Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Mercury in Wildlife Monitoring Report

TEMP-2019-17

KEEYASK

Manitoba Sustainable Development Client File 5550.00
Manitoba Environment Act Licence No. 3107

2018 -2019

KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2018-17

MERCURY MONITORING IN WILDLIFE 2017 AND 2018

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

June 2019

This report should be cited as follows:

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SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station will affect the environment, and whether more needs to be done to reduce harmful effects.

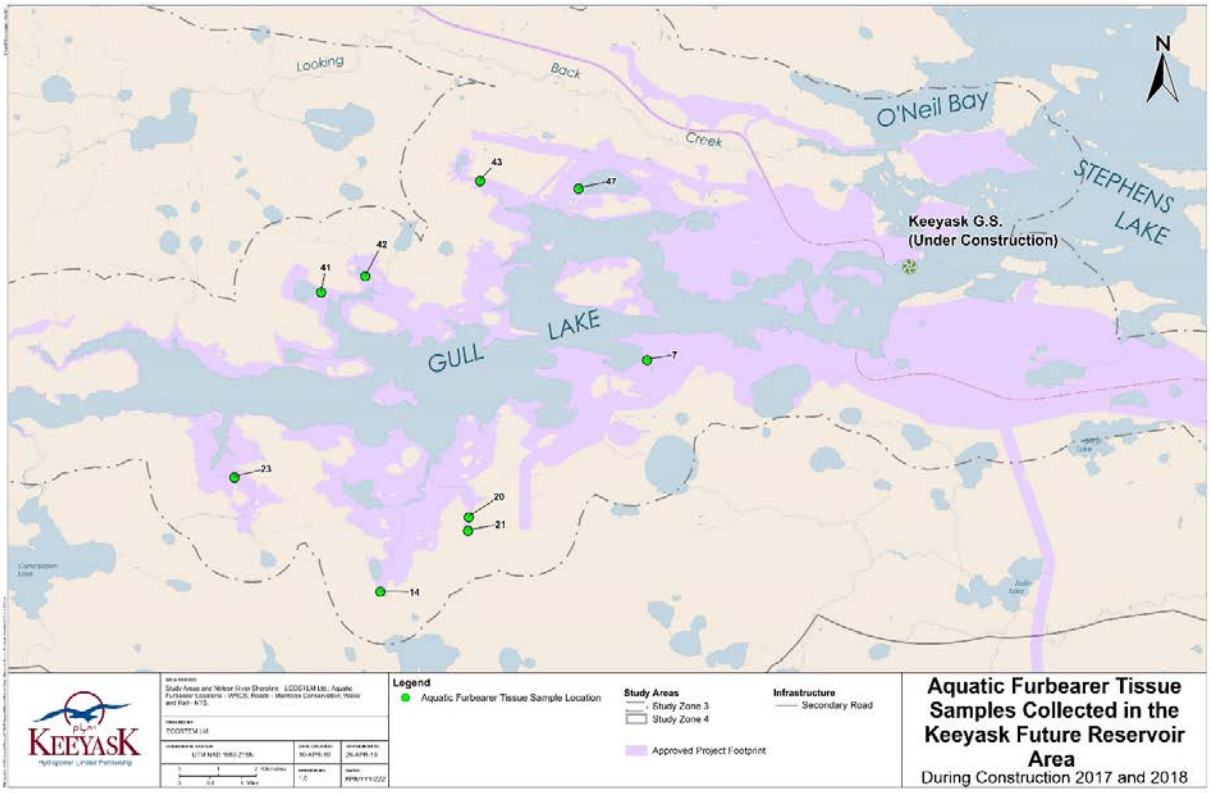
Flooding is expected to increase mercury levels in the future Keeyask reservoir, which could affect aquatic furbearers such as beaver, muskrat, mink, and river otter. Potential Project effects include increased mercury concentrations in fish, and in mink and river otter—the fish-eating aquatic furbearers that consume them. Effects on aquatic furbearers are linked to domestic resource use.

Why is the study being done?

The objective of the study is to compare mercury levels in aquatic furbearers before and during Project construction with post-impoundment levels to determine if the concentration of mercury in beaver, muskrat, mink, and river otter changes during Project operation.

What was done?

