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Subject: Methyl Mercury Letter
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Peter 

Comments on Appeal Letter from Nunatsiavut Government on the HHRA Plan

18-Aug-2016

Nalcor offers the following comments in response to Nunatsiavut Government's appeal to the approval of the HHRA Plan.

The Nunatsiavut Government provided the following grounds for appeal in their letter dated, August 12:

> *(a) the Decision fails to act on the new scientific information which shows that the Project will have significant impacts on methylmercury concentrations in the Lake Melville ecosystem and increased Inuit exposure to methylmercury;*
> *(b) the Project will impair or damage the Lake Melville environment and have adverse effects on Inuit, including Inuit health and culture;*
> *(c) the Decision fails to require measures that will ensure risks associated with methylmercury concentrations in the environment as a result of the Project are properly mitigated, monitored and managed; and*
> *(d) the Decision, by approving the HHRAP before the results of the Human Health Risk Assessment (HHRA) are complete and can be assessed and acted on, is premature and an error in law.*

Environmental Assessment for the Project Considered the Effects of Methylmercury

The Lower Churchill Hydroelectric Generation Project has been released from the most rigorous and comprehensive environmental assessment process available in Canada. ~~The potential for increases in methylmercury were assessed during the~~ A key consideration during this process was the potential for elevated water column methyl mercury concentrations in the in the Muskart Falls reservoir and downstream into Lake Melville~~environmental assessment~~. ~~These effects were known and~~The effects of bioaccumulation and biomagnification of methyl mercury in fish and wildlife food chains, the potential effects on human health and the likely requirement for consumption advisories was comprehensively reviewed. In addition, the issue is well understood throughout Canadian hydroelectric ~~-~~watersheds. Mechanisms for methyl mercury production in Lake Melville and mercury release from organics in the Muskrat Falls reservoir identified in Schartup et al. suggests a potential for increased extent for a period of elevated methyl mercury concentrations do not provide sufficient deviation from the predicted methyl mercury concentrations modeled for the environmental assessment. Therefore, ~~assessed at that time, and included the potential effects on human health and the likely requirement for consumption advisories. It is Nalcor's position that~~ the new research and predictions made in Schartup et al. and the Lake Melville Report do not change the outcomes of the environmental assessment. The environmental assessment for the project was, and is, scientifically defensible, and completed by experts on the subject matter. Where there was uncertainty in the effects, the precautionary principle was applied, as indicated by the comprehensive monitoring programs that have been instituted by the Lower Churchill Project. The monitoring programs are robust and scientifically defensible and are reviewed and revised as appropriate, and in compliance with regulatory approvals.

The JRP provided the following conclusions and recommendations on the fate of mercury:

> *"The Panel notes that Natural Resources Canada challenged the notion that mercury mobilization is an inevitable consequence of hydro power development and consumption advisories are adequate as the only response. The benefits of carrying out pre-inundation mitigation such as more extensive clearing of vegetation or soils would need to be evaluated in the context of effects of the predicted mercury levels on fish-eating wildlife (Chapter 7), the use of renewable resources (Chapter 8) and human health (Chapter 13). Similarly, the significance of the cumulative effect of another period of methylmercury contamination on the lower Churchill system, following the effects of the Churchill Falls project, should be evaluated in the context of human health and the use of renewable resources.*
>
> *The Panel recognizes that there appears to be no clear evidence that predicted levels of mercury would adversely affect fish health but questions how much research has been carried out on the effects of mercury on fish health in conjunction with other stresses imposed by reservoir creation projects, and also why Nalcor initially confined its measure of fish health to mercury effects.*
>
> *The Panel accepts that selective soil removal around the reservoir rim is not yet proven as mitigation but observes that this approach appears to have merit, especially if the clearing can be confined to the reservoir rim. The Panel also notes that the type of preparation required for this mitigation might be complementary with the riparian and fish habitat measures that Nalcor would already be undertaking.*
>
> *The Panel concludes that consumption advisories transfer part of the cost of generating hydroelectricity to local populations and it is therefore important to find better approaches to reducing methylmercury in reservoirs. Therefore the Panel believes that Natural Resources Canada should move ahead with testing the mitigative approach of removing soil in the drawdown zone, including determining how to avoid or minimize environmental impacts, and ways to make beneficial use of the materials removed.*
>
> ***RECOMMENDATION 6.5 Pilot study for methylmercury mitigation through soil removal***
> *The Panel recommends that Natural Resources Canada, in consultation with Nalcor and, if possible, other hydroelectricity developers in Canada, carry out a pilot study to determine (a) the technical, economic and environmental feasibility of mitigating the production of methylmercury in reservoirs by removing vegetation and soils in the drawdown zone, and (b) the effectiveness of this mitigation measure. The pilot study should take place in a location where the relevant parameters can be effectively controlled (i.e. not in the Lower Churchill watershed) and every effort should be made to complete the pilot before sanction decisions are made for Gull Island. If the results of the pilot study are positive, Nalcor should undertake to employ this mitigation measure in Gull Island to the extent possible and monitor the results."*

