Program under the Adverse Effects Agreement. This information will be available to Tataskweyak and War Lake representatives on the SLRMB and will be shared as appropriate.

At this time, it is not anticipated that the Moose Harvest Sustainability Plan and related program monitoring will be able to obtain harvest information for other First Nations Members and Metis, beyond Tataskweyak Cree Nation and War Lake First Nation. However, estimates of moose harvest within the Split Lake Resource Management Area

by other Aboriginal groups will be made by the Access Program managers and will be incorporated into the computer models for each of the moose management units.

In addition, Table 8-4 on p. 8-24 of the Response to EIS Guidelines does indicate that the Partnership will monitor moose populations throughout the Split Lake Resource Management Area during construction and for up to 30 years of operation, depending on results. Information to be collected includes productivity, mortality and recruitment. This information will be provided on an annual basis to regulators and will be available to the SLRMB for overall management purposes.

The Partnership is also in the process of developing community-specific ATK monitoring programs with each of the Keeyask Cree Nations. As noted on p. 8-39 of the Response to the EIS Guidelines, these programs will be based on Cree perspectives and understandings about potential effects of the Project. Specific ATK monitoring programs will be developed on an annual basis, based on construction and/or operational activities and related community concerns about potential effects. It is possible that these plans may include monitoring of a community's resource use activities, but that has yet to be determined by each of the communities.

**REFERENCE: Volume: Physical Environment Supporting Volume; Section: 8.0 Groundwater, Section: 11.0 Sensitivity of Effects Assessment to Climate Change; p. N/A**

# MCWS-WQ-0001a

## PREAMBLE:

The reservoir area is in an area of permafrost.

## QUESTION:

How might the rates of shoreline erosion change under various climatic regimes and how might these relate to observed water quality conditions under the least and greatest annual temperature predicted by global climate change models for this region?

## RESPONSE:

The sensitivity of the conclusions related to shoreline erosion processes with respect to potential climate change conditions, both temperature and river flow, is discussed in Physical Environment Supporting Volume, Section 11.0.

The potential implications of climate change on water quality are discussed in the Aquatic Environment Supporting Volume, Section 8.3.

**REFERENCE: Volume: Terrestrial Environment Supporting Volume;**
**Section: 2.0 Habitat and Ecosystems; p. N/A**

# MCWS-WQ-0001b

## PREAMBLE:

The reservoir area is in an area of permafrost.

## QUESTION:

Much of the reservoir area is underlain by peat, how does the proportion of peat and wetland area compare to other reservoirs in Northern Manitoba? For example proportion of wetland area is often attributed to elevated concentrations of mercury in reservoirs.

## RESPONSE:

Kettle (Stephens Lake) and Notigi reservoirs were used as proxy areas for the Keeyask studies. Data from these studies are outlined in the Terrestrial Environment Supporting Volume Table 2C-20 and indicate that:

- The Keeyask initial flooding and 30 year reservoir expansion areas are approximately 91% peatland and other types of wetlands (2% of the 91% is marsh).
- For the Kettle reservoir study area, 93% was peatland and other type of wetlands.
- For the Notigi reservoir study area, 99% was peatland and other types of wetlands.

The Terrestrial Environment Supporting Volume (Section 2.0) provides more detail on the habitat types in the flooded and expansion areas of the Keeyask reservoir.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 7.2 Mercury; p. 7-1

# MCWS-WQ-0002

## QUESTION:

Of particular concern is the impact of reservoir creation on the release of mercury, and bio-magnification at higher trophic levels. The environmental assessment documents show that methyl mercury concentrations in predatory fish such as walleye and northern pike are expected to increase beyond tissue concentrations that would be considered safe for unrestricted human consumption. Fish mercury concentration increases are predicted for both Stephens Lake and the proposed Keeyask Reservoir. High mercury concentrations in fish are expected to persist for up to 35 years before eventually stabilizing near a baseline concentration. Much of the information on mercury concentrations in fish tissue with time after reservoir creation is based on case studies of existing reservoirs. It is understood that fish mercury concentrations recover at different rates. Are there any reservoirs in northern Manitoba where mercury concentrations in fish have not recovered? The proponent is asked to comment on the factors that affect recovery time and why some reservoirs may not recover as fast as others?

## RESPONSE:

The exact time at which fish mercury concentrations may be considered as “recovered” from the effects of reservoir flooding is difficult to determine for Manitoba reservoirs because of:

- a lack of suitable pre-impoundment data on fish mercury levels for the vast majority of reservoirs;
- a lack of an adequate sampling frequency during the period of declining concentrations (in the best cases, reservoirs are sampled every three years, but for most reservoirs the frequency is less); and
- year to year variation in measured fish mercury concentrations that may reflect conditions at that time (i.e., natural processes such as water level fluctuations, changes in fish community composition and trophic levels) or are caused simply by differences in the fish available for analysis, such as sample size, sampling time and location.

In addition, there are no established statistical criteria to determine “stable” mercury concentrations.

Given these limitations, Bodaly et al. (2007) have provided data on "years to return to background" for lake whitefish, northern pike, and walleye for several Manitoba lakes affected by hydroelectric development. These range from 10 to 32 years and must be considered low (i.e., potentially too short) based on the statistical procedure used to establish "return". This was taken into account in the EIS predictions for the Keeyask reservoir and Stephens Lake by extending the recovery time frame to potentially 35 years, even though the Keeyask reservoir will not experience flooding anywhere close to that observed for some of the lakes used in Bodaly et al. (2007). By 2007, mercury concentrations in the above three large-bodied species from all northern Manitoba lakes affected by the Churchill River Diversion (with the possible exception of Threepoint Lake) had reached a level similar to pre-diversion levels and/or comparable to those observed in several lakes in the general geographical area not affected by hydroelectric development.

Factors that affect the recovery time of fish mercury concentrations in reservoirs and, thus, are responsible for differences in recovery time between reservoirs, mainly relate to the supply of resources to methylating bacteria and the efficiency of food chain transfer of methyl-mercury ( i.e., the form of mercury that bio-accumulates). Experiments at the Experimental Lakes Area near Kenora, Ontario have shown that, for example, the quality (lability) of carbon in flooded terrestrial soils may be more important than total carbon stores for the rate of methyl-mercury production (Bodaly et al. 2004). However, total carbon stores may be determining the duration of methyl-mercury production. Bodaly et al. (2004) also documented that the rates of methyl-mercury production may not be closely linked to methyl-mercury bioaccumulation in the food chain such that fish mercury concentrations 3 years after flooding can be higher in a reservoir with low methyl-mercury water concentrations than in a reservoir with high water concentrations. Data from Manitoba and Québec reservoirs indicate that the time of recovery is often positively related to the maximum mercury concentrations reached in a species.

## REFERENCES:

Bodaly, R. A., K. G. Beaty, L. H. Henzel, A. R. Majewski, M. J. Paterson, K. R. Rolfhus, A. F. Penn, V. L. St. Louis, B. D. Hall, C. J. D. Matthews, K. A. Cherewyk, M. Mailman, J. P. Hurley, S. L. Schiff, and J. J. Venkitesvaran. 2004. Experimenting with hydroelectric reservoirs. Environmental Science & Technology September 15, 2004:347-352.

Bodaly, R. A., W. A. Jansen, A. R. Majewski, R. J. P. Fudge, N. E. Strange, A. J. Derksen, and D. J. Green. 2007. Postimpoundment time course of increased mercury concentrations in fish in hydroelectric reservoirs of northern Manitoba, Canada. Arch. Environ. Contam. Toxicol. 53:379-389.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 7.2 Mercury; p. N/A**

# MCWS-WQ-0003

## PREAMBLE:

While having provision for Keeyask Cree Nations Members to be able to eat fish from 'off-system' unaffected lakes through the Keeyask Cree Nations' Adverse Effects Agreements Offsetting Programs will help mitigate the potential for adverse effects to human health, this will not be of benefit to mitigating the impacts on wildlife consumers of fish or the fish themselves. A number of studies have attempted to quantify the impacts of elevated mercury concentrations of behaviour and survival. In particular, maternal transfer of MeHg to fish larvae may be a source of mortality.

## QUESTION:

This raises the question if the potential mercury concentrations in the Keeyask Reservoir be high enough to contribute to mortality of larval fish such as Lake Sturgeon, Walleye of Northern Pike? Other studies have documented adverse effects on behaviour of fish and wildlife that were experimentally exposed to mercury. How will mercury concentrations in wildlife be monitored and potential impacts on behaviour of fish and wildlife documented?

## RESPONSE:

It is correct that the effect of mercury exposure on fish health has been increasingly studied over the past decade and that (mainly) laboratory studies have shown the potential for environmentally relevant mercury levels (0.5-1.2 ppm in axial muscle) to adversely affect biochemical processes, cell and tissue integrity, reproduction, and behaviour (review by Sandheinrich and Wiener 2011). However, the Partnership is not aware of any documented effect on fish survival at the above mercury tissue concentrations. Maternal transfer of mercury to the eggs has shown inconsistent results. The uptake of waterborne mercury by the eggs post-spawning has resulted in a moderate reduction in hatching success only at mercury concentrations normally not encountered in northern Manitoba waters (e.g., Latif et al. 2001).

Most importantly, there are no documented cases of effect to fish populations or fish communities as a result of elevated environmental mercury concentrations. This includes the detailed studies by Hydro Québec on several reservoirs for which maximum mercury levels in lake whitefish, northern pike, and walleye were several times higher and persisted longer than what is expected for the Keeyask reservoir (Schetagne et al. 2003; Roger Schetagne, Hydro Québec, pers. comm., July 2001).

Mercury concentrations in fish will be monitored one more time in the Keeyask area prior to construction and yearly post-construction until maximum levels are reached. Thereafter, monitoring will continue every 3-years until stable fish mercury concentrations are reached. There are no plans to study mercury effects on fish (and wildlife, see below) behaviour. Potential effects of the Project, including elevated environmental mercury levels on fish populations and fish communities will be assessed as part of the fish community monitoring. Details of the proposed Keeyask monitoring program are provided in the Aquatic Effects Monitoring Plan, which will be provided to regulatory agencies in the second quarter of 2013 (also see CEAA-0011).

As stated by the reviewer, adverse effects of mercury exposure have been demonstrated for several fish-eating wildlife species. To the best of the Partnership's knowledge, most of these dietary exposures were from laboratory experiments and at unrealistically high mercury concentrations. Estimated lowest observed effects levels have been established at 1.1 ppm dietary methylmercury (MeHg) for mink (Scheuhammer et al. 2007), a concentration the vast majority of fish in the Keeyask reservoir is not expected to exceed. Field studies on osprey (DesGranges et al. 1999) and bald eagle (Weech et al. 2006) have not found an effect of mercury exposure on reproduction and population health. The only well documented case of environmentally relevant mercury exposure on wildlife populations that the Partnership knows of exists for the common loon. Evers et al. (2008) found impaired loon reproduction resulting in substantially reduced numbers of fledged young for several North American areas at prey (fish) mercury concentrations as low as 0.16 ppm.

Post-Project monitoring will include tissue mercury concentrations in mink, river otter, muskrat, and beaver from samples voluntarily supplied by local harvesters in the Keeyask and Stephens Lake areas, and from nearby off-system areas where no increase in mercury levels is predicted. If required, voluntary sampling of mink, river otter, muskrat, and beaver may be supplemented by Scientific Permit collection. Monitoring of mercury in country foods (e.g., moose, caribou) will include voluntary submission of samples by First Nations. Wildlife behaviour will not be monitored as part of the Project.

## REFERENCES:

Evers, D. C., L. J. Savoy, C. R. Desorbo, D. E. Yates, W. Hanson, K. M. Taylor, L. S. Siegel, J. H. Cooley Jr., M. S. Bank, A. Major, K. Munney, B. F. Mower, H. S. Vogel, N. Schoch, M. Pokras, M. W. Goodale, and J. Fair. 2008. Adverse effects from environmental mercury loads on breeding common loons. Ecotoxicology 17:69 81.

DesGranges, J.-L., J. Rodrigue, B. Tardif, and M. Laperle. 1999. Breeding success of osprey under high seasonal methyl-mercury exposure. In: "Mercury in the

Biochemical Cycle", Lucotte, M., Schetagne, R., Thérien, N., Langlois, C., and Tremblay, A., eds., Springer, Berlin pp. 287-293.