Tissue samples (kidney, liver, and/or leg muscle) from six beavers, one muskrat, and two river otters trapped at beaver lodges in the future reservoir area were analyzed for mercury. All individuals were trapped by the registered trapline holder in March 2017 and January or February 2018, during Project construction.



Aquatic Furbearer Tissue Samples Collected in the Keeyask Future Reservoir Area during Construction, 2017 and 2018

What was found?

Mercury levels were low in beaver and muskrat and somewhat greater in river otter during Project construction. No change in mercury levels in these species was observed from the pre-construction to construction periods. Caution should be used in the interpretation of these results because sample sizes were small.

What does it mean?

No changes from pre-construction mercury levels in aquatic furbearers were anticipated because the reservoir has not yet been impounded.

What will be done next?

Trapping was conducted in the future reservoir area in the winter of 2018/19 and will continue in the winter of 2019/20. Mercury concentrations in these individuals will be analyzed and added to the existing database for comparison with mercury concentration in aquatic furbearers during Project operation. If samples of beaver, muskrat, mink, or river otter tissue are submitted voluntarily by local trappers and resource users, these will also be included in the overall analysis of mercury levels in aquatic furbearers.

STUDY TEAM

We would like to thank Sherrie Mason, Rachel Boone, Brian Crockatt, Brian Fournier, and Michelle Ewacha of Manitoba Hydro and Ron Bretecher of North/South Consultants Inc. for logistical assistance in the field. We would also like to thank Dr. James Ehnes of ECOSTEM Ltd. for GIS cartographic services. Biologists and other personnel who designed, participated in trapping, and drafted the survey results included:

- Robert Berger (M.N.R.M.) – Reporting
- Andrea Ambrose (B.Sc.) – Data analysis and reporting
- Nicholas LaPorte (M.N.R.M.) – Trapping assistant and reporting
- Jonathan Saunders – Licensed trapper, Tataskweyak Cree Nation (TCN)
- Mark Saunders – Trapping assistant, TCN
- Anthony Jacobs – Trapping assistant, TCN

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1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695-megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS.

The *Keeyask Generation Project Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the terrestrial environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume* (TE SV). The *Keeyask Generation Project Terrestrial Effects Monitoring Plan* (TEMP) was developed as part of the licensing process for the Project. Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, mercury in wildlife, during the construction and operation phases.

Mercury is a naturally occurring metal that exists in several forms in the environment. Microorganisms in soil and water can transform mercury from one form to another. Methylmercury, a common form of organic mercury, can easily enter the aquatic food web and bioaccumulate when higher-level organisms absorb it from the lower-level organisms that they consume. Methylmercury levels typically increase in water after flooding, as the inorganic mercury released from inundated soil is converted to organic mercury by bacteria feeding on decomposing plants (St. Louis et al. 2004). Because plants typically accumulate relatively low levels of mercury (Lindsay and Bookhout 1978), methylmercury levels in herbivorous aquatic furbearers such as beaver (*Castor canadensis*) and omnivores such as muskrat (*Ondatra zibethicus*) are considerably lower than in carnivorous aquatic furbearers such as river otter (*Lontra canadensis*) and mink (*Neovison vison*) that eat fish and other aquatic animals (Sheffy and St. Amant 1982).

Flooding is expected to increase mercury levels in the future Keeyask reservoir area, which could affect aquatic furbearers such as beaver, muskrat, mink, and river otter. Potential Project effects include increased mercury concentrations in fish, and in mink and river otter—the fish-eating aquatic furbearers that consume them. Effects on aquatic furbearers are linked to domestic resource use. Mercury levels in beaver, muskrat, mink, and river otter were measured in tissue samples collected before Project construction began. Because reservoir impoundment will flood their habitat, beaver and muskrat were trapped out of the future reservoir area in the winters of 2016/17 and 2017/18 to prevent prolonged exposure and displacement deaths (Wildlife Resource Consulting Services MB Inc. [WRCS] 2018). All individuals were trapped by the registered trapline holder. Tissue samples from trapped individuals were collected and submitted for mercury analysis. As described in Section 7.0 of the TEMP, the objective of the study is to compare mercury levels in aquatic furbearers before and during Project construction

with post-impoundment levels to determine if the concentration of mercury in beaver, muskrat, mink, and river otter changes during Project operation.

