Memo

To:	Jackie Wells
From:	Matthew Gosse
cc:	James McCarthy
Date:	19 October 2020
Re.	Muskrat Falls Reservoir Methylmercury Monitoring – May 2020 Update

Dear Ms. Wells,

In order to provide additional monitoring coverage of possible changes in methylmercury concentrations in water during headpond and reservoir formation, the provincial government requested an additional sampling program be implemented by Nalcor. Nalcor provided a program description to government and engaged Wood Environment & Infrastructure Solutions (Wood) to implement the sampling program. This memo provides an update on information regarding the Methylmercury Monitoring program completed to date.

Methylmercury

Typically, total mercury is monitored for most Environmental Effects Monitoring Programs (EEMs), however, the Muskrat Falls Methylmercury Monitoring Program is specifically designed to monitor methylmercury (total and dissolved) as well as total mercury and various parameters which could affect methylation (i.e. total phosphorus, DOC, and temperature). Methylmercury is the organic form of mercury, which is bioavailable and biomagnifies within the food chain (Mergler et al. 2007, Chen et al. 2014). Health Canada (2004) has published drinking water guidelines for methylmercury, stating that long-term, daily exposure to 0.25 mg/L (250,000 ng/L) of methylmercury can lead to neurological disorders, and have therefore established maximum allowable concentrations in drinking water of 0.001 mg/L (1,000 ng/L).

Headpond Formation and Reservoir Creation

Headpond formation was completed in early February 2017, with the first set of impoundment samples being collected February 6, 2017. The inundation to full supply water level (38.5-39 m elevation) began on August 7, 2019 and was completed on September 5, 2019.

Sampling Program Overview

Water sampling began in October 2016, with initial samples being collected before any headpond/reservoir formation began in order to capture natural methylmercury concentration. Headpond formation in February 2017 initiated weekly water sample collection from 11 of the 13 sample locations (Figure 1). Throughout headpond formation, inundation had not affected sample locations N2 and N3, therefore they were omitted from the weekly sampling regime until full reservoir inundation, as per WRMD request.

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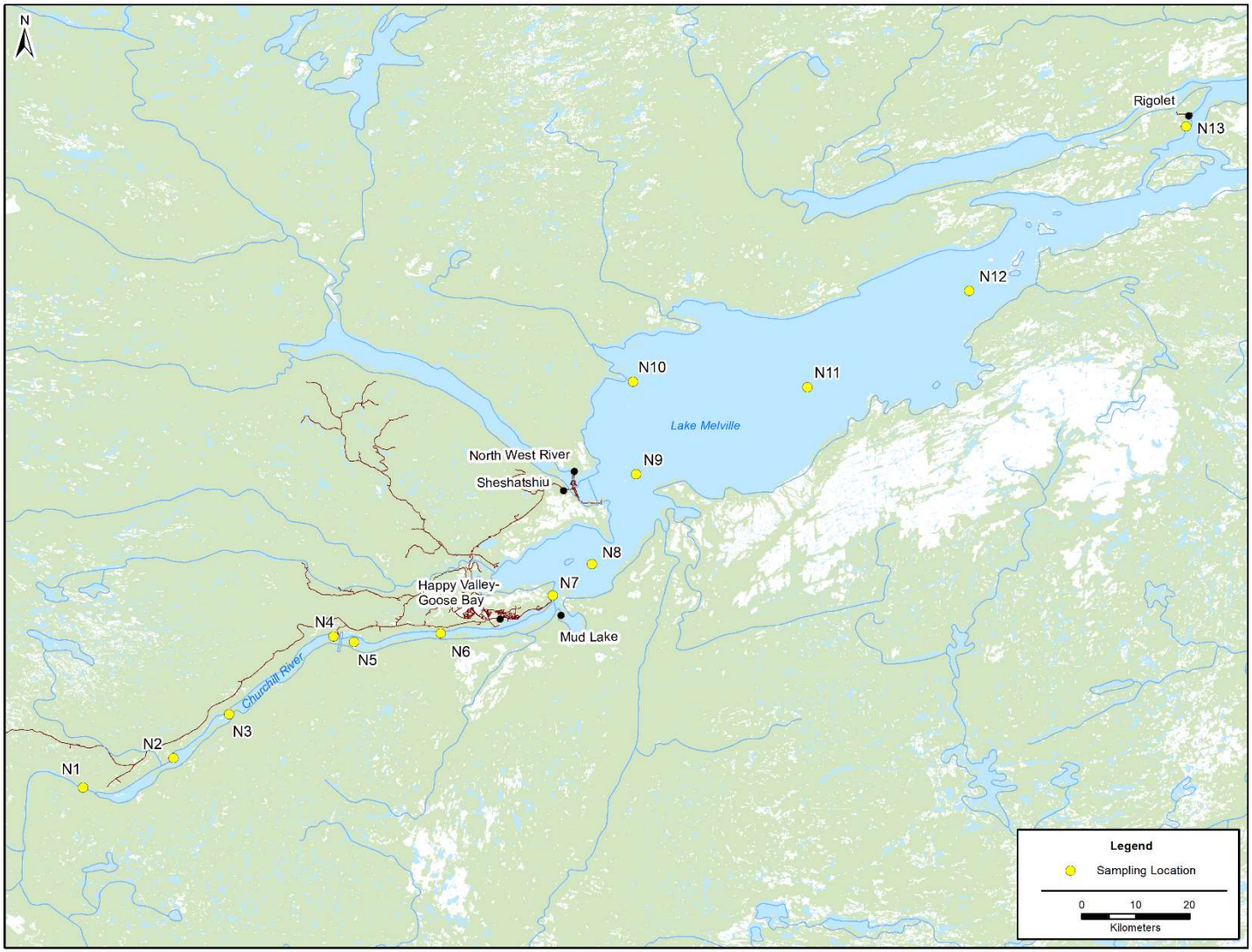