Latif, M. A., R. A. Bodaly, T. A. Johnston, and R. J. P. Fudge. 2001. Effects of environmental and maternally derived methylmercury on the embryonic and larval stages of walleye (Stizostedion vitreum). Environmental Pollution 111:139-148.

Sandheinrich, M. B., and J. G. Wiener. 2011. Methylmercury in freshwater fish Recent advances in assessing toxicity in environmentally relevant exposures. In: "Environmental Contaminants in Biota", Beyer, W. N. and Meador, J. P., eds., CRC Press, Boca Raton, FL, pp. 169-190.

Scheuhammer, A.M., M.W. Meyer, M.B. Sandheinrich, and M.W. Murray. 2007. Effects of environmental methylmercury on the health of wild birds, mammals, and fish. Ambio 36(1): 12-18.

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Weech, S. A., A. M. Scheuhammer, and J. E. Elliott. 2006. Mercury exposure and reproduction in fish eating birds breeding in the Pinchi Lake region, British Columbia, Canada. Envir. Tox. Chem. 25:1433 1440.

**REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: N/A; p. N/A**

# MCWS-WQ-0004

## PREAMBLE:

While the impacts to fish and fish habitat are best referred to Manitoba Fisheries Branch, the potential creation of artificial spawning grounds implies that much is known about how fish choose spawning areas and that fish would choose these constructed spawning areas.

## QUESTION:

While we cannot directly ask fish about where they would like to spawn or direct them to a newly created habitat, some comment on the relative success and failure of artificially created spawning habitat would be appreciated from the proponent as it is understood these projects are not always successful.

## RESPONSE:

A lake sturgeon spawning structure downstream of the Keeyask Generating Station will be constructed to mimic a natural lake sturgeon spawning ground by providing depth, water velocity and substrate that typify a natural spawning location. Creation of lake sturgeon spawning habitat downstream of the Des Prairie Generating Station on the Des Prairie River in Quebec had a positive effect on lake sturgeon recruitment. In Manitoba, attempts to create lake sturgeon spawning habitat downstream of the Pointe Du Bois Generating Station on the Winnipeg River have been undertaken, as part of a Manitoba Hydro-funded research project. Although results collected to date are inconclusive, there is evidence that lake sturgeon have spawned either on or adjacent to the structures, and a considerable amount of data has been gathered on the habitat known to be used for spawning.

It may be difficult to monitor the success or failure of the Keeyask lake sturgeon spawning structure because present day lake sturgeon populations are extremely low and this limits the ability to clearly identify even slight increases in success. As part of the Aquatic Effects Monitoring Plan (to be provided to regulatory agencies in the second quarter of 2013) the structure at Keeyask will be monitored, in addition to recruitment of lake sturgeon in Stephens Lake. Lake sturgeon are known to spawn downstream of several generating stations in the Winnipeg River, particularly below Pointe du Bois where a combination of lake sturgeon egg collection mats and a DIDSON acoustic camera have effectively been utilized to monitor spawning extent and success. If possible or deemed feasible, a similar approach will adopted for the Keeyask Generating Station spawning structure. Provisional plans and design concepts have been developed

to modify the constructed spawning site to better meet this life cycle requirement, based on if monitoring results and discussions with MCWS and DFO indicate modifications are required.

## REFERENCE: Volume: N/A; Section: N/A; Page No.: N/A

# NCN-0001

## QUESTION:

What impact will there be on system operations from the addition of the Keeyask Generating Station when combined with the Wuskwatim Project, as part of Hydro's operation of the Integrated Power System (also referred to as "systems effects" issues?

## RESPONSE:

Manitoba Hydro operates its system as an integrated system in order to meet Manitoba Hydro's load commitments in a secure, reliable and economic manner. The largest factor influencing system operations is the amount of water inflow from the large overall watershed into the hydroelectric system. These inflows vary widely from year to year. Manitoba Hydro has some limited ability to manage system flows and water levels primarily through the Churchill River Diversion (CRD), Grand Rapids (GR), and Lake Winnipeg Regulation (LWR) projects. Other factors that can impact system operations (system effects) include increased load demand as a result of growth of Manitoba's domestic demands and/or changes in export sales, change in export transmission capability, and the addition of supply such as Keeyask. System effects have occurred in the past and will continue to occur as all these factors will change in the future with or without the construction of the Keeyask Generating Station.

The expected system effects on specific areas of Manitoba Hydro's system as a result of adding Keeyask are described below:

- **Winnipeg River:** The hydroelectric generating stations on the Winnipeg River are "run-of-the-river" Stations. The water entering the reservoirs equals the water leaving the reservoir, generally within a day, i.e., no storage is used to alter river flows. This mode of operation will not change with the addition of the Keeyask Generating Station.
- **Churchill River Diversion:** CRD allows Manitoba Hydro to use storage in Southern Indian Lake (SIL) and divert flows from the Churchill River into the Burntwood River and then into the Nelson River to provide for more generation at the Lower Nelson Generating Stations. The CRD is most useful to Manitoba Hydro in the winter period to meet energy needs. Accordingly, Manitoba Hydro endeavours to fill Southern Indian Lake by the beginning of winter and to then withdraw stored water during the course of the winter to augment outflow from Lake Winnipeg. Typically, Southern Indian Lake water levels are drawn down from the maximum to levels approaching the minimum by late winter. The addition of the Keeyask Generating Station is not expected to change this fundamental operation of the CRD. In fact,

the addition of new generation on the lower Nelson River further supports operation of the CRD in this manner.

- **Grand Rapids:** Grand Rapids and operation of Cedar Lake provide both generation and storage operations for the Manitoba Hydro system. Cedar Lake storage and Grand Rapids generation are primarily used during high load hours during the winter and summer months. The addition of Keeyask Generating Station is not expected to change the mode of operation.
- **Lake Winnipeg Regulation:** The Lake Winnipeg Regulation Project allows Manitoba Hydro to control the outflow of Lake Winnipeg according to certain specified licensed conditions. Between the elevations of 711 ft and 715 ft asl, Manitoba Hydro is licensed to regulate Lake Winnipeg outflows for power production purposes. This includes managing outflows to meet Manitoba Hydro's load commitments in a secure, reliable and economic manner. When water levels are below 711 ft, the outflows are set by the Minister of Conservation and Water Stewardship to address drought conditions. When water levels are above 715 ft, Manitoba Hydro is required to maximize outflows from Lake Winnipeg for flood control purposes.

Future water regime conditions with and without the addition of the Keeyask Generating Station, were studied and it was concluded that:

- The water levels in the waterbodies downstream of Lake Winnipeg would follow the same general pattern as presently exists, since the main factor influencing water levels is the amount of system inflow.
- The changes in water levels associated with the addition of Keeyask are not expected to be discernible in the context of existing water level variations in the waterbodies downstream of Lake Winnipeg.

## REFERENCE: Volume: Executive Summary; Section: Appendix - Environmental Effects Analysis: Summary of Potential Effects, Mitigation/Enhancement and Residual Effects; p. 57

# NCN-0002a

## QUESTION:

Given experience on other recent Hydro projects, why is there no VEC listed on page 57 for disturbance of heritage sites that may not be documented as a "known archaeological site" but which may be disturbed during construction?

## RESPONSE:

The Valued Environmental Component (VEC) of Heritage Resources includes sites that have been identified and those that may be disturbed in the future.

The question references a table at the conclusion of the Executive Summary (page 57). This table summarizes potential effects on each VEC, measures to mitigate potential adverse effects and to enhance potential benefits, and a conclusion regarding the residual effect of the Project on each VEC. This table makes the following references to sites that may be disturbed during construction:

- "The shoreline will be monitored should erosion expose any unknown sites; controlled artifact collection will occur if required; and
- A Heritage Resources Protection Plan (HRPP) will be developed to protect heritage resources that may be discovered during construction."

By definition, an Executive Summary summarizes information in a larger document. In the case of heritage resources, for example, heritage resources are discussed in Sections 6.2.3.7 and 6.8 of the Response to the EIS Guidelines and in Part 3 of the Socio-economic Supporting Volume. These sections discuss sites that have been discovered and that may be found during construction.

**REFERENCE: Volume: Executive Summary; Section: Appendix Environmental Effects Analysis: Summary of Potential Effects, Mitigation/Enhancement and Residual Effects; p. 57**

# NCN-0002b

## QUESTION:

Also, why are heritage resources only defined using the definition in provincial legislation without incorporating Aboriginal concepts of sacred heritage sites, cultural property and values although it is recognized there is a discussion of the intangible nature of heritage resources (see e.g. page 1-4)?

## RESPONSE:

The definition of heritage resources is legislated in The Heritage Resources Act (Manitoba) (1986) and provides the foundation for the environmental assessment. The Partnership relied heavily on local values during the assessment.

For example, for the heritage resources impact assessment, Elders regularly participated in fieldwork investigations alongside the archaeologist and provided knowledge and anecdotes related to archaeological sites. Elders were instrumental in directing archaeological field investigations to areas that they remembered from their past experiences. Where knowledge of past activities was shared, the locations were investigated principally on this cultural knowledge.

Aboriginal concepts of sacred heritage sites, cultural property and values are discussed under Section 6.2 Aboriginal Traditional Knowledge (Keeyask Generation Project: Response to the EIS Guidelines p. 6-425 to 6-428) and Section 6.6.5.6 Culture and Spirituality (Keeyask Generation Project: Response to EIS Guidelines, p. 6-488 to 6-494).

The KCNs' Environmental Evaluation Reports, which were included in the EIS filing, provide extensive information about Cree values and worldview. Chapter 2 of the Response to the EIS Guidelines is focused largely on Cree values and worldview. The remainder of the Response to the EIS Guidelines contains many references to Cree values and worldview. The Waterways Management Plan (JKDA, schedule 11) indicates continued involvement of the KCNs in identifying and protecting spiritually and culturally significant, historical or heritage sites.

## REFERENCE: Volume: Socio-Economic, Resource Use and Heritage Resources Supporting Volume; Section: Part 3 Heritage Resources; p. 1-34 and 1-35

# NCN-0003

## QUESTION:

What is the plan for ensuring there is Aboriginal control over any finding of Aboriginal human remains and related belongings given that page 1-34 of the Supporting Volume on Socio-Economic Environment, Resource Use and Heritage Resources indicates that provincial legislation and the HRPP will prevail if "unknown heritage resources are unearthed or exposed during construction" and page 1-35 indicates that "if the human remains are determined to be non-forensic" provincial legislation and policies will be followed?

## RESPONSE:

The approach used is consistent with provincial legislation and this will be reflected in the Heritage Resources Protection Plan (HRPP), which will be provided to regulatory agencies in the first quarter of 2013 (also see CEAA-0011). The Historic Resources Branch is the provincial authority responsible for managing *The Heritage Resources Act* (Manitoba) (1986) and the Policy Concerning the Reporting, Exhumation and Reburial of Found Human Remains (1987). *The Act* protects all heritage resources regardless of whether a project occurs or not and regardless of cultural affiliation. The HRPP will address both known and yet-to-be-discovered heritage resources; they will receive immediate attention and mitigation should an event arise that places known and discovered sites at risk. Several core concepts will be incorporated into the HRPP, including value and respect for Cree cultural heritage, stewardship, meaningful involvement, consistency with existing legislation, and culturally appropriate application of protocol.

### Found Human Remains

In the case of found human remains, the RCMP along with a delegate of the Historic Resources Branch, are notified. If the human remains are considered to be of a forensic nature, that is, a suspicious death, the RCMP takes charge of the investigation under *The Fatality Inquiries Act*. If it is determined that the human remains are not forensic, *The Heritage Resources Act* (Manitoba)(1986) takes precedence. Provincial policy states that the Province will work with the closest Aboriginal group to ensure that the remains are respectfully handled in a tradition that is identified by the Aboriginal group. (Please see Part IV Section 43 (1) for the definition of human remains; as well as Manitoba's Burials Policy pamphlet, Point 3 "Community consultation takes place before exhumation or removal of human remains or associated grave goods").

The HRPP, as part of the Environmental Management Program, sets out the process of authority in a manner that is easily accessible and understandable to construction crews and the Environmental Officers at the construction site. Any human remains that are found during construction and operation will be placed in a consecrated cemetery to be identified by TCN in consultation with the other project partners at a location chosen prior to the start of construction.

## REFERENCE: Volume: Socio-Economic Environment, Resource Use and Heritage Resources; Section: Part 3 Heritage Resources; p. 1-33

# NCN-0004

## PREAMBLE:

It is acknowledged that avoidance of heritage sites may not be possible (page 1-33).