2.0 METHODS

To prevent the potential for prolonged exposure and displacement deaths of aquatic furbearers during Project construction, animals were trapped from the future reservoir area in (Table 1; Photo 1), as described in the EIS and the *Terrestrial Mitigation Implementation Plan* (TMIP; KHLP 2015). Tissue samples were collected from these individuals for mercury analysis. Tissue samples (kidney, liver, and/or leg muscle) from six beavers, one muskrat, and two river otters trapped at beaver lodges in the future reservoir area (Map 1) in March 2017, January 2018, and February 2018 were analyzed for mercury. For testing purposes, submissions of adult beaver organs were limited to kidneys. The age of each trapped animal was estimated by measuring body weight and skull length (WRCS 2018).

No additional mammal tissue samples were submitted by partner First Nation community members for analysis.

Table 1: Aquatic Furbearer Tissue Samples Collected from the Future Reservoir Area during Construction, 2017 and 2018

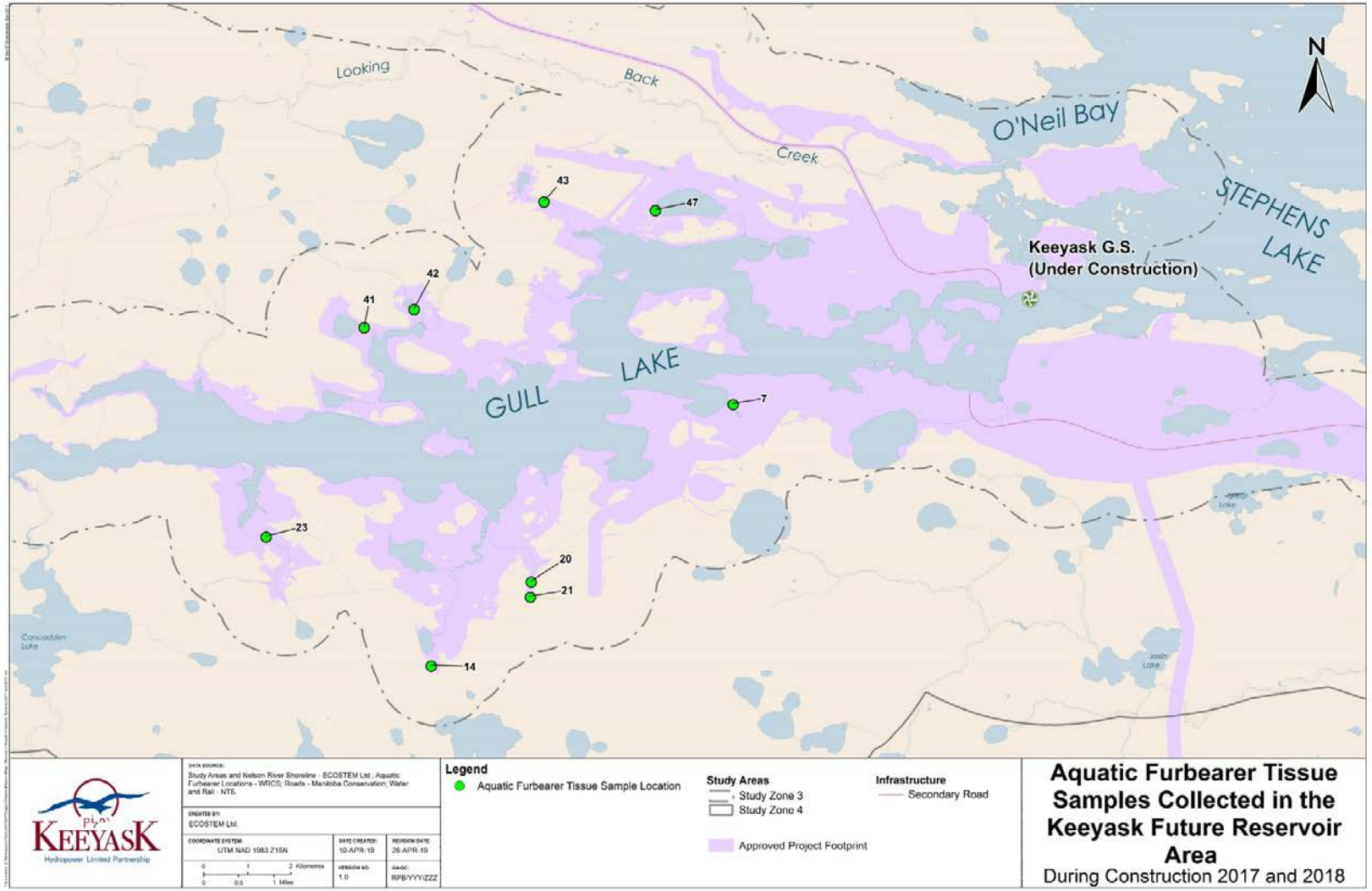
Year Trapped	Lodge Number	Species	Age of Individual	Tissue Collected	Lodge Location
2017	7	Beaver	Juvenile	Muscle	15 V 357954 6244917
	14	River otter	Adult	Kidney, liver, muscle	15 V 351273 6239131
	20	River otter	Adult	Kidney, liver, muscle	15 V 353487 6240990
	23	Beaver	Adult	Kidney, muscle	15 V 347619 6241984
2018	21	Beaver	Adult	Kidney, muscle	15 V 353469 6240652
	41	Beaver	Adult	Kidney, muscle	15 V 349789 6246611
	42	Beaver	Adult	Muscle	15 V 350894 6247016
	43	Muskrat	Adult	Kidney, liver, muscle	15 V 353769 6249395
	47	Beaver	Juvenile	Muscle	15 V 356236 6249204