These conclusions demonstrate that the fate of mercury and pre-impoundment mitigation was entirely considered in the assessmented.

The Government of Canada provided the following response to Recommendation 6.5:

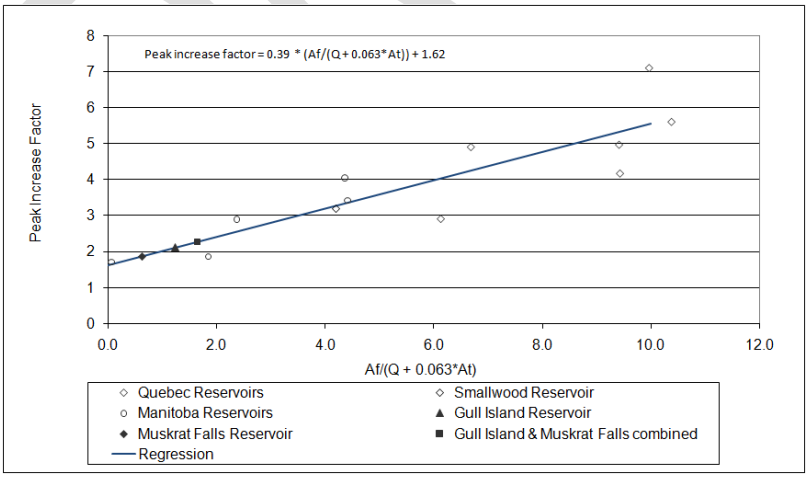
> *"The Government of Canada agrees with the intent of this recommendation and notes that it is directed to Natural Resources Canada, Nalcor and, if possible, other hydroelectric developers in*

Canada. However, the Government of Canada cannot commit to carrying out the suggested pilot study, and believes that the Panel's recommended pilot project would be more appropriately led by a University-based research group with which Natural Resources Canada could collaborate."

Predictions versus Observations

Methylmercury uptake from water to fish is an extremely complex process with many interacting parameters making predictions uncertain. The research presented in the studies referenced in the Nunatsiavut Government's letter showed values for post-impoundment fish concentrations many times higher than observed data from much larger reservoirs with larger drawdowns and potential for anoxic conditions (not predicted for Muskrat Falls given the floe regime). This biomagnification factor was then used in extrapolating and predicting concentrations to Lake Melville residents. The biomagnification factor used to predict methylmercury concentrations is currently unsupported in the published research. Observed post-impoundment data from other Canadian reservoirs were used by Nalcor to predict future values that included a robust regression model (see Nalcor's response to JRP IR.156). The peak concentrations predicted in the NG referenced research are up to 2015-fold (as presented by Sunderland at the August workshop), which is double that observed in other Canadian reservoirs. It appears that the human exposure and health risk prediction is propagated from their prediction that an increased low salinity water layer will increase methylmercury concentrations in a linear manner, and assumed to ~~be~~ have a ~~completely~~ close linear relationship to organic carbon loading.