## QUESTION:

Given this assessment, why are there no mitigation measures to reduce winter construction in the areas of potential sites, along with ground truthing in advance of heavy equipment operation that may disturb such sites, both of which may help to avoid disturbance of known and unknown heritage sites?

## RESPONSE:

Extensive work has been undertaken during the environmental assessment to identify heritage resources within the heritage resources study area (see Response to the EIS Guidelines Section 6.2.3.7 and Socio Economic Supporting Volume, Part 3, Sections 1.2 through 1.5).

Mitigation measures have been identified to reduce adverse effects on heritage resources. They include archaeological salvage of seven known sites, working with KCN participants in the Waterways Management Plan pertaining to high priority heritage sites, recovering any heritage resources found in dewatered areas, development of a cemetery for reburial of human remains found during construction and operation of the Project, monitoring of the shoreline until the full supply level of the reservoir is reached and educating those working at the site about the importance of heritage resources (see Response to the EIS Guidelines Sections 6.8.3.1 and 6.8.3.2 and Socio-Economic Supporting Volume, Part 3, Section 1.6).

Even with these measures in place, it is important to be prepared to address undiscovered heritage resources if they are encountered during construction of the Keeyask Generation Project. The Partnership will be providing regulators with a Heritage Resources Protection Plan, which will describe the processes that will be followed should heritage resources be discovered (see Response to the EIS Guidelines Sections 6.8.3.1 and 6.8.3.2 and Socio-Economic Supporting Volume, Part 3, Section 1.6).

## REFERENCE: Volume: Project Description; Section: 2.0 Project Components; p. 2-24 and 2-25

# NRCan-0001

## PREAMBLE:

The proponent plans to construct and utilize 3 landfill sites to dispose of waste. Details on the location and construction of the landfill sites are not provided. Therefore the potential effect on groundwater quality cannot be assessed. Information on the placement and construction of landfills provided in a hydrogeological context allows for the assessment of whether groundwater may become contaminated from such a facility.

## QUESTION:

Information on geographic location and depth of the landfill is requested. Discuss the type of liner to be used (natural, engineered). Discuss which hydrogeological units (and the characteristic properties of the units) are expected to be in contact with the waste.

## RESPONSE:

Section 4.3.2.1 of the Response to EIS Guidelines indicated that a landfill would be developed at the camp or solid waste would be hauled to a licensed landfill. Since completing the EIS, it has been determined that waste will be hauled to the Thompson Waste Disposal Site. Written approval has been granted from the Thompson Waste Disposal Site to accept solid waste generated during the Keeyask Infrastructure Project and Keeyask Generation Station Project. If the decision had been to develop a landfill, it would have been constructed and operated in accordance with Manitoba legislation and standards.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.6.14 Water and Wastewater Treatment; p. 4-39

# NRCan-0002

## PREAMBLE:

The proponent plans to drill a potable water well for use during the construction phase of the project. Details on the location, construction and future usage of this well are not provided.

## QUESTION:

Provide details on the location, construction, and future usage of the potable well to be drilled and utilized during the project construction phase.

## RESPONSE:

Potable water for the main camp will be obtained from two new 10" wells. The location of the wells is as shown in Figure 2.2-1 of the Keeyask Infrastructure Project (KIP) Environmental Assessment Report (Appendix A). If the wells are not required after construction they will be decommissioned in compliance with the *Groundwater and Water Well Act* (Manitoba).

### Appendix A: Location of Potable Well

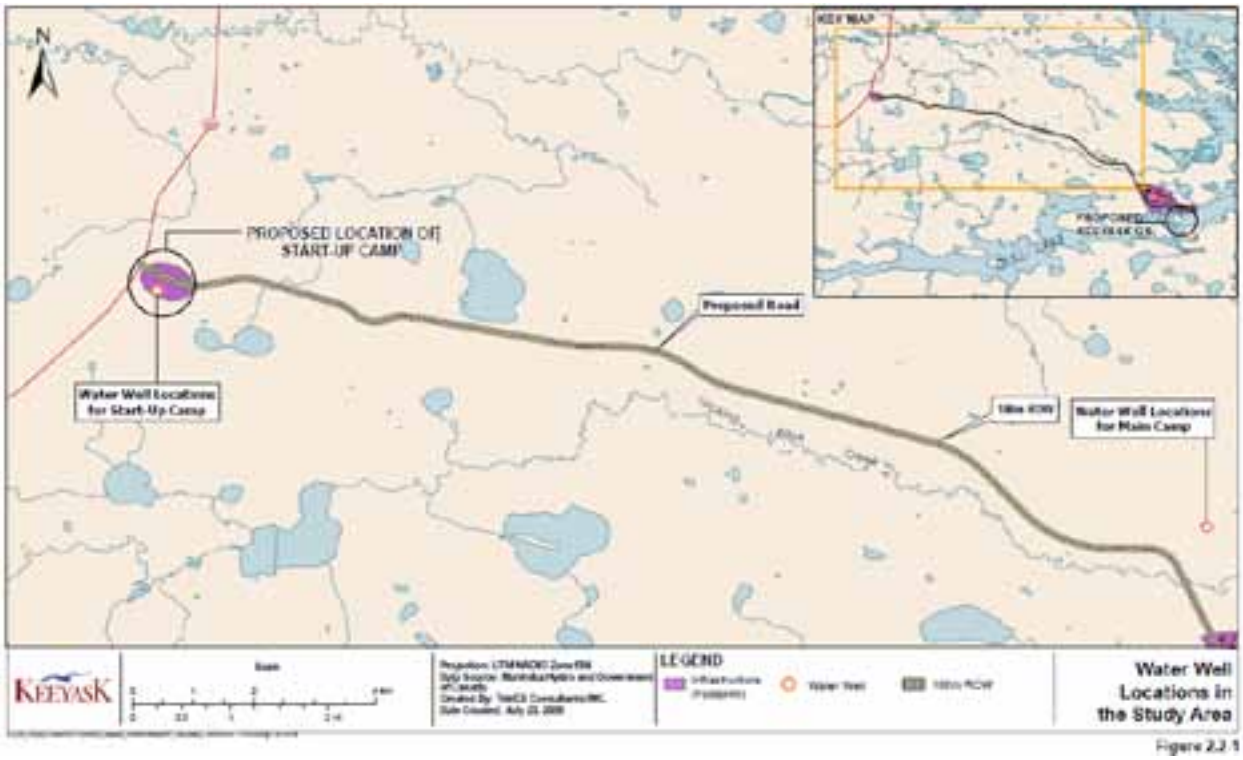


Figure 2.2-1

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.6.16 Decommissioning of Temporary Infrastructure; p. 4-40 to 4-41

# NRCan-0003

## PREAMBLE:

The proponent plans to drill a potable water well for use during the construction phase of the project. It is not clear if this well will be used beyond the construction phase or if it will be decommissioned following the construction phase. Decommissioning of wells no longer needed is required in order to protect groundwater. Abandoned wells can provide a conduit for groundwater contamination.

## QUESTION:

Clarify if the potable well to be drilled and utilized during project construction will be used beyond this phase or decommissioned. Provide details on the future decommissioning of this well.

## RESPONSE:

The potable wells (see response to NRCan-0002) are expected to be temporary and only used during the project construction. If no further requirement is identified for the wells post-construction, they will be decommissioned in compliance with the *Groundwater and Water Well Act* (Manitoba).

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.2.3.2.9 Groundwater; p. 6-48

# NRCan-0004

## PREAMBLE:

The proponent acknowledges an inconsistent relationship between water levels in groundwater and adjacent lakes. This assessment is based on only 8 monitoring wells drilled on site. In order to better understand the relationship between groundwater and surface water, data collection from additional monitoring wells is recommended.

## QUESTION:

NRCan recommends that the proponent construct and monitor additional monitoring wells for a better understanding of the baseline groundwater-surface water relationships.

## RESPONSE:

While a limited number of monitoring wells were used in the groundwater assessment, the installation and monitoring of additional wells is not warranted to fulfill the intended purpose and level of detail for which the groundwater assessment was performed. The assessment is based on a substantial amount of information in addition to the data from the eight monitoring wells drilled on site.

The groundwater model for the Keeyask project is a regional model that was primarily developed to provide an overall assessment of the potential Project effects on terrestrial valued ecosystem components (VECs). The groundwater study area considered in the model is extensive, covering approximately 565 $km^2$ (Physical Environment Supporting Volume, Section 8.2.2 and Map 8.2-1), which is about 20% larger than the area of the City of Winnipeg (about 464 $km^2$). Because of the large size of the model area, it is not reasonably practical to develop the model to a level of detail that might be used in a more typical assessment for projects that, relatively speaking, affect a much smaller area (e.g., sewage lagoon). Rather, the approach taken was to develop an understanding of the general groundwater regime in the study area. In addition to the eight monitoring wells referenced, the model drew upon multiple sources of information to characterize the study area for modeling purposes including:

- stratigraphy/geology from more than 850 boreholes drilled across and beyond the study groundwater study area for various engineering studies (Figure 1);
- data from over 500 soil sampling locations (from terrestrial environment studies) along current and future shorelines and within future flooded areas, which

identified surficial soil layers, and at most locations identified the depth to mineral material such as till or bedrock (Figure 2);

- surface terrain classifications which, in conjunction with data from the soil sampling studies, can provide an estimate of depth to mineral material in areas not sampled (Figure 3);
- shoreline material classifications, which provide an indication of material type at the existing shoreline boundary (Figure 4);
- topography from a digital terrain model based on various surface elevation data sets extending beyond the groundwater study area (Figure 5);
- water level time series data at 23 sites along the Nelson River under different flow conditions (Figure 6);
- water level time series data from eight monitoring wells (Figure 6, 'diver' locations) and 12 surface water locations (Figure 6, 'hobo' locations);
- information from geotechnical studies (see NRCan-0011);
- bathymetry of the river in the study reach; and
- environmental data including precipitation.

While the monitoring wells do not extend across the breadth of the study area, they are located in areas that are well characterized with respect to surficial soils and subsurface geology. Monitoring results from these wells were used to calibrate the model (see also NRCan-0013), which provides confidence that the groundwater characteristics are being reasonably reproduced for surface/subsurface materials that are generally representative of those within the groundwater study area. The model was peer reviewed by two independent, outside parties who concluded it was appropriately constructed as a regional model and suitable for the intended use.

Predicted effects of the Project on groundwater were found to be laterally localized, extending outward from the reservoir shoreline. Predicted indirect groundwater effects on the terrestrial environment were identified as occurring along the edges of the Keeyask reservoir and not inland areas (Terrestrial Environment Supporting Volume Section 2.3.6.3.1, p. 2-101). These results are consistent with observations from proxy study areas on the Kettle reservoir (i.e., Stephens Lake immediately downstream of Keeyask), where shoreline conditions are similar to those that would be present in the Keeyask reservoir (Terrestrial Environment Supporting Volume Section 2.3.6.3.1 p. 2-101).

While additional monitoring wells might provide further information regarding the existence or non-existence of connections between surrounding area lakes and the groundwater system, the proponent does not believe additional monitoring would substantively change the assessed effects to an extent that would justify the significant level of effort and cost that would be required.