Tissue samples were submitted to ALS Environmental for mercury analysis, where the EPA 200.3/EPA 1631E (mod) method was used. Results were reported as milligrams of mercury per kilogram of wet weight (mg/kg wwt).

Results were compared with those from aquatic furbearer tissue samples collected voluntarily from traplines in the Split Lake, York Landing, and Fox Lake Resource Management Areas from February 2003 to April 2008, during the pre-construction period (TE SV Section 8.4). A trapline was categorized as “on-system” if it overlapped the Nelson River and was also located in Study Zone 5. The home ranges of beaver, muskrat, mink, and river otter within this category were presumed to overlap the regulated water system. “Off-system” traplines were considered representative of unregulated water systems and included creeks, rivers, ponds, or lakes that were not in immediate contact with the Nelson River but were also located within or near Study Zone 5. Traplines outside Study Zone 5 were categorized as comparison areas and included waterbodies that may or may not have been in direct contact with the Nelson River (TE SV Section 8.4). The lower mercury detection limit of pre-construction samples was 0.01 mg/kg

wwt. See Appendix 1 for the pre-construction mercury concentrations in aquatic furbearer tissue.

Photo 1: Installation of Underwater Traps at a Beaver Lodge, January 2018



Map 1: Aquatic Furbearer Tissue Samples Collected in the Keeyask Future Reservoir Area during Construction, 2017 and 2018

3.0 RESULTS

During the Project construction period from 2017 to 2018, mercury levels were low in beaver muscle tissue, ranging from 0.003 to 0.0124 mg/kg wwt (Table 2). The highest concentration was in a juvenile trapped from lodge 47 in 2018; mercury levels were an order of magnitude greater in muscle tissue from this individual than in other beavers. Similar mercury levels were measured in muscle and in kidney tissue samples from two river otters; these concentrations were considerably higher than in most beaver tissues. However, the mercury level in one river otter liver sample, trapped at lodge 14, was roughly ten times greater than in the other individual sampled. Overall, mercury levels in beaver kidney tissue were considerably lower than those in river otter kidneys.

Table 2: Mercury Concentration in Aquatic Furbearers Removed from the Future Reservoir Area during Construction, 2017 and 2018

Year Trapped	Lodge Number	Species	Age of Individual	Mercury Concentration (mg/kg wwt)		
				Kidney	Liver	Muscle
2017	7	Beaver	Juvenile			0.0052
	14	River otter	Adult	1.28	3.66	0.600
	20	River otter	Adult	1.38	0.354	0.588
	23	Beaver	Adult	0.0395		0.0058
2018	21	Beaver	Adult	0.0086		0.0039
	41	Beaver	Adult	0.0428		0.0082
	42	Beaver	Adult			0.003
	43	Muskrat	Adult	—[1]	0.0039	—[1]
	47	Beaver	Juvenile			0.0124