The scientific evidence, published in the literature, based on other hydro projects is not consistent with the predictions presented in the Lake Melville reports. Data observed from other reservoirs in Canada indicate mercury increases in fish after flooding range from less than 2X baseline up to about 7-8X baseline. Figure 2 from Nalcor's response to JRP IR.156 presented the peak increase factor for northern pike based on other reservoirs in Canada and the predictions for the Muskrat Falls reservoir.



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Nalcor's assessment and modeling of methyl mercury biomaginfication in ~~predicted in 2011 that~~ fish indicated ~~Hg~~ concentrations downstream of Muskrat Falls could increase by 2-5X baseline.

Full Clearing is unproven as a mitigation measure

'Full Clearing' as defined by Nunatsiavut Government is a significant deviation from the project that was proposed during the EA and would require ~~a~~ provincial and federal EA processes. This would severely compromise project completion and more likely result in project abandonment. The mitigation would require multiple years of study~~Given~~ to understand the likely adverse environmental effects, and in addition to the ~~the~~ lack of precedence, ~~and unknown effects~~ the potential for EA release is uncertain. Stockpiles of soil removed from the reservoir may lead to increased methylmercury production in situ, among other potential environmental impacts based on the massive volume of material. There are concerns that a stockpile of soil has the potential for methylmercury formation that could drain back into a water body and could create greater methylmercury loadings.

The statement that "Nalcor did not identify any feasible way to reverse mercury contamination in the ecosystem once flooding takes place" is incorrect. At this time a feasible mitigation measure does not exist. ~~It was assessed~~Consideration of alternatives ~~during the environmental assessment,~~ can be reviewed in ~~see~~ Nalcor's Response to JRP IR.33 ~~that~~ which requested, "The Proponent is asked to address the following: provide an evaluation of alternative strategies for reservoir preparation to reduce the uptake of mercury, as required by the EIS Guidelines."

Commented [JW1]: I'm not sure if I've answered this correctly.

The statement that "Nalcor during the EA of a 10% additional reduction in methylmercury levels in the reservoir when moving from partial clearing to full clearing of trees (with an implicit assumption of a zero reduction in downstream methylmercury effects as no measurable effects were predicted in the first place)" is erroneous. This prediction was regarding methyl mercury concetration reductions for both full and partial clearing of timber ~~based on full clearing~~ as defined in the environmental assessment, suggesting both approaches would yield similar reductions.~~.~~

Commented [JW2]: Review this too.

HHRAP is adequate

It is also unclear what aspects of the Human Health Risk Assessment Plan (HHRAP) are being appealed as the purpose of the HHRAP is to outline the key tasks and activities in relation to conducting a final baseline pre-inundation HHRA that focuses on human exposures and risks to mercury and methylmercury in key country food Items. The HHRAP is intended to serve as a general framework or process document for the key components of the baseline HHRA program, which includes a dietary survey (DS) and a human biomonitoring program (HBP), in addition to the HHRA study itself.

The first revision (B1) of the HHRAP was submitted for review and comment in March, 2014. The HHRAP and the detailed Dietary Survey and Human Biomonitoring Workplan have been reviewed by Health Canada, including the First Nations, ~~and~~ Inuit Health Branch and a Health Canada nutritionist, and the provincial Department of Health and Community Services. It has also been reviewed by Aboriginal groups, including the Nunatsiavut Government. Comments received on the HHRAP have been incorporated. Comments received from the Nunatsiavut Government in February 2015 were addressed by Nalcor, and resulted in the B4 revision. Since that time, no comments have been received by Nalcor on the content of the HHRAP (B5).

The baseline dietary survey and human biomonitoring program is a key component to completing an HHRA. The results of a baseline dietary survey and human biomonitoring program were provided to the Nunatsiavut Government (and other stakeholders) in December 2015, and posted to the Project's website. A follow up meeting was held with Nunatsiavut Government in January, 2016, to discuss the findings of the baseline report.