73 Please see also NRCan-0007 for additional discussion on monitoring.

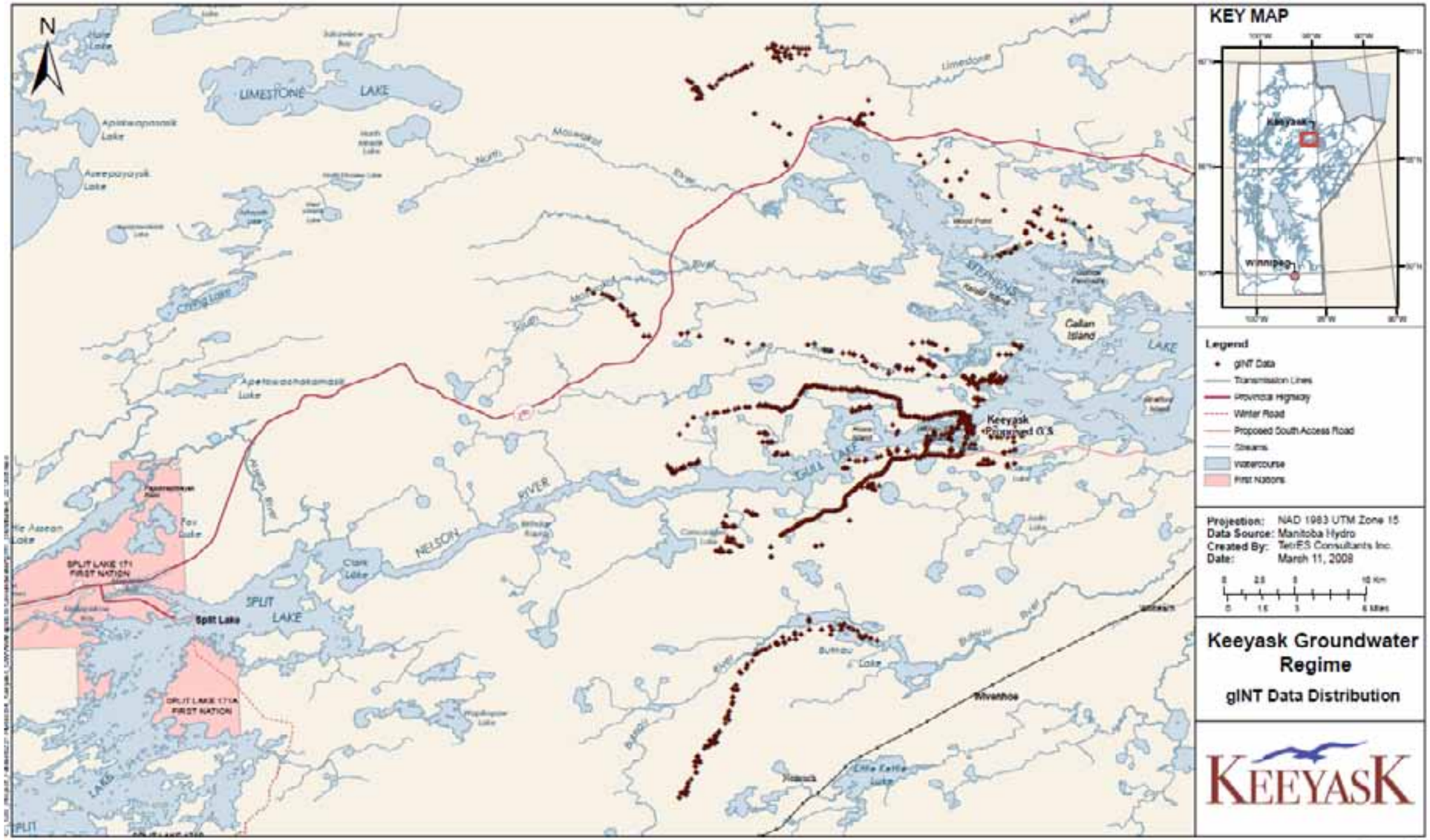


Figure 1 – Borehole locations in the Keeyask area

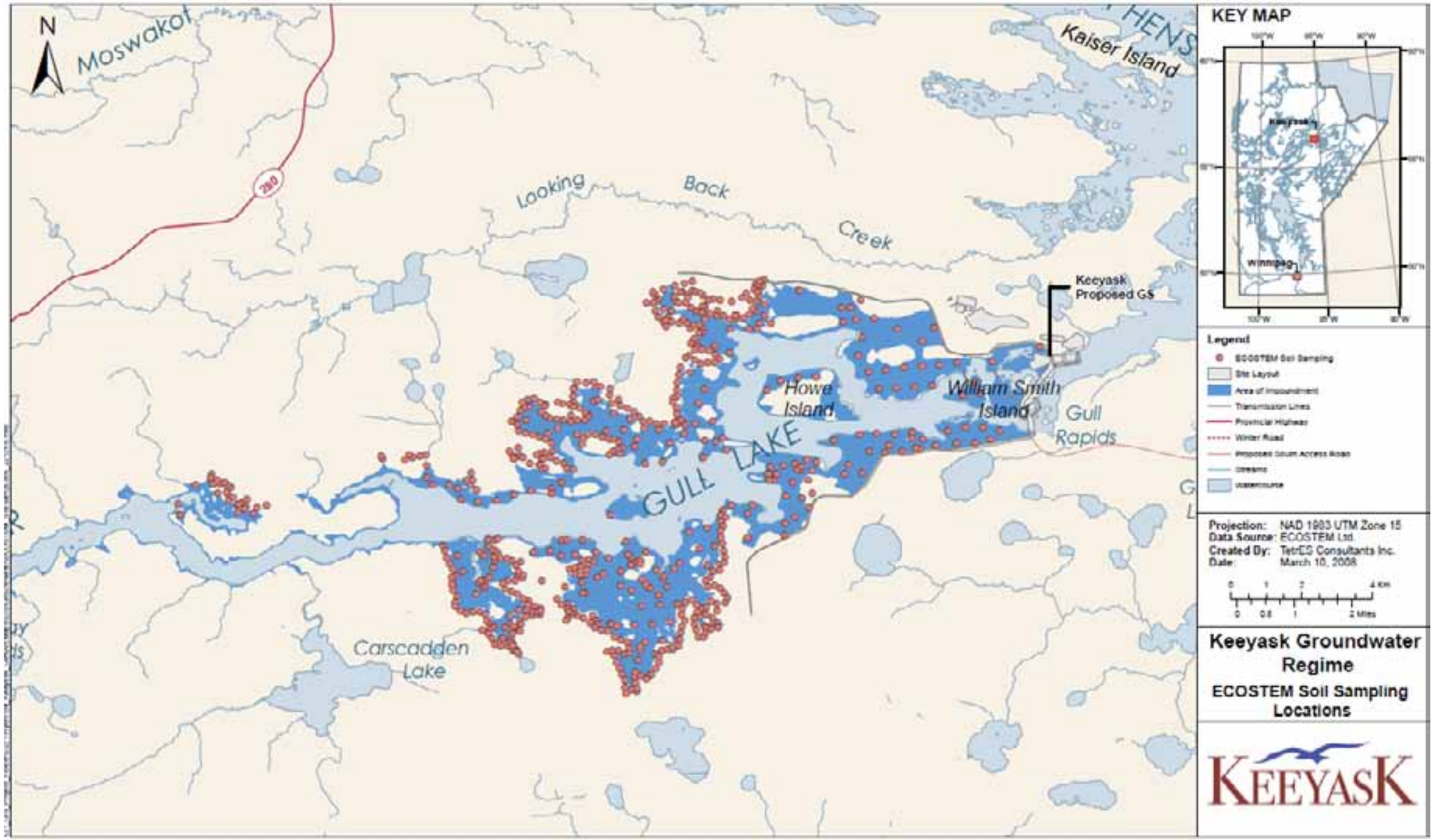


Figure 2 –Terrestrial Environment Soil Sampling Locations

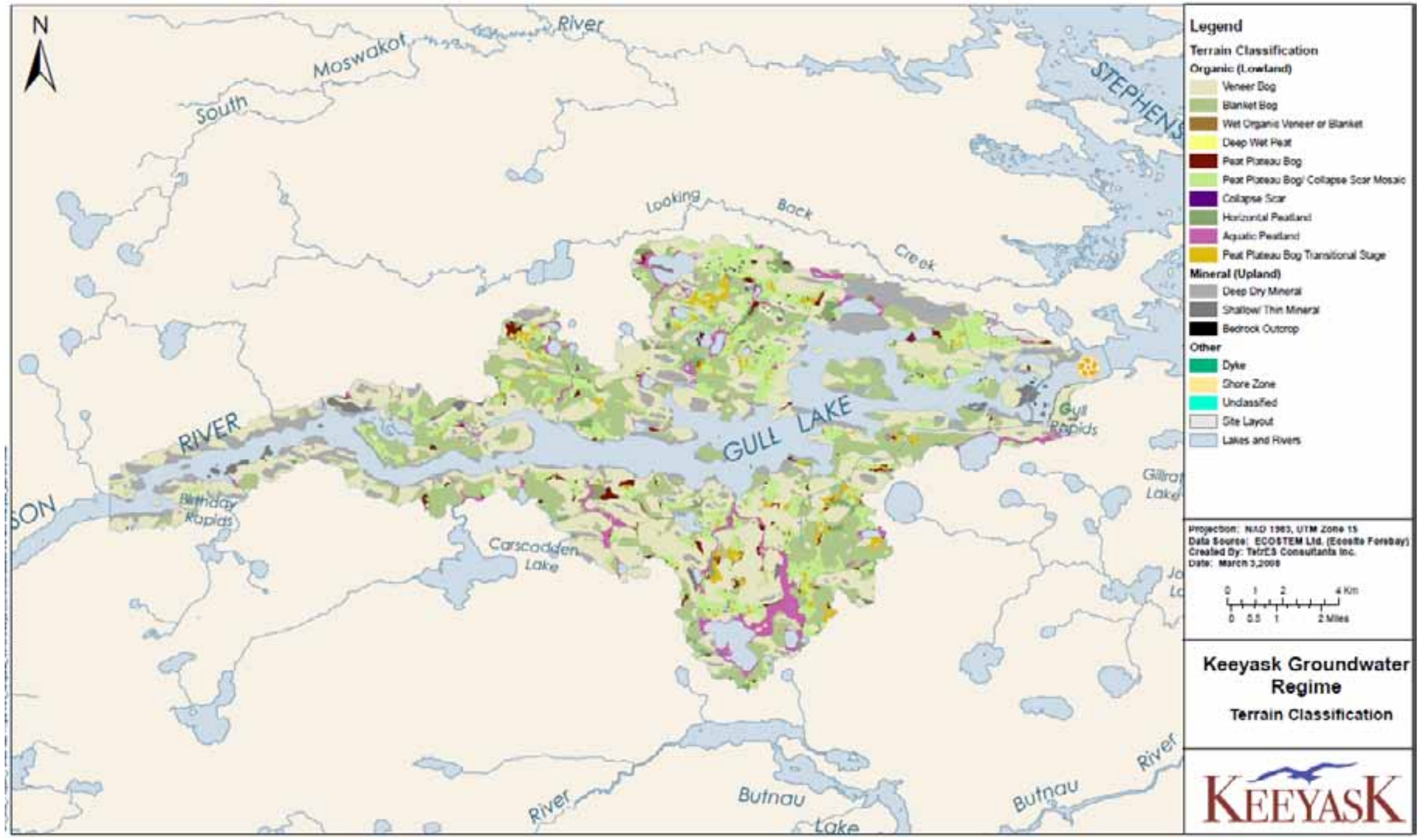


Figure 3 – Terrain Classification

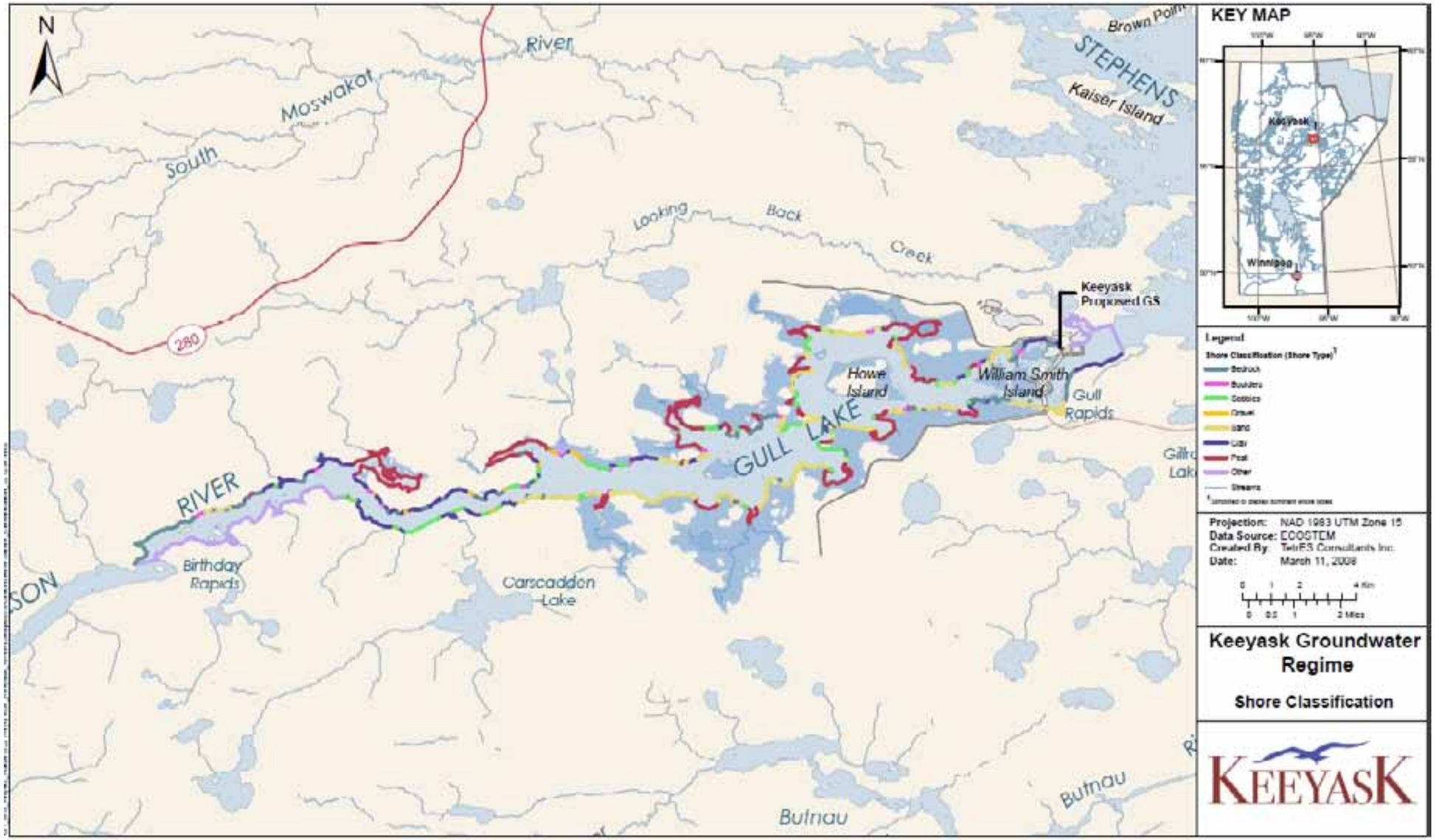


Figure 4 – Shoreline Material Classification

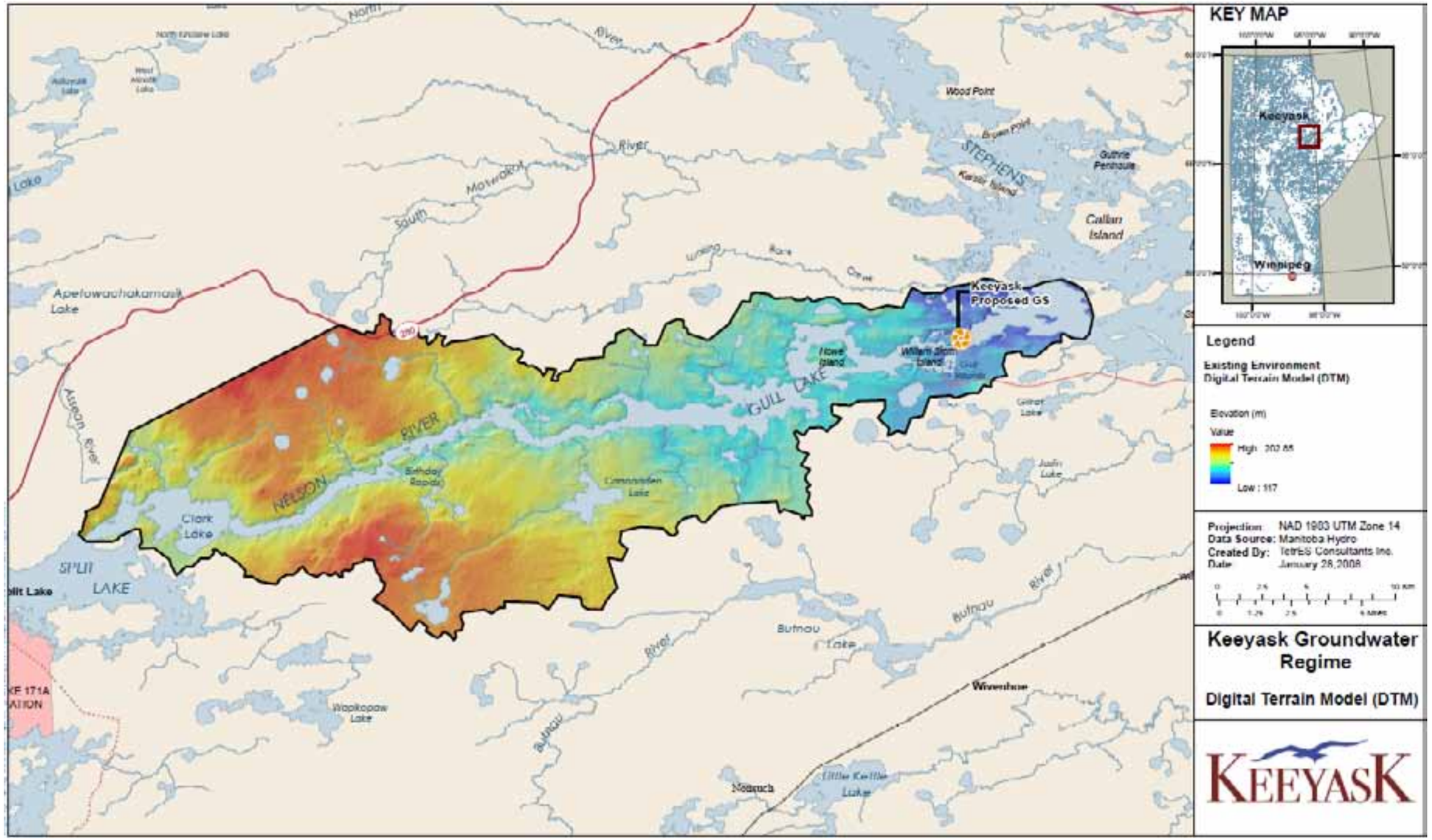


Figure 5 – Digital Terrain Model

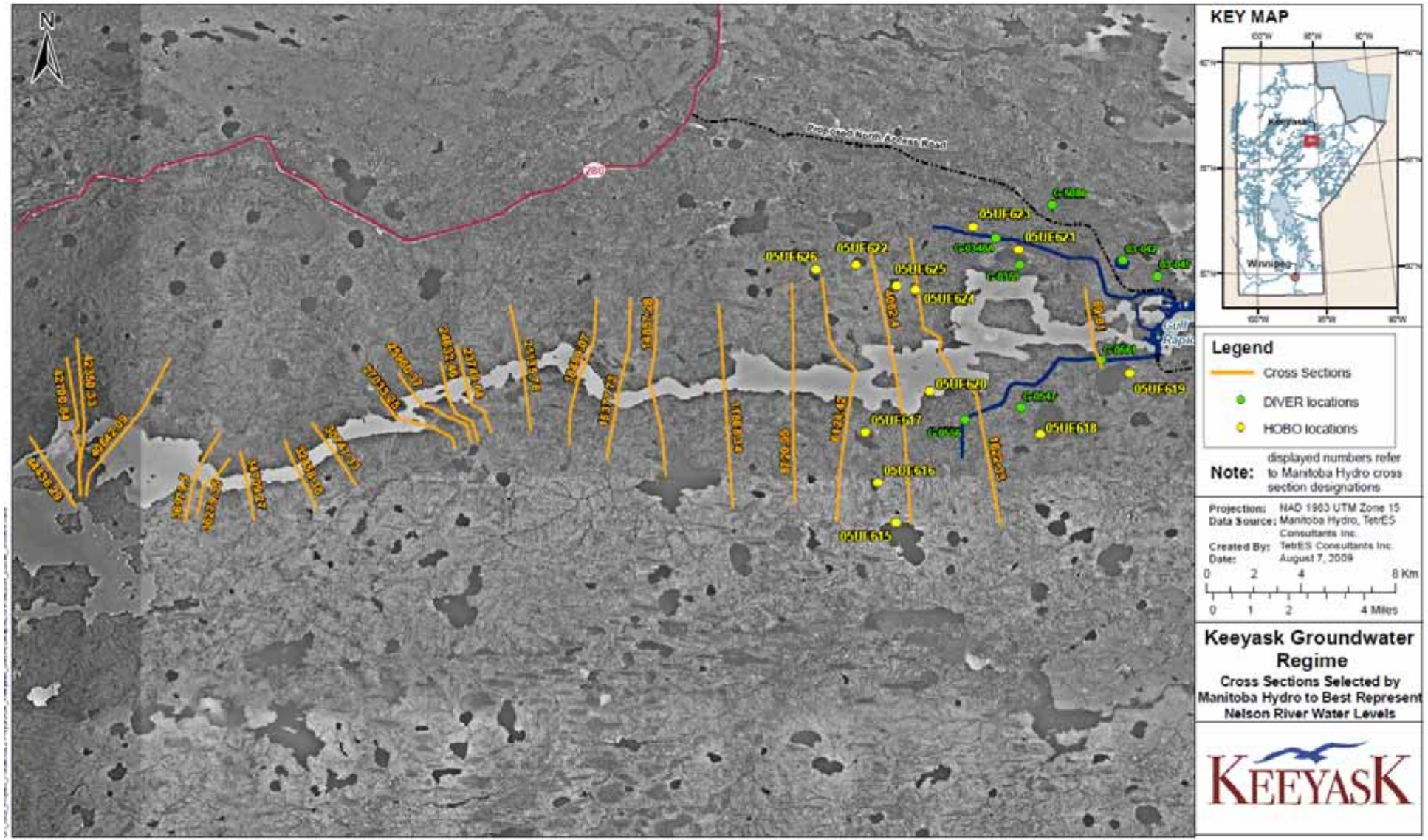


Figure 6 –Locations at which Nelson River water levels were defined (i.e., river level time series)

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.2.3.2.9 Groundwater; p. 6-50

# NRCan-0005

## PREAMBLE:

The proponent discusses baseline groundwater quality based on reference to the literature. They also mention that on-site groundwater analyses confirm this and discuss elevated zinc concentrations. However, there is no information provided with respect to on-site sampling. It is unclear how many on-site samples were collected and what parameters they were analysed for. The analytical results are not presented. The absence of this information makes it impossible to assess if baseline conditions of groundwater quality have been adequately determined.

## QUESTION:

Provide the location of on-site groundwater monitoring well sampling sites. Provide information on the frequency of groundwater sampling from these sites. Provide information on sampling and laboratory methodologies, including a discussion of quality assurance and quality control. Present the analytical results of all field-derived and laboratory analyses. Provide a direct comparison, by means of a table, of groundwater quality determined from on-site measurements versus groundwater quality gleaned from the literature. It is recommended the following physical and chemical parameters be tested for in groundwater: alkalinity, temperature, pH, Eh, electrical conductivity (EC), major ions, nutrients, minor and trace constituents, and metals (including methyl mercury).

## RESPONSE:

Although there are no identified users of groundwater in the Local Study Area, and no likely future users, groundwater monitoring was completed on two occasions in the Local Study Area:

- During a camp well investigation; and
- As part of the groundwater assessment supporting the Keeyask EIS.

Note that groundwater will be used for the camp, and will be treated in a treatment plant, but the planned well location is well beyond predicted effects of the Project on groundwater. Samples collected during these field campaigns were collected following industry-standard protocol, in laboratory-issued containers, field stabilized (as appropriate) and then submitted for analysis to ALS Labs (a CAEAL-accredited laboratory) in Winnipeg. Field measurements included temperature, pH, electrical conductivity (EC), and total dissolved solids (TDS). The requested analysis by the

laboratory included: alkalinity, major ions, nutrients, minor and trace constituents, and metals (including mercury). Redox potential (Eh) is routinely used in metal mining applications, but was not deemed necessary for the purposes of the Keeyask study.

The analytical results from both monitoring events confirmed the previous findings of Betcher *et al.* (1995), finding calcium-magnesium-bicarbonate water with a pH between 6.5 and 7.5 and field-measured TDS concentrations between 470 and 550 mg/L. Table 1 below presents sample analytical results, which were summarized in the EIS submission. The locations of the wells shown in Table 1 are shown on Map 8.2-2 in Section 8 (Groundwater) of the Physical Environment Supporting Volume. As indicated in the EIS and Table 1 below:

- Groundwater-manganese concentrations exceeded the aesthetic objective for drinking water;
- Groundwater-zinc concentrations exceeded the water quality guideline for the protection of aquatic life stipulated by the Canadian Council of Ministers of the Environment (CCME), but were below the respective drinking-water objective; and
- A single exceedance of the CCME copper water-quality guideline for protection of aquatic life was observed in one well (well G0348A), however, it is believed that this elevated measurement may have been a result of the use of, and contamination of the sample, by a copper rod used to weight the bailer during groundwater collection.