1. Lab analysis for mercury levels not successful.

Because they were collected from the future reservoir area, all tissue samples collected during construction were on-system. Mean mercury levels in beaver muscle tissue during Project construction were comparable to those from the pre-construction period; all were less than 0.01 mg/kg wwt (Table 3). The mercury level in the muskrat liver tissue collected in 2018 was approximately 10 times lower than the mean mercury level in pre-construction on-system muskrat liver tissue and was comparable to pre-construction mercury levels in muskrat livers in off-system and comparison areas. The muskrat muscle tissue sample collected during Project construction was not successfully analyzed for mercury; however, mercury levels in muskrat muscle would not be expected to differ substantially from the pre-construction period.

The mean mercury level in river otter liver tissue was greater during Project construction than in the on-system, off-system, or comparison areas during the pre-construction period (Table 3). While there was a considerable range in mercury levels in river otter livers collected during construction (i.e., 0.354 and 3.66 mg/kg wwt), there was a similar range in pre-construction on-system liver samples (0.30–3.81 mg/kg wwt). The mean mercury level in river otter muscle tissue was similar before and during construction (Table 3).

Table 3: Mean Mercury Concentration (mg/kg wwt) in Aquatic Furbearer Tissue before and during Construction, 2003–2008 and 2017–2018

Area	Beaver Muscle		Muskrat Liver		Muskrat Muscle	River Otter Muscle		River Otter Liver	
	2003–2008	2017–2018	2003–2008	2017–2018	2003–2008	2003–2008	2017–2018	2003–2008	2017–2018
On-system	<0.01 (34)[1]	0.006 (6)	0.03 (3)	0.0039 (1)	0.01 (6)	0.59 (14)	0.594 (2)	1.66 (12)	2.007 (2)
Off-System	<0.01 (16)	–	<0.01 (14)	–	<0.01 (16)	0.29 (28)	–	0.78 (22)	–
Comparison	<0.01 (6)	–	<0.01 (3)	–	<0.01 (3)	0.38 (8)	–	1.02 (8)	–

1. Number of samples is in brackets.

4.0 DISCUSSION

No change in mercury levels in beaver are anticipated after reservoir impoundment due to the minute quantities of mercury taken up by the vegetation that they consume. Small increases in mercury levels in muskrat are expected because they forage on aquatic plants and animals, the latter of which will likely accumulate more mercury following impoundment. As expected, mercury levels in beaver tissue collected during Project construction in 2017 and 2018 were low and there has been no apparent change since the pre-construction samples were collected from 2003 to 2008. should be used in the interpretation of these results because sample sizes were small. The level of mercury in the single muskrat liver collected in 2018 was within the range of those collected before Project construction. No changes from pre-construction levels were anticipated because the reservoir has not yet been impounded. Caution should be used, however, in the interpretation of these results, because sample sizes were small.

Mercury levels in mink and river otter are expected to increase over pre-Project levels and peak approximately seven years after the reservoir is impounded. Mercury levels are then expected to decline and reach pre-Project levels, or be considered stable at a new background level, approximately 20 to 30 years post-impoundment. The mean mercury level in on-system river otter muscle and liver tissue was somewhat greater during than before Project construction, but the ranges of mercury levels from each period were similar. Caution should be used, however, in the interpretation of these results, because sample sizes were small. As with beaver and muskrat, no changes from pre-construction levels were anticipated during the 2017–2018 period, because the reservoir has not yet been impounded.

5.0 SUMMARY AND CONCLUSIONS

No change in mercury levels in beaver, muskrat, or river otter was observed from the pre-construction to construction sampling periods. Caution should be used in the interpretation of these results because sample sizes were small. Trapping of beaver and muskrat was also conducted in the future reservoir area in the winter of 2018/19 and will continue in the winter of 2019/20, prior to reservoir impoundment in 2020. Mercury concentrations in samples from the animals trapped during these years will be analyzed and added to the existing database for comparison with mercury concentration in aquatic furbearers during Project operation. If additional samples of beaver, muskrat, mink, or river otter tissue are submitted voluntarily by local trappers and resource users, these will be analyzed and included in the overall analysis of mercury levels in aquatic furbearers. If samples from other country foods such as moose, caribou or snowshoe hare are submitted, these will also be analyzed.