The statement by Nunatsiavut Government in the appeal letter that the "*only measure proposed in the HHRAP to manage adverse human health effects is consumption advisories"* is correct. Alternative mitigation measures to the increase in methylmercury were fully assessed in the environmental assessment (see Nalcor's Response to JRP IR.33). And Nalcor's response to JRP IR.156 presented the recommended fish consumption for people eating fish in the Project area~~from the lower Churchill River~~ based on predicted peak MeHg concentrations.

The statement that "The Decision, by approving the HHRAP before the results of the HHRA are complete and can be assessed and acted on, is premature. Currently, the complete results of the HHRA are not available; Nalcor is still collecting data and monitoring." Nalcor is not currently collecting data and monitoring. Nalcor is currently preparing an HHRA as described in the HHRAP and the detailed work plan reviewed by federal and provincial regulators and stakeholders over the last two years.

Adaptive Management

The findings presented in Schartup et al. and the Lake Melville report have been reviewed by Nalcor and its independent consultants, along with federal and provincial regulators. This included a review by the Canadian Science Advisory Secretariat to confirm the merit of the Aquatic Environmental Effects Monitoring program. As a part of Nalcor's review of Schartup et al., it was found that there are similarities between Nalcor modelling presented during the environmental assessment and Schartup et al. with respect to methylmercury leaving the reservoir.

The appeal letter's comments that suggest a "poor analysis" are unfounded and incorrect. The findings in these reports make predictions based on a limited sampling regime (e.g., one year of sampling, limited sampling over a large geographical area (i.e., Churchill River to Groswater Bay). These findings do not provide "scientific evidence regarding methylmercury effects of the Project on Inuit health". The findings make predictions that are contrary to the evidence collected in reservoirs elsewhere in Canada. These scientific findings do not "demonstrate that under the current partial clearing plan, the Project will cause a significant increase". Again, these findings, as presented in Schartup et al. and the Lake Melville report are predictions that demonstrate unprecedented effects.~~.~~

The appeal letter also states that topsoil stripping is feasible as "the North Spur has been stripped of vegetation and that Nalcor has removed a significant amount of soil to ensure the stability of the North Spur and mitigate Project safety concerns. This demonstrates that topsoil stripping and complete vegetation removal in the context of this Project is indeed feasible and justifiable." The suggestion that the stabilization work undergoing on the north spur merits the feasibility of the suggested mitigation has no basis. This comparison supports the evidence provided previously that the undertaking would be immense and likely not feasible. The engineering and analysis required to ensure stabilization of the north spur took many years of study and assessment.

The safety factors required to work on the unstable surfaces result in the initial stabilization of the entire area through extensive engineering practices. The project itself will take 2 years to complete.

The suggested mitigation would require significant engineering and construction effort; slopes must be reduced to ensure safety and stability and then stabilized with graded materials to prevent ongoing erosion, as unprotected slopes will eventually fail. Unlike the North Spur that was already impacted, the siting and construction of spoil areas will require significant effort, requiring the destruction of significant areas of untouched forest habitat. Nalcor's justification for not removing the topsoil from the reservoir is based on the uncertainty with this unproven method.

The North Spur geological formation has been eroded over time by natural processes. Eventually, this erosion will result in the re-alignment of the Churchill River through this natural sand deposit. Similar instability is common through-out the Churchill River basin as evidenced by frequent slope failures and erosion. Overburden and soils removed from the North Spur were removed to reduce the elevation of the Spur thus reducing the significant weight of material prone to slope failure. The work also included the reduction of the existing slopes to a stable incline, followed by a rock cover on both the upstream and downstream sides of the spur. In addition, a clay cut-off wall has been installed along the upstream side of the spur to prevent water from the River from undermining the foundation of the Spur.

The organics and soils removed from the North Spur were placed in a managed spoil deposit. A deposit designed for long term stability. The spoil pile is an engineering structure that incorporates slope protection, storm water drainage, ditching, and sedimentation ponds. The order of magnitude greater volumes of spoils from the proposed stripping of the reservoir will require similar management and stabilization.