**Table 1: Concentrations of Dissolved Components (mg/L) in Groundwater within the Study Area.**

| Parameter | G0547 | G0348A | G0359 | CCME Guidelines | |
|---|---|---|---|---|---|
| | | | | Aquatic Life | Community Water |
| pH | 6.8 | 7.4 | 7.5 | 6.5-9 | *6.5-8.5* |
| Alkalinity, Total (as $CaCO_3$) | 356 | 343 | 306 | - | - |
| Bicarbonate ($HCO_3$) | 434 | 418 | 373 | - | - |
| Ammonia ($NH_3$) | 0.023 | 0.272 | 0.059 | 4.4-6.7 | - |
| Chloride (Cl) | 1.0 | 1.6 | 1.2 | - | *250* |
| Fluoride (F) | 0.4 | 0.6 | 0.6 | - | 1.5 |
| Nitrate+Nitrite-N | 0.081 | 0.048 | 0.093 | 60 | 45 |
| Sulphate | 8 | 6 | 6 | - | *500* |
| Mercury (Hg) | <0.00005 | <0.00005 | <0.00005 | 0.0001 | 0.001 |

| Parameter | G0547 | G0348A | G0359 | CCME Guidelines | |
|---|---|---|---|---|---|
| | | | | Aquatic Life | Community Water |
| Silver (Ag) | <0.0005 | <0.0005 | <0.0005 | 0.0001 | - |
| Aluminum (Al) | <0.02 | <0.02 | <0.02 | 0.005-0.1 | - |
| Arsenic (As) | <0.0005 | 0.0012 | 0.0009 | 0.005 | 0.025 |
| Boron (B) | <0.02 | <0.02 | <0.02 | - | - |
| Barium (Ba) | 0.0228 | 0.0355 | 0.0342 | - | 1 |
| Beryllium (Be) | <0.001 | <0.001 | <0.001 | - | - |
| Bismuth (Bi) | <0.0003 | <0.0003 | <0.0003 | - | - |
| Calcium (Ca) | 65.8 | 84.3 | 59.2 | - | - |
| Cadmium (Cd) | <0.0002 | <0.0002 | <0.0002 | 0.00017 | 0.005 |
| Cobalt (Co) | 0.0011 | <0.0002 | 0.0016 | - | - |
| Chromium (Cr) | <0.001 | <0.001 | <0.001 | 0.01 | 0.05 |
| Cesium (Cs) | <0.0001 | <0.0001 | <0.0001 | - | - |
| Copper (Cu) | 0.0019 | **0.125** | 0.0015 | **0.002-0.004** | 1 |
| Iron (Fe) | <0.01 | <0.01 | <0.01 | 0.3 | *0.3* |
| Potassium (K) | 1.75 | 2.45 | 1.67 | - | - |
| Magnesium (Mg) | 15.1 | 17.8 | 16.7 | - | - |
| Manganese (Mn) | **0.0758** | **0.0811** | **0.117** | - | ***0.05*** |
| Molybdenum (Mo) | 0.0010 | 0.0011 | 0.0010 | 0.073 | - |
| Sodium (Na) | 1.70 | 4.34 | 3.16 | - | *200* |
| Nickel (Ni) | 0.0011 | 0.0007 | 0.0019 | 0.025 | - |
| Phosphorus (P) | 0.04 | 0.06 | 0.02 | - | - |
| Lead (Pb) | <0.0001 | 0.0004 | <0.0001 | 0.001 | 0.01 |
| Rubidium (Rb) | 0.0008 | 0.0018 | 0.0006 | - | - |
| Antimony (Sb) | <0.001 | <0.001 | <0.001 | - | 0.006 |
| Selenium (Se) | <0.001 | <0.001 | <0.001 | 0.001 | 0.01 |
| Silicon (Si) | 3.7 | 5.3 | 4.5 | - | - |

| Parameter | G0547 | G0348A | G0359 | CCME Guidelines | |
|---|---|---|---|---|---|
| | | | | Aquatic Life | Community Water |
| Tin (Sn) | 0.0004 | 0.0011 | <0.0003 | - | - |
| Strontium (Sr) | 0.0526 | 0.0926 | 0.0596 | - | - |
| Tellurium (Te) | <0.0005 | <0.0005 | <0.0005 | - | - |
| Titanium (Ti) | <0.0005 | <0.0005 | <0.0005 | - | - |
| Thallium (Tl) | <0.0001 | 0.0002 | <0.0001 | 0.0008 | - |
| Uranium (U) | 0.0039 | 0.0016 | 0.0005 | 0.02 | - |
| Vanadium (V) | <0.001 | 0.001 | 0.001 | - | - |
| Tungsten (W) | 0.0002 | <0.0002 | <0.0002 | - | - |
| Zinc (Zn) | **0.295** | **1.74** | **1.09** | **0.03** | 5 |

*Notes: CCME aesthetic objective for drinking water shown in italics; "-" = no guideline established; **bold** text denotes an exceedance of a guideline(s).*

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.3.9.1 Construction Effects and Mitigation, Section: 6.3.9.2 Operation Effects and Mitigation; Map 6-54; p. 6-218 to 6-219

# NRCan-0006

## PREAMBLE:

The proponent considers the possibility of groundwater contamination as a result of accidents/spills and claims that with proposed protection measures no residual quality effects are predicted. However, they do not assess any other sources of possible contamination. These could include contamination resulting from the landfill (see NRCan comment 1) or contamination of groundwater caused by project-induced changes to the hydrogeological regime that result in potentially contaminated surface water flowing into the groundwater system. Modeled groundwater flow directions (post project) indicate that flow along the Nelson River is generally from groundwater towards the River. However, this may not be the case in the vicinity of the generator/dams. For example, groundwater on the south side of Gull Lake will decrease in velocity or flow away from the flooded zone (p. 6-219).

## QUESTION:

Discuss the possibility of flow from the Nelson River to groundwater in the vicinity of the generator/dams during the construction and operation phases of the project. Discuss the possibility of groundwater contamination from potentially contaminated surface water, including possible methyl mercury contamination. Discuss measures taken to avoid groundwater contamination in this area.

## RESPONSE:

Since completing the EIS, the Partnership has decided not to develop a landfill. Rather, waste will be hauled to a licensed landfill (also see response to NRCan-0001).

As indicated in Section 8.4.2.3 of the Physical Environment Supporting Volume , groundwater flow direction is not predicted to change with the construction and operation phases of the Project, except in the immediate vicinity of the principal structures near Gull Rapids and the South Dyke (regardless of meteorological and river-flow conditions). Groundwater movement is expected to remain towards the surface-water network (i.e., the Nelson River, its tributaries, and/or adjacent lakes and streams), except in the vicinity of the principal structures where some small changes during operation are predicted (see Map 8.4-1 and Appendix 8B). In this area, the groundwater flows are altered due to the construction of the dykes and dams, which cut off the connection between the Nelson River (i.e., reservoir) and the local groundwater flow. Seepage through the dykes will be minor and will be collected by surface drainage

systems that direct this water to natural drainage networks that flow back to the Nelson River.

Groundwater quality (and therefore the potential for groundwater contamination) is not predicted to change with the above highly localized alterations to the existing groundwater flows.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.3.9.1 Construction Effects and Mitigation; p. 6-218

# NRCan-0007

## PREAMBLE:

The proponent states that future monitoring of groundwater levels in the project vicinity is not proposed. Monitoring of groundwater levels is an important means for validating the numerical groundwater model which is used to predict project-related effects to groundwater. Given that there were only 8 on-site groundwater monitoring wells, additional monitoring wells (see NRCan comment 4) and future monitoring of those wells is recommended.

## QUESTION:

NRCan recommends that future monitoring (pre-construction, construction, and operation phases) of groundwater levels continue in order to validate model predictions.

## RESPONSE:

The primary purpose for developing a groundwater model and conducting the groundwater analysis was to support the terrestrial environment studies, such as those related to terrestrial plants and habitats. Increased groundwater elevation adjacent to the reservoir may have indirect effects on the terrestrial environment. For example, wetter conditions in the root zone may result in changes to surface vegetation, which can be observed during project monitoring.

Groundwater predictions will be verified by monitoring the direct and indirect Project effects on the terrestrial environment. Post-project monitoring is planned on the terrestrial environment around the reservoir shoreline (Terrestrial Environment Supporting Volume, Section 2.12, Table 2-52) and will be designed to document actual direct and indirect effects on terrestrial habitat (i.e., habitat loss and change), including indirect groundwater effects. Monitoring activities will include periodic in-situ observations at terrestrial monitoring sites, including measuring depth to groundwater within the root zone to determine if a change in groundwater is causing an effect on the terrestrial environment. Terrestrial monitoring to measure habitat loss and change will provide an overall indication of groundwater effects on a broader scale around the +/- 250 km reservoir shoreline than would be reasonably practicable using a limited number of groundwater wells at discrete locations. The monitoring will thus be focused on the verification of the predicted effects on the terrestrial environment, which would indirectly verify the groundwater assessment results used in the prediction of terrestrial effects.

Except for development of the Keeyask Generation Project, there are no present or reasonably foreseeable future groundwater users in the groundwater study areas (also see response to NRCan-0009), therefore, monitoring of groundwater for effects on groundwater users is not required.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 8.2 Approach and Methodology, 8.3 Environmental Setting; p. 8-2 to 8-15

# NRCan-0008

## PREAMBLE:

There is no mention of other possible groundwater users in this area. It is essential to know if there are any groundwater users within the defined study area, particularly those who may use the water as drinking water. Groundwater may become contaminated as a result of project activities and any existing groundwater wells may become contaminated as a result.

## QUESTION:

Clarify if there are any present or reasonably foreseeable future groundwater users in the groundwater study area (defined in Section 8.2.2). If there are, provide the location of the wells, well completion details, the existing water quality in the wells, and discuss whether the wells are used for drinking water.

## RESPONSE:

Except for development of the Keeyask Generation Project, there are no present or reasonably foreseeable future groundwater users in the groundwater study area (also see response to NRCan-0009).

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 8.2.1.3 Future Environment With the Project; p. 8-3 to 8-4

# NRCan-0009

## PREAMBLE:

The proponent acknowledges that potential changes to future groundwater quality resulting from the proposed project are assessed only in a qualitative manner. It is unclear why these potential changes were not assessed quantitatively, using the numerical groundwater model.

## QUESTION:

Provide justification for the absence of a quantitative assessment of changes to future groundwater quality.

## RESPONSE:

There are no present or reasonably foreseeable future groundwater users in the groundwater study area with the exception of the construction camp. The camp will use groundwater drawn from an area outside the predicted effects of the Project on groundwater, and the water will be treated in a treatment plant (see also response to NRCan-0006 and NRCan-0008). Groundwater water quality does not directly affect vegetation; rather, effects on vegetation are a result of changes to groundwater levels. For these reasons, the quantitative assessment of changes to future groundwater quality was not deemed to be required.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 8.2.3.3 Groundwater Data and Information Sources; p. 8-7

# NRCan-0010

## PREAMBLE:

The hydraulic conductivity range is given as 1x10-4m/s to 1x108 m/s. This must be a typo (should be 1x10-8), as this range is unrealistic.

## QUESTION:

Correct typo on page.

## RESPONSE:

The value shown ($1x10^{8}$ m/s) is a typo. The value should read $1x10^{-8}$ m/s.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Table 8.3-1 Soil and Bedrock Properties: Keeyask GS Area; p. 8-12

# NRCan-0011

## PREAMBLE:

No reference is provided for this table of hydraulic conductivity values. It is unclear if these values are derived from the literature or from on-site data.

## QUESTION:

Clarify the source of the hydraulic conductivity data in Table 8.3-1.

## RESPONSE:

The hydraulic conductivities used in the groundwater model are based on typical values which are considered to be representative of the materials encountered at the site. These values were supported by a limited number of falling head permeability tests performed during field exploration programs carried out for the Keeyask project. As expected, there were variations on the field test results due to variability of the soil conditions encountered at the site. The assumed hydraulic conductivities are conservative values taking into consideration the variation in field test results and typical values used in the literature.