6.0 LITERATURE CITED

Keeyask Hydropower Limited Partnership. 2015. Keeyask Generation Project Terrestrial Mitigation Implementation Plan. October 2015.

Lindsay, S.F. and Bookhout, T.A. 1978. Lead and mercury levels in vegetation from strip-mined areas in eastern Ohio. Bulletin of Environmental Contamination and Toxicology 19: 360–364 pp.

Sheffy, T.B. and St. Amant, J.R. 1982. Mercury burdens in furbearers in Wisconsin. The Journal of Wildlife Management 46(4): 1117–1120 pp.

St. Louis, V.L., Rudd. J.W.M., Kelly, C.A., Bodaly, R.A., Paterson, M.J., Beaty, K.G., Hesslein, R.H., Heyes, A., and Majewski, A.R. 2004. The rise and fall of mercury methylation in an experimental reservoir. Environmental Science & Technology 38(5): 1348–1358 pp.

WRCS (Wildlife Resource Consulting Services MB Inc.). 2018. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2018-19: Beaver Habitat Effects and Mortality 2016 to 2018. A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., June 2018.

APPENDIX 1:
MERCURY RESULTS 2003–2008

Table A-1: Mercury Concentration (mg/kg wwt) in Aquatic Furbearers before Construction, 2003–2008

Species	Area	Muscle			Liver		
		Mean	Range	Number of Samples	Mean	Range	Number of Samples
Beaver	On-system	<0.01	<0.01–0.01	34	<0.01	All <0.01	16
	Off-system	<0.01	<0.01–0.03	16	0.01	<0.01–0.04	12
	Comparison	<0.01	<0.01–<0.01	16	<0.01	<0.01–0.03	14
Muskrat	On-system	0.01	<0.01–0.03	6	0.03	0.01–0.06	3
	Off-system	<0.01	<0.01–0.01	16	<0.01	<0.01–0.03	14
	Comparison	<0.01	<0.01–<0.01	3	<0.01	All <0.01	3
River otter	On-system	0.59	0.13–1.52	14	1.66	0.30–3.81	12
	Off-system	0.29	0.13–0.73	28	0.78	0.08–3.97	22
	Comparison	0.38	0.11–0.99	8	1.02	0.28–2.90	8

APPENDIX 2:
LABORATORY RESULTS 2017–2018

Wildlife Resource Consulting Services MB Inc.
ATTN: KEVIN MCRAE
495-B Madison Street
Winnipeg MB R3J 1J2

Date Received: 10-DEC-18
Report Date: 29-JAN-19 13:19 (MT)
Version: FINAL

Client Phone: 204-452-2197

Certificate of Analysis

Lab Work Order #: L2208162
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Comments: NOTE: Unable to analyze frac -5 NS1 MUSK LEG - LODGE 43 & frac -7 NS1 MUSK KIDNEY - LODGE 43. There was a problem with the original digestion of the sample and due to the limited amount of sample there was insufficient sample remaining to re-do the digestion for Mercury.

Hua Wo
Chemistry Laboratory Manager

ADDRESS: 1329 Niakwa Road East, Unit 12, Winnipeg, MB R2J 3T4 Canada | Phone: +1 204 255 9720 | Fax: +1 204 255 9721
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