Figure 1: Map of sampling locations for the Muskrat Falls Methylmercury Monitoring Program

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As per Independent Expert Advisory Committee (IEAC) recommendation, each location is now sampled weekly when water temperatures exceed 6°C. When water temperatures are below 6°C, sampling occurs on a bi-weekly basis unless there is a change in water elevation of the Headpond/reservoir by Nalcor which would re-trigger weekly sampling.

With the completion of reservoir formation in September 2019, samples are currently being collected from all 13 sampling locations, including N2 and N3 (surface). All water samples are analysed for total mercury, dissolved methylmercury, and total methylmercury as well as other parameters known to possibly affect methylmercury generation and transport.

Temporal Trends in Dissolved Methylmercury

To date, over 1,900 water samples have been collected for this monitoring program, with the most recent results received from the lab collected on August 25, 2020. Within the sites included in this summary, approximately 15% of the measurements are at or below the lab detection limit (0.010 ng/L). These values have been included in all analysis as the detection limit. All methylmercury analysis is completed by AGAT Labs and Flett Research, while all the various inorganic water quality parameters are completed solely by AGAT.

Measured concentrations of dissolved methylmercury throughout the sampling area have typically been low, with approximately 3% of the measurements exceeding 0.050 ng/L, and a maximum measured value of 0.089 ng/L (taken mid water column at N4 on August 25, 2020). These maximum values remain well below the Health Canada's Drinking Water Guidelines of 1,000 ng/L (0.001 mg/L; Health Canada 2004).

Measured dissolved methylmercury concentrations at stations within and downriver of the headpond/reservoir have been adjusted for baseline, using the control site (N1), which is located upriver beyond any project influence. Concentrations from sample sites N4, N5 and N8 have been analysed to determine whether any potential increases in dissolved methylmercury within the reservoir and immediately downstream are occurring, relative to sample concentrations above the influence of the Muskrat Falls Reservoir (Table 1; Figure 2). As shown, mean concentrations at N4 and N5 have a slight increasing trend relative to N1, while this trend does not appear to continue downstream into Goose Bay (N8) at this time.