The reference for the data presented in Table 8.3-1 (Physical Environment Supporting Volume, Section 8) is as follows: ACRES Manitoba Limited. 2004. Design Memorandum GN-4.1.3 of Gull Generating Station Stage IV Studies – Axis GR-4 Geotechnical Design Criteria. November 2004.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 8.4.6 Environmental Monitoring and Follow-Up; p. 8-31

# NRCan-0012

## PREAMBLE:

The number and distribution of groundwater wells is insufficient to provide a good basis for numerical modeling. Only 8 on-site groundwater monitoring wells were used. Only 3 wells are proximal to the proposed generator/dams. As this is an area where the groundwater-surface water relationship is more complex and groundwater flow reversals could occur, a greater well density is warranted. Additionally, there is only 1 well west of Caribou Island. This is a very low number of wells considering that this area represents at least half of the area to be inundated by the reservoir.

## QUESTION:

To provide greater confidence in the numerical groundwater model it is recommended that additional groundwater monitoring wells be installed to monitor water levels. It is recommended that multi-level wells be installed in some locations in order to delineate vertical groundwater flow gradients.

## RESPONSE:

Please refer to the response provided to NRCan-0004 regarding installation of more monitoring wells.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 8A Model Description; p. N/A

# NRCan-0013

## PREAMBLE:

There is no mention of model verification or model validation for the numerical groundwater model. Verification is used to establish greater confidence in the model by using the set of calibrated parameter values and stresses to reproduce a second set of field data (above and beyond model calibration). Model validation is completed years after modeling is completed in order to determine if the model's prediction was accurate. This is particularly important for this project as there is considerable uncertainty in model predictions due to the lack of on-site data.

## QUESTION:

Provide details on model verification if it was conducted and plans for future model validation.

## RESPONSE:

As described in Appendix 8A of Section 8 in the Physical Environment Supporting Volume, calibration of the groundwater-flow model to measured hydrologic conditions was completed over the entire 15 month period of available data. This calibration process included representation of a range of meteorological and river-flow conditions. The calibration process resulted in a high degree of correlation between the simulated and observed groundwater tables. The sensitivity of the calibrated model was then determined and reported (see Appendix 8A). Also see NRCan-0004 for additional information regarding on-site data used in the development of the model.

Regarding future plans to verify the model predictions, please see response to NRCan-0007.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.9.3.5 Seismic Activity, Section: 6.2.3.2.5 Physiography; p. 6-583, p. 6-28 to 6-29

# NRCan-0014

## PREAMBLE:

NRCan expert reviewed the information related to the seismic activity. Although the expert concurs that the known earthquake activity in the area is very low and that the potential for significant reservoir-triggered seismicity is also extremely low, the following sentence needs to be changed. "It is evident from the historical records since the 1600s and relatively recent seismic monitoring, which presents the distribution of magnitude 3 and greater earthquakes in Canada since 1627 (Natural Resources Canada 2008), that no major earthquakes, and hence no important earthquake generating fault movements, have occurred in Manitoba (Map 6-6)."

## QUESTION:

This sentence suggests that the earthquake reporting is complete in Manitoba for magnitude 3 and larger since 1927 based on an NRCan map that displays the known earthquakes between 1627 and 2008. This is not so. Potentially damaging earthquakes in this area of the Precambrian Shield could only be known since the late 19th century at the earliest when written reports from Manitoba started to be available. The earthquake detection in the area is about M 5 since approximately 1940 and M 5.5 and larger since about 1900 (extrapolated from Southern Saskatchewan in Basham et al., 1979). M 3 and larger could be detected only since the 1990's. Other studies may have looked at the detection completeness of this part of the Canadian Shield. Also, the proposed link between an absence of major earthquakes in recent times and no fault movements is incorrectly presented. Earthquake-induced surface ruptures could have been produced prior to earthquake reporting or detection by human beings. Pre-19th century fault movements could only be known from special geological studies, not deduced from our time-limited earthquake coverage. One must note, however, that even if the text is changed along the lines we present therein, it will not modify the conclusions of the report, i.e. that the design should use the accepted values of seismic hazard for this area of the Canadian Shield. The expert, however, would like the text to better reflect the seismological knowledge of Manitoba to minimize the risk of a false perception.

## RESPONSE:

The additional information will be duly noted in the errata report.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.9.3.5 Seismic Activity, Section: 6.2.3.2.5 Physiography; p. 6-583, p. 6-28 to 6-29

# NRCan-0015

## PREAMBLE:

Description of local seismicity does not consider completeness of earthquake catalog.

## QUESTION:

See comment 14

## RESPONSE:

Please see response to NRCan-0014.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 5.3.2.1 Regional Study Area; p. 5-5 to 5-6

# NRCan-0016

## PREAMBLE:

The nature of underlying bedrock (and overlying materials) is an important component, even in projects such as Keeyask where it provides not only the solid ground on which the Generating Station rests but also it may contain trace elements that may affect groundwater and surface water quality.

## QUESTION:

The Precambrian bedrock is described as consisting of greywacke gneisses, granite gneisses and granites. What are greywacke gneisses? Please provide a more detailed description of regional and local bedrock that includes information such as: local fracture/joint density, orientation, etc.

## RESPONSE:

Following are the requested definitions:

- Greywacke gneiss: a foliated or banded metamorphic rock that is the result of the metamorphic recrystallization of greywacke.
- Greywacke: a clay rich, poorly sorted sandstone. Sand grains are commonly quartz, feldspar and volcanic rock fragments, and are usually angular to subangular.
- Metagreywacke; interlayered pelite (metamorphosed mudstone) and psammite (metamorphosed siltstone/sandstone), medium to dark grey, Fe-rich, composed of quartz+biotite+/-fedspar+/-garnet+/-amphibolite+/-staurolite+/-cordierite; locally arkosic with calc-silicate layers; contains up to 80% granitoid injection pegmatite (unit 4).
- Unit 2a Banded oxide-, sulphide- and silicate-facies iron formation; composed of quartz-chert-magnetite+/-hematite+/-garnet+/-biotite+/-amphibolite+/-sulphide; form discontinuous boudinaged layers in unit 2 metasedimentary rocks.

## Reference:

Bohm, C.O., Bowerman, M.S. and Downey, M.W. 2006: Bedrock geology of the geology of the Gull Rapids area, Manitoba (part of NTS 54D6); Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Open File Report OF2006-32, digital map on DVD.

## Geological Overview

The Keeyask project area is underlain by Precambrian crystalline bedrock of the Canadian Shield. It is located at the northern margin of the Archean Superior Geological Province; proximal to the boundary with the adjacent Proterozoic Churchill Geological Province to the north. The Churchill–Superior boundary is a poorly defined zone of cataclastic rocks which resulted from the collision of two tectonic plates. Based on field investigations in 2003 and 2004 the understanding is that the Churchill–Superior boundary occurs to the east of the Keeyask site.

Regional mapping by the Manitoba Geological Survey indicates that the rocks forming the Superior Geological Province comprise a wide variety of metasedimentary, metavolcanic, intrusive rocks which trend east-west and are of Archean age. The rocks forming the Churchill Geological Province in the area proximal to the Keeyask site comprise intrusive and metasedimentary rocks of Proterozoic age. The contact between the two structural provinces occurs close to the Keeyask project area.

Sedimentary rocks of Paleozoic age cover the Precambrian bedrock to the east and southeast of the Keeyask site.

The area has undergone multiple glaciations during the Pleistocene Era, i.e., last two million years. The present topography is largely the result of the latest Wisconsian glaciation. The area is largely covered by overburden consisting of glacial till or other glacial related deposits.

Recent mapping by Manitoba Geological Survey presents similar information as previous mapping , but with more detail. The major subdivisions are also shown, including the Superior – Assean Lake Boundary Zone which is the main contact zone between the Churchill Geological Province to the north and the Superior Geological Province to the south. The Keeyask site is located proximal to the northern fault contact of this zone.

## Detailed Description of Local Bedrock

The Keeyask site is located at the margin of the Superior Geological Province near the Churchill–Superior boundary. The rocks that occur at Keeyask are significantly different compared to the dominantly meta-igneous amphibolite and granulite rocks of the Split Lake Block of the Superior Geological Province to the west and the Kisseynew type metasedimentary rocks of the Churchill Geological Province to the east.

The Keeyask project area is underlain by a sequence of rocks consisting primarily of Archean supracrustal and intrusive rocks. The bedrock at the Keeyask site has undergone polyphase metamorphism and deformation. The supracrustal rock are identified as Archean amphibolites-grade rocks consisting of amphibolite (metabasalt), and Fe-rich metagreywacke, with interlayered banded oxide-, sulphide and silicate-facies iron formation. Immediately to the west of the Keeyask site is a sequence of

granodiorite gneisses. Leucocratic felsic injections intrude both the supracrustal and granodiorite rocks, and major east-trending Paleoproterozoic mafic dikes crosscut all rock types.

At the Keeyask site, the bedrock is predominantly metagreywacke. The bedrock in the powerhouse area is predominantly amphibolite.

## Local bedrock Conditions Observed During Exploration Programs

- Bedrock in the Keeyask Generating Station area is typically fresh, strong to very strong with moderately spaced jointing, averaging approximately 300 mm. Most of the joints appear tight with little or no alteration.
- Typically the joints in the bedrock in the powerhouse and spillway areas are moderately spaced, tight, with little or no alteration. Those open joints which are present are typically widely to very widely spaced, slight to faintly altered and may be infilled with clay. Carbonate, chlorite and limonite coatings were frequently observed on joint surfaces.
- Open joints are typically widely to very widely spaced, slightly to faintly altered and may be infilled with clay. Carbonate and chlorite coatings were frequently observed on joint surfaces. Generally the open joints are subhorizontal and not confined to a particular joint set.
- Within the powerhouse and spillway areas proper, a total of 50 joints were noted to be slickensided. Based on the information available, it appears that the movements which produced these slickensides are not confined to a particular joint set.
- Within the powerhouse and spillway areas proper, a total of 41 joints were noted as having clay or kaolinite coatings. Based on the information available, it appears that the clay coatings are not confined to a particular joint set.
- Core losses during drilling were generally less than 70 mm at any single location within drill holes and were associated with drill action and/or closely spaced joints.
- The rock quality of the bedrock is considered to be good to excellent as indicated by an average RQD value of 90%. Local zones of low RQD are associated with narrow ones of closely spaced joints.
- The average Lugeon (Lu) value determined by the Water Pressure Tests (WPT) is generally below 3, indicating that the bedrock has a low permeability. Local zones of medium permeability, generally with Lugeon values less than 20 Lu, are associated with open or partly open joints. Testing results suggests tighter bedrock conditions exist at depth.
- Rock Mass Rating (RMR) and the (GSI) values were determined to assist with rock classification. The bedrock encountered at Gull Rapids area is classified as fair to good quality rock.

- Fracture/shear zones were observed within the bedrock outcrops to the south and west of the Powerhouse area. These zones are generally less than 0.5 m in width, inactive, and are typically healed or recrystallized and strong.

## Powerhouse Area

- The bedrock lithology encountered in the drill holes located in the powerhouse area consist of greywacke gneiss, amphiloblite, granitic intrusions, and diabase dykes, which is consistent with the regional bedrock geological interpretation.
- In the powerhouse area, four major and two minor joint sets were identified from a total of 708 oriented core measurements, not including discontinuities described as healed. Jointing trends are summarized in the Table below.
- Within the powerhouse area, the majority of the joint sets will dip away from the excavations.

### Keeyask GS - Stage IV Investigation Program, Axis GR-4 - Summary of Joint Trend Measurements in Powerhouse Area

| Powerhouse Joint Set | Orientation | | | Description |
|---|---|---|---|---|
| | Strike (deg) | Dip [1] (deg) | Dip Direction (deg) | |
| J1 | 198 | 1 | 288 | Major, subhorizontal joint set |
| J2 | 320 | 30 | 50 | Major |
| J3 | 60 | 23 | 150 | Major |
| J4 | 237 | 25 | 327 | Major |
| J5 | 335 | 80 | 65 | Minor, subvertical joint set |
| J6 | 65 | 53 | 155 | Minor |

Note: (1) Dip from horizontal. Dip direction is 90 deg right of the strike.

## Spillway Area

- The bedrock lithology encountered in the drill holes located in the spillway area consists of greywacke gneiss, iron formation, granitic intrusions, and diabase dykes, which is consistent with the regional bedrock geological interpretation.
- In the spillway area, two major and two minor joint sets were identified from a total of 364 oriented core measurements, not including discontinuities described as healed. Jointing trends are summarized in the Table below.
- Within the spillway area, the majority of the joint sets will dip away from the excavations.