L2208162 CONTD....
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2208162-1 SS2-2 BEAV LEG - LODGE 21							
Sampled By: CLIENT on 24-JAN-18							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							
Mercury (Hg)	0.0039		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	73.7		0.10	%		04-JAN-19	R4428096
L2208162-2 SS2-2 BEAV KIDNEY- LODGE 21							
Sampled By: CLIENT on 24-JAN-18							
Matrix: KIDNEY							
Miscellaneous Parameters							
Mercury (Hg)	0.0086		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	81.1		0.10	%		04-JAN-19	R4428096
L2208162-3 NS1-1 BEAV LEG - LODGE 47							
Sampled By: CLIENT on 13-JAN-18							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							
Mercury (Hg)	0.0124		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	68.6		0.10	%		04-JAN-19	R4428096
L2208162-4 NS3-1 BEAV LEG - LODGE 42							
Sampled By: CLIENT on 13-JAN-18							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							
Mercury (Hg)	0.0030		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	73.8		0.10	%		04-JAN-19	R4428096
L2208162-6 NS1 MUSK LIVER - LODGE 43							
Sampled By: CLIENT on 22 FEB 18							
Matrix: LIVER							
Miscellaneous Parameters							
Mercury (Hg)	0.0039		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
L2208162-8 L3-1 RIOT LEG - LODGE 14							
Sampled By: CLIENT on 13-MAR-17							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							
Mercury (Hg)	0.600		0.0050	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	71.9		0.10	%		04-JAN-19	R4428096
L2208162-9 L3-1 RIOT LIVER - LODGE 14							
Sampled By: CLIENT on 13-MAR-17							
Matrix: LIVER							
Miscellaneous Parameters							
Mercury (Hg)	3.66		0.020	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	71.2		0.10	%		04-JAN-19	R4428096
L2208162-10 L3-1 RIOT KIDNEY - LODGE 14							
Sampled By: CLIENT on 13-MAR-17							
Matrix: KIDNEY							
Miscellaneous Parameters							
Mercury (Hg)	1.20		0.010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	73.0		0.10	%		04-JAN-19	R4428096
L2208162-11 S17-2 BEAV LEG - LODGE 23							
Sampled By: CLIENT on 14-MAR-17							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

L2208162 CONTD....
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Version: FINAL

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2208162-11 S17-2 BEAV LEG - LODGE 23							
Sampled By: CLIENT on 14-MAR-17							
Matrix: LEG MUSCLE							
Mercury (Hg)	0.0058		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	74.5		0.10	%		04-JAN-19	R4428096
L2208162-12 S17-2 BEAV KIDNEY - LODGE 23							
Sampled By: CLIENT on 14-MAR-17							
Matrix: KIDNEY							
Miscellaneous Parameters							
Mercury (Hg)	0.0395		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	81.0		0.10	%		04-JAN-19	R4428096
L2208162-13 NS4-6 BEAV LEG - LODGE 41							
Sampled By: CLIENT on 16-FEB-18							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							
Mercury (Hg)	0.0082		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	66.5		0.10	%		04-JAN-19	R4428096
L2208162-14 NS4-6 BEAV KIDNEY - LODGE 41							
Sampled By: CLIENT on 16-FEB-18							
Matrix: KIDNEY							
Miscellaneous Parameters							
Mercury (Hg)	0.0428		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	78.5		0.10	%		04-JAN-19	R4428096
L2208162-15 S2 BEAV LEG - LODGE 7							
Sampled By: CLIENT on 23-JAN-17							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							
Mercury (Hg)	0.0052		0.0010	mg/kg wwt	03-JAN-19	18-JAN-19	R4458630
% Moisture	60.0		0.10	%		04-JAN-19	R4428096
L2208162-16 S9 RIOT LEG - LODGE 20							
Sampled By: CLIENT on 21-JAN-17							
Matrix: LEG MUSCLE							
Miscellaneous Parameters							
Mercury (Hg)	0.588		0.0050	mg/kg wwt	08-JAN-19	18-JAN-19	R4464948
% Moisture	58.8		0.10	%		04-JAN-19	R4428096
L2208162-17 S9 RIOT LIVER - LODGE 20							
Sampled By: CLIENT on 21-JAN-17							
Matrix: LIVER							
Miscellaneous Parameters							
Mercury (Hg)	0.354		0.0020	mg/kg wwt	08-JAN-19	18-JAN-19	R4464948
% Moisture	68.4		0.10	%		04-JAN-19	R4428096
L2208162-18 S9 RIOT KIDNEY - LODGE 20							
Sampled By: CLIENT on 21-JAN-17							
Matrix: KIDNEY							
Miscellaneous Parameters							
Mercury (Hg)	1.38		0.010	mg/kg wwt	08-JAN-19	18-JAN-19	R4464948
% Moisture	55.9		0.10	%		04-JAN-19	R4428096

* Refer to Referenced Information for Qualifiers (if any) and Methodology

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-WET-CVAA-WP	Tissue	Mercury in Tissue	EPA 200.3/1631E (mod)
Tissue samples undergo hotblock digestion with nitric and hydrochloric acids, in combination with repeated additons of hydrogen peroxide, followed by cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analysis by CVAAS.			
MOISTURE IN WP	Tissue	Percent Moisture	ASTMD2974 87, Method B