Table 1: Summary of mean relative difference from control (Grizzle Rapids site N1) of dissolved methylmercury immediately upriver and downriver of Muskrat Falls (N4 and N5), and Goose Bay (N8)

Sample Site	Operation Phase					
	Pre Headpond		Headpond		Reservoir	
	n	Mean	n	Mean	n	Mean
N4	2	-0.006 (0.016)	93	0.004 (0.002)	28	0.014 (0.008)
N5	2	-0.008 (0.014)	93	0.002 (0.002)	25	0.014 (0.009)
N8	1	-0.015 (-)	79	-0.003 (0.002)	25	0.004 (0.006)

Note Pre headpond include samples prior to February 2017; Headpond includes February 2017 to September 6, 2019; Reservoir includes samples post September 6, 2019
95% confidence interval of the mean relative difference is presented in brackets
n represents the number of paired samples for each site/phase with N1 (control)

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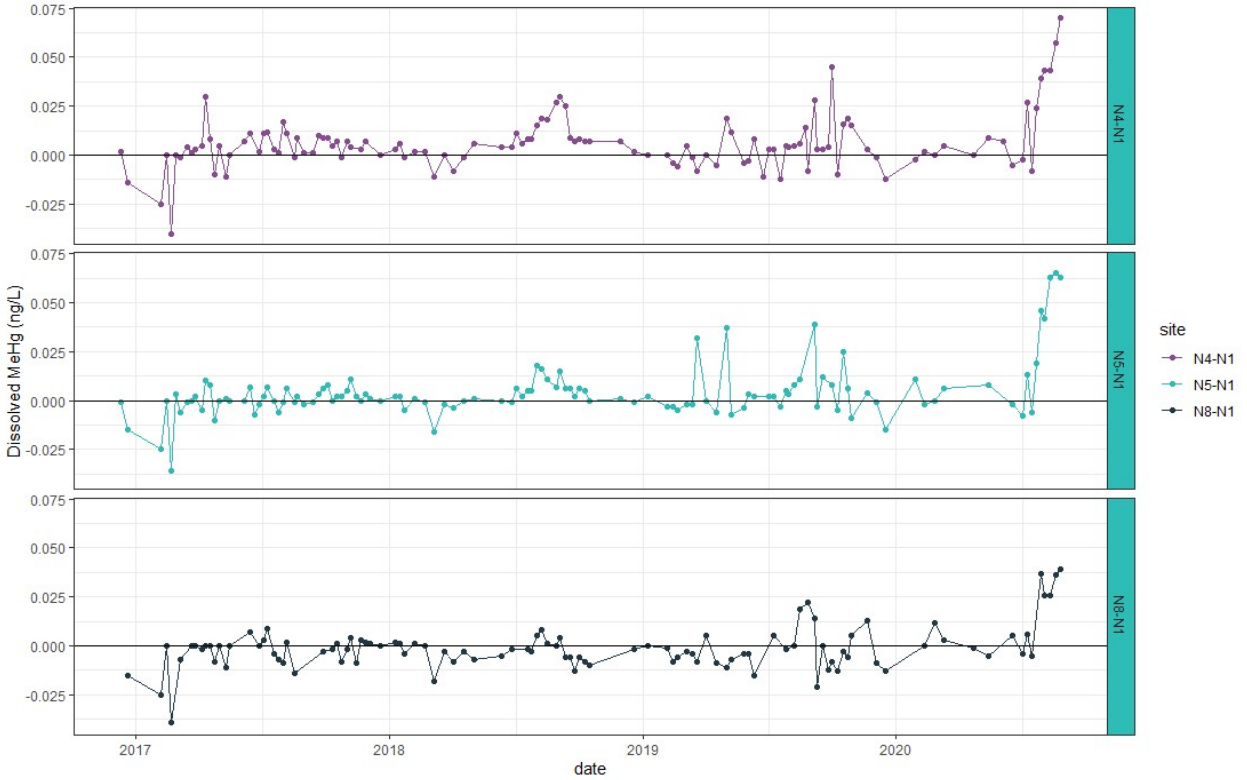

Figure 2: Relative difference from control (Grizzle Rapids site N1) in dissolved methylmercury immediately upriver and downriver of Muskrat Falls (N4 and N5), and Goose Bay (N8)