## Keeyask GS – Stage IV Studies, Axis GR-4 - Summary of Joint Trend Measurements in Spillway Area

| Spillway Joint Set | Orientation | | | Description |
|---|---|---|---|---|
| | Strike (deg) | Dip [1] (deg) | Dip Direction (deg) | |
| J1 | 25 | 32 | 115 | Major |
| J2 | 126 | 30 | 216 | Major |
| J3 | 210 | 25 | 300 | Minor |
| J4 | 103 | 72 | 193 | Minor |

Note: (1) Dip from horizontal. Dip direction is 90 deg right of the strike.

**REFERENCE: Volume: Response to EIS Guidelines; Section: 4.3.3.1 Measures in Joint Keeyask Development Agreement, 4.6.3 Reservoir Clearing; p. 4-15 and 4-34**

# NRCan-0017

## PREAMBLE:

The proponent indicates that standing woody material, including dead and living trees and shrubs 1.5 m tall or taller, as well as fallen trees will be removed from the areas to be flooded. Reservoir clearing addresses boating safety issues and aesthetic issues and is also intended to reduce the production of methylmercury in the future reservoir.

## QUESTION:

The reduction of methylmercury production would be more effective if reservoir clearing included the removal of labile organic materials such as shrub foliage. Labile organic matter from flooded foliage is one of the main factors favouring the algal bloom that occurs in the first years after impoundment, and this in turn favours the methylation of mercury and its uptake in the reservoir foodweb. NRCan recommends considering whether this strategy could be applied for the Keeyask project.

## RESPONSE:

The vast majority of the release of stored methylmercury and the methylation of inorganic mercury will result from the flooding of the initial 45 $km^2$ of land, particularly the decomposition of peat and other organic soils. The reduction of methylmercury production due to vegetation (i.e. , shrub foliage) clearing is not expected to significantly reduce the mobilization of methylmercury in the food web.

Please refer to NRCan-0018 for additional information.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 6.4.7 Mercury, Palatability and Cysts in Fish; p. 6-288 to 6-291

# NRCan-0018

## PREAMBLE:

The proponent expects a significant increase of mercury concentrations in large piscivorous species, such as walleye and northern pike and to a lesser extent in lake whitefish. This increase is expected to peak within 3 to 5 years after flooding and to decrease gradually in the following 25 to 30 years. Peak concentrations on the order of 0.8 to 1.4 ppm (Table 6-18), well above the 0.5 ppm guideline for commercial marketing, are expected for walleye and northern pike. Given the amplitude of the mercury residual effect, monitoring of Hg concentrations in fish muscle tissue will take place until concentrations return to long-term stable levels.

## QUESTION:

The main measures proposed to mitigate the mercury issue in reservoir biota are (1) the clearing of trees and large shrubs prior to flooding and (2) the monitoring of Hg concentrations in large fish and (3) the ensuing publication of consumption advisories. In an effort to reduce as much as possible the increase of mercury concentrations, NRCan recommends that the proponent consider extending the reservoir clearing activities to areas expected to be affected by peatland disintegration (cf. Section 6.3.7), one possible effect of which may be is to stretch beyond 30 years the period of strong mercury contamination in the Keeyask reservoir. This consideration should be discussed with relevant federal departments (e.g. Environment Canada) and provincial ministries.

## RESPONSE:

The vast majority of the release of stored methylmercury and the methylation of inorganic mercury will result from the flooding of the initial 45 $km^2$ of land, particularly the decomposition of peat particularly the decomposition of peat. The introduction of additional peat and vegetation due to reservoir expansion will occur much more slowly and over much smaller areas when compared to the initial flooded area. During the first year following reservoir impoundment, the reservoir is expected to expand by approximately 1 $km^2$. In years two to five the average rate is expected to be less than 0.5 $km^2$ per year, in years six to 15 the rate is expected to be approximately 0.3 $km^2$ per year and in years 16-30 the rate is expected to be less than 0.2 $km^2$ per year (Physical Environment Supporting Volume Section 6.4.2.1.1). Predicted methylmercury concentrations in fish flesh considering the reservoir area immediately following reservoir impoundment and five years after reaching full supply level are provided in Aquatic Environment Supporting Volume Table 7-2. The increase in flooded area over the first five years after impoundment has a negligible effect on peak methylmercury

concentrations. However, as discussed in Aquatic Environment Supporting Volume Section 7.2.4.2.3, continued breakdown of shorelines and introduction of peat to the reservoir is expected to prolong the duration of elevated methylmercury levels in fish in the reservoir and this has been accounted for in the predictions.

Clearing the trees and tall shrubs in the areas where the reservoir will expand well into the future prior to reservoir impoundment may be detrimental if natural soils are disturbed. The disturbance of the soil organic layer and the removal of vegetation can dramatically increase methylmercury concentrations in runoff, and has been identified as a major source of mercury to aquatic ecosystems.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Section 7.0 Fish Quality; p. No.: 7-1 to 7-75

# NRCan-0019a

## PREAMBLE:

This section presents a well documented and fairly comprehensive account of the mercury issue in boreal hydroelectric reservoirs, and more specifically in the Keeyask reservoir and nearby water bodies. It presents in a single document much of the information which is otherwise scattered in various other EIS documents.

## QUESTION:

However, this document presents no information on the variability of Hg concentrations in soils (particularly in organic horizons) that will be affected by reservoir flooding, whether immediately following impoundment or much later as a result of peatland disintegration. In NRCan's view this information, and its links with vegetation cover and wildfire history, are critical in the development of strategies to reduce the remobilization of mercury and to reduce methylation rates in flooded terrain.

## RESPONSE:

The Partnership acknowledges that fish mercury concentrations respond to changes in mercury load to aquatic systems. In the case of reservoir inundation, the magnitude and timing of this response is only minimally related to mercury concentrations in soils and vegetation prior to flooding, but is mainly dependent on ecosystem characteristics such as controls on net methylation, the availability of methylmercury to the food web, the trophic transfer of methylmercury, or fish growth rate (Kidd et al. 1995; Power et al. 2002; Simoneau et al. 2005; Trudel and Rasmussen 2006).

When completely burned, boreal plants and soils lose between 79 and 95% of their carbon, total mercury, and methylmercury, resulting in lower water mercury concentrations after experimental flooding compared to unburned vegetation and soils (Mailman and Bodaly 2005; Mailman et al. 2006). These studies also confirm that, regardless of soil and vegetation burn treatment (incomplete, complete), water mercury concentrations post-flooding are not related to concentrations in benthic invertebrates. Similarly, Beganyi and Batzer (2011) found that mercury concentrations decreased in several taxa of aquatic invertebrates after wildfires burned 75% of a wetland. All these results indicate that fish mercury concentrations after flooding are not substantially affected by the mercury concentrations of the flooded soils and that forest fires contribute, if at all, to a reduction in mercury concentrations in biota.

It should be noted that the predictions of fish mercury concentrations for the Keeyask reservoir were not based on a mechanistic model that included, for example, a functional relationship between peat or other organic soil mercury concentrations and mercury methylation rates, but used an empirical model of the relationship between the relative size of the flooded reservoir area and fish mercury levels. Thus the availability of information on soil mercury content did not affect estimates of future fish mercury concentrations.

NRCan-0018 outlines the reasons why there are no plans to clear peat or other organic soils prior to reservoir creation.

With respect to Section 8.1.3 of the guidelines, the importance of wildfire and potential Project effects on the fire regime are referenced in many locations throughout Section 2 of the Terrestrial Environment Supporting Volume (e.g., Section 2.3.3.3). A description of the regional fire regime, including fire history, is provided in Terrestrial Environment Supporting Volume, Section 2.5 and Appendix 2D. Fire regime monitoring is described in Section 2.12.

## Literature

Beganyi, S. R., and D. P. Batzer. 2011. Wildfire induced changes in aquatic invertebrate communities and mercury bioaccumulation in the Okefenokee swamp. Hydrobiologia 669:237-247.

Kidd K. A., R. H. Hesslein, R. J. P. Fudge, and K. A. Hallard. 1995. The influence of trophic level as measured by δ15N on mercury concentrations in freshwater organisms. Water Air Soil Pollut. 80:1011- 1015.

Mailman, M., L. Stepmuk, N. Cicek, and R. A. Bodaly. 2006. Strategies to lower methyl mercury concentrations in hydroelectric reservoirs and lakes: A review. Science of the Total Environment 368: 224-235.

Mailman, M., and R. A. Bodaly. 2006. The burning question: does burning before flooding lower methyl mercury production and bioaccumulation. Science of the Total Environment 368: 407-417.

Power, M., G. M. Klein, K. R. R. A. Guiguer, and M. K. H. Kwan. 2002. Mercury accumulation in the fish community of a sub-arctic lake in relation trophic position and carbon sources. J. appl. Ecol. 39:819- 830.

Simoneau, M., M. Lucotte, S. Garceau, and D. Laliberte. 2005. Fish growth rates modulate mercury concentrations in walleye (*Sander vitreus*) from eastern Canadian lakes. Environmental Research 98:73-82.

Trudel, M., and J. B. Rasmussen. 2006. Bioenergetics and mercury dynamics in fish: a modelling perspective. Can. J. Fish. Aquat. Sci. 63:1890-1902.

## REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 7.0 Fish Quality; p. No.: 7-1 to 7-75

# NRCan-0019b

## PREAMBLE:

This section presents a well documented and fairly comprehensive account of the mercury issue in boreal hydroelectric reservoirs, and more specifically in the Keeyask reservoir and nearby water bodies. It presents in a single document much of the information which is otherwise scattered in various other EIS documents.

## QUESTION:

Moreover, the EIS documents contain no information on forest fire history, as had been requested in the Guidelines (Section 8.1.3). NRCan recommends that this information be included in the EIS.

## RESPONSE:

Please see the response to NRCan-0019A for the locations in the EIS where the forest fire history information is provided.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.3.1.1.2 Bedload and Bed Material; p. 7-16

# NRCan-0020

## PREAMBLE:

Quality of conclusions from limited data

## QUESTION:

The general lack of bedload through the Local Study Area is not surprising given that the Split and Clark lakes are immediately upstream and represent sediment traps. Also, the general low rates of bank erosion, lack of alluvial bars, and the coarse character of the channel bed are all consistent with a very limited transport and supply of bedload materials.

## RESPONSE:

The comments are noted.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: Table 7.4-6 Summary of Sedimentation Residual Effects; p. 7-39

# NRCan-0021

## PREAMBLE:

Content of summary assessments of the sedimentation resulting from the project

## QUESTION:

NRCan has no issues with the summary assessments of the sedimentation effects resulting from the project.

## RESPONSE:

The comment is noted.

## REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.6 Environmental Monitoring and Follow-Up; p. 7-43

# NRCan-0022

## PREAMBLE:

Monitoring actual post-project effects contributes to improving the modelling of impacts from future projects

## QUESTION:

NRCan strongly encourages the monitoring of the changes in sedimentation resulting from the project. NRCan recommends that the proponent should consider undertaking a regular and detailed suspended sediment sampling program for different discharges, particularly in the first 10 years of the project, when change is most likely to be significant.

## RESPONSE:

A Physical Environment Monitoring Plan (PEMP) is being developed that includes a number of components pertaining to sediment monitoring during construction and operation. CEAA-0011 provides information about the Partnership's environmental protection program, including the preliminary PEMP. The Partnership intends to provide a preliminary version of that report to regulators in the second quarter of 2013.

## REFERENCE: Volume: Response to EIS Guidelines; Section: 4.6.3 Reservoir Clearing; p. 4-34

# TC-0001

## PREAMBLE:

The south access road will cross the Butnau River with culverts

## QUESTION:

Provide details regarding the conceptual design and construction methodology of this crossing.

## RESPONSE:

Details about the design of Butnau River crossing are limited at this time because detailed design of the crossing is currently underway. Details of the design and construction methodology will be included in *Navigable Waters Protection Act* application file# 8200-2010-600391-012, which is expected to be submitted in 2013.

The current preliminary plan is to widen the road towards the downstream side of the existing earth structure by placing a subgrade made of granular, filter and impervious material and overlay this subgrade with granular material. The existing culvert and internal weir structure will be extended or relocated to a new location along the existing earth structure. The crossing will be designed to have minimal impacts on the existing water regime and hydraulics of the upstream pool and downstream creek.