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Quality Control Report

Workorder: L2208162 Report Date: 29-JAN-19 Page 1 of 3

Client: Wildlife Resource Consulting Services MB Inc.
495-B Madison Street
Winnipeg MB R3J 1J2

Contact: KEVIN MCRAE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-WET-CVAA-WP	Tissue							
Batch R4458630								
WG2969081-3 CRM		**DORM-4N**						
Mercury (Hg)			111 9		%		70-130	18-JAN-19
WG2969081-4 DUP		**L2208162-15**						
Mercury (Hg)		0.0052	0.0053		mg/kg wwt	2.1	40	18-JAN-19
WG2969081-2 LCS								
Mercury (Hg)			106.0		%		80-120	18-JAN-19
WG2969081-1 MB								
Mercury (Hg)			<0.0010		mg/kg wwt		0.001	18-JAN-19
Batch R4464948								
WG2969091-3 CRM		**DORM-4N**						
Mercury (Hg)			107.8		%		70-130	18-JAN-19
WG2969091-2 LCS								
Mercury (Hg)			102.0		%		80-120	18-JAN-19
WG2969091-1 MB								
Mercury (Hg)			<0.0010		mg/kg wwt		0.001	18 JAN 19
MOISTURE-IN-WP	Tissue							
Batch R4428096								
WG2964337-1 DUP		**L2208162-9**						
% Moisture		71.2	71.4		%	0.2	20	04-JAN-19

Quality Control Report

Workorder: L2208162 Report Date: 29-JAN-19 Page 2 of 3

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Quality Control Report

Workorder: L2208162 Report Date: 29-JAN-19 Page 3 of 3

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Percent Moisture							
	1	24-JAN-18	04-JAN-19 15:00	180	345	days	EHTR
	2	24-JAN-18	04-JAN-19 15:00	180	345	days	EHTR
	3	13-JAN-18	04-JAN-19 15:00	180	356	days	EHTR
	4	13-JAN-18	04-JAN-19 15:00	180	356	days	EHTR
	8	13-MAR-17	04-JAN-19 15:00	180	662	days	EHTR
	9	13-MAR-17	04-JAN-19 15:00	180	662	days	EHTR
	10	13 MAR 17	04 JAN 19 15:00	180	662	days	EHTR
	11	14-MAR-17	04-JAN-19 15:00	180	661	days	EHTR
	12	14-MAR-17	04-JAN-19 15:00	180	661	days	EHTR
	13	16-FEB-18	04-JAN-19 15:00	180	322	days	EHTR
	14	16-FEB-18	04-JAN-19 15:00	180	322	days	EHTR
	15	23-JAN-17	04-JAN-19 15:00	180	711	days	EHTR
	16	21-JAN-17	04-JAN-19 15:00	180	713	days	EHTR
	17	21-JAN-17	04-JAN-19 15:00	180	713	days	EHTR
	18	21 JAN 17	04 JAN 19 15:00	180	713	days	EHTR
Total Metals							
Mercury in Tissue							
	8	13-MAR-17	03-JAN-19 16:00	365	661	days	EHTR
	9	13-MAR-17	03-JAN-19 16:00	365	661	days	EHTR
	10	13-MAR-17	03-JAN-19 16:00	365	661	days	EHTR
	11	14-MAR-17	03-JAN-19 16:00	365	660	days	EHTR
	12	14-MAR-17	03-JAN-19 16:00	365	660	days	EHTR
	15	23-JAN-17	03-JAN-19 16:00	365	710	days	EHTR
	16	21 JAN 17	08 JAN 19 16:00	365	717	days	EHTR
	17	21-JAN-17	08-JAN-19 16:00	365	717	days	EHTR
	18	21-JAN-17	08-JAN-19 16:00	365	717	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2208162 were received on 10-DEC-18 13:20.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Methodology L1766540

Job Reference
Report To ROBERT BERGER
Date Received
Report Date
Report Version

ALS Test Code	ALS Test Description	Lab Location	Matrix	Method Reference
Physical Tests (Tissue)				
MOISTURE-IN-WP	Percent Moisture	Winnipeg	Tissue	ASTMD2974-87, Method B
Metals (Tissue)				
HG-WET-L-CVAF-WP	Mercury in Tissue by CVAFS, Wet Weight	Winnipeg	Tissue	EPA 200.3/EPA 1631E (mod)