The existing slopes within the Reservoir are much the same as those at the Spur, inherently unstable and prone to erosion. Therefore, much like the work completed at the North Spur, significant analysis will be required to develop an excavation plan that will provide a safe work area and stable slope. Studies of similar materials and slopes at the North Spur support a conclusion that, in order to achieve stability, reservoir slope inclines will need to be reduced, and therefore the volumes of soil requiring removal will be significantly greater than the thin overburden layer suggested in the correspondence.

Removal of soils and overburden within the Reservoir is certainly feasible, however it will require a significant engineering and construction effort; slopes must be reduced to ensure safety and stability and then stabilized with graded materials to prevent ongoing erosion, as unprotected slopes will eventually fail. Unlike the North Spur that was already impacted, the siting and construction of spoil areas will require significant effort, requiring the destruction of significant areas of untouched forest habitat. Nalcor's justification for not removing the topsoil from the reservoir are based on the uncertainty with this unproven method.

Commented [PM3]: I'm not sure how to incorporate this info provided by Dave….for your reference GB

Concerns with the findings

At the workshop in August, methylmercury increases for fish species for the three scenarios included species that were not included in the graph (Figures 6.8 and 6.10 in the Lake Melville Report) and included species that should basically be unaffected by the reservoir. The biggest examples are two species shown as having some of the highest increases – land-locked salmon (ouananiche) and lake trout. For these to be land-locked they would have to be upstream of Muskrat Falls and to be affected by the reservoir, they would have to be residing within the reservoir. Both are at extremely low

abundance in the reservoir area. Since 1998, under the aquatic baseline program, less than 10 ouananiche and 3 lake trout have been caught. Even if these numbers are higher as predicted in the presentation, they are very rare in this area so the actual potential for consuming these is very low. In addition, observations indicate that little fishing occurs in this area (some fishing occurs at the base of Grizzle Rapids), also suggesting that consumption would be low. All non-landlocked salmon below Muskrat Falls would head to the ocean as juveniles and therefore have limited interaction with Lake Melville (although they would spend some time there feeding as they migrate). As adults, they would return to their natal rivers to spawn the following year (12-15 months later). They do not feed during this process.

Since both anadromous salmon and cod are marine species and are not likely to have increases. However, the information presented at the workshop by Sunderland stated that project-related methyl mercury increases in salmon and cod could contribute to a consumers overall mercury intake. An increase in methyl mercury in salmon would happen if they do not return to the ocean – there is no evidence to support that abnormal behavior.

Concentrations predicted in fish as presented by at the workshop in August were based on an average increase in Lake Melville. This is critical given that increases will likely reduce west to east in Lake Melville, resulting in potentially lower concentrations in fish harvested in that region, depending on migration factors.

The methodological details on the HHRA presented in the Lake Melville Report are not available for review. There are pending scientific papers that may provide some of the details. There is no indication that uncertainty or sensitivity analysis has been conducted, which could help put their findings into perspective or speak to the confidence of their findings. The HHRA presented used an atypical and overly complex approach to estimate future exposures and risks.

The Health Canada toxicity reference value of 0.2 ug/kg of body weight/day is the threshold for children under 12 years of age and females of childbearing age. The Lake Melville report predicts the number of Inuit people who are predicted to be above this Health Canada guideline. As indicated in Figure 6.9 of the Lake Melville Report, more than half of the subjects were older than 45 years of age. Health Canada toxicity reference value for males older than 12 years of age and females no longer of childbearing age is 0.47 ug/kg/day.

Information was presented on how estimated methylmercury loads to the reservoir, but no information in the presentation on the actual models used to predict MeHg increases in water or biota in the reservoir or downstream. This is an important step in the extrapolation and predictions made.

~~As methylmercury levels in most fish in Lake Melville are at levels below or non-detectable, it is unclear how the mercury levels in residents is~~ At present methyl mercury concentrations in Lake Melville residing fish are below non-detectable, although it is suggested that Lake Melville is a highly efficient producer of methyl mercury and the same fish will ultimately cause health concerns in the resource users.

It is also noteworthy that under all scenarios suggested at the August meeting (low, medium and high

increases, with low representing topsoil removal), consumption advisories are still likely. This would result in the same concerns over consumption by resources users as would be without implemting this measure.