Quality Assurance/Quality Control

Blind field duplicates are collected randomly from different sampling locations during each sampling round and sent to the lab for full analysis. Using concentrations from the two replicates, the Relative Percent Difference (RPD) is calculated with the following equation, where A and B represent each replicate:

$$RPD = \frac{|(A-B)|}{[(A+B)/2]}\ x\ 100$$

Analysing field duplicates accounts for field sampling error as well as error associated with laboratory analysis. For field duplicates, an RPD of 30% or less is considered acceptable (Azimuth 2017). An extensive QA/QC sampling round is also completed during the spring of each year, when ice conditions do not allow for the safe collection of all sampling locations.

Throughout 2019, the majority of the RPD values calculated were lower than 30%, with a mean RPD of 19.0% and a maximum RPD of 74.2% (Figure 3). There have been 15 samples completed in 2020 to date, with a mean RPD of 22.0%, ranging from 0% to 61.5%.

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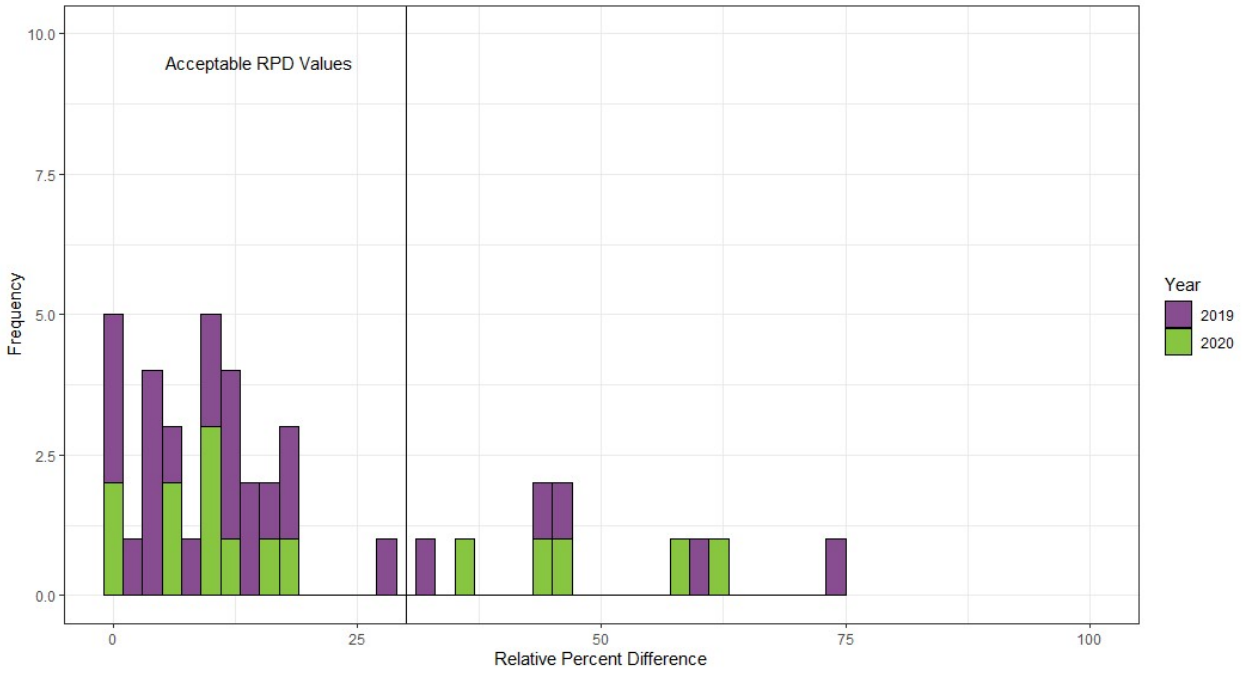

Figure 3: Distribution of RPD values from 2019-2020. Vertical line represents the typical RPD values considered acceptable.

Closure

Should you have any questions, comments of concerns regarding the information presented within this summary, please do not hesitate to contact us at your convenience.

Prepared by

X

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Reviewed by

X

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