# Keeyask Generation Project

## Terrestrial Effects Monitoring Plan

# Mercury In Plants Monitoring Report

**TEMP-2019-06**

KEEYASK

Manitoba Sustainable Development Client File 5550.00
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# KEEYASK GENERATION PROJECT

## TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2019-06

## MERCURY IN PLANTS MONITORING

Prepared for

Manitoba Hydro

By

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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 or not more needs to be done to reduce harmful effects.

This report describes the results of mercury in plants monitoring conducted during the fifth summer of Project construction.

## Why is the study being done?

Members of partner First Nations are concerned about Project-related changes in mercury levels in plants that are eaten or have traditional uses. During the Project's environmental assessment, members of the Keeyask Mercury and Human Health Technical Working Group decided that mercury levels should be monitored in Labrador tea, northern Labrador tea, blueberries, and sweet flag (Wihkis in Cree).

This study is being conducted to evaluate whether the creation of the Project reservoir increases mercury content in several traditionally used plants.

## What was done?

Mercury levels in plants are being monitored as a component of the technical science monitoring, including voluntary submission of plant samples by members of partner First Nations.

To evaluate if there are changes in mercury levels in selected terrestrial plants, mercury levels in plants after the reservoir flooding will be compared with those found in plants that were collected prior to reservoir flooding.

Plant tissue collection to test for mercury levels prior to impoundment began in 2017 and continued in 2018. In 2018, blueberries were collected at 30 locations between August 17 and 22. Labrador tea leaves were collected at 26 locations on September 12 and 13. Northern Labrador tea and sweet flag/Wihkis, the other two species of interest, were not found in the searched areas.

## What was found?

Analysis of the berries collected from blueberry bushes found that mercury content was below the smallest amount that the laboratory could measure (5.0 ng/g) in all of the samples.

Mercury content in the Labrador tea leaves was below the smallest amount that could be measured in 16 of the 26 (62%) samples. The highest measured mercury content was 6.4 ng/g.

### What does it mean?

Mercury occurs naturally in the environment. There are no established guidelines for safe levels of consumption of country food plants in local diets.

In the meantime, studies from other places in Canada provide an idea of what can be expected for mercury in boreal plants. These studies found the average mercury content values for 17 different plant species ranged from 4.9 ng/g up to 39.3 ng/g, with most being higher than 10.0 ng/g. For the 2018 samples, all of the blueberry concentrations were below the bottom end of this range and all of the Labrador tea leaf concentrations were either below or near the bottom end of the range.

### What will be done next?

Monitoring of mercury in plants will continue in 2019.

# ACKNOWLEDGEMENTS

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Chiefs and Councils of Tataskweyak Cree Nation (TCN), War Lake First Nation (WLFN), York Factory First Nation (YFFN) and Fox Lake Cree Nation (FLCN) are gratefully acknowledged for their support of this program.

We would also like to thank North/South Consultants Inc., in particular Ron Bretecher and Shari Fournier for their guidance, logistical support and other resources that made these studies possible. Additionally, we thank Wildlife Resource Consulting Services field staff for cooperating on fieldwork logistics.

Custom Helicopters is gratefully acknowledged for providing transportation during fieldwork and Nicole Pokornowska and Ben Hofer for coordinating the logistics.

# STUDY TEAM

Dr. James Ehnes was the project manager and study designer.

Fieldwork was conducted by Brock Epp and Barry Flett (TCN).

Data analysis and report writing were completed by Brock Epp and James Ehnes. Cartography was completed by Nathan Ricard.

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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; KHLP 2012a), 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; KHLP 2012b). The *Keeyask Generation Project Terrestrial Effects Monitoring Plan* (TEMP; KHLP 2015) 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 plants, during the construction and operation phases.

This study addresses concerns that members of the partner First Nations have expressed about mercury levels in traditionally used terrestrial plant species. Mercury levels in these plant species are being monitored via tissue collected as a component of the TEMP, including any plant samples collected and submitted by partner First Nations community members. During Project operation, mercury levels in selected terrestrial plant species will be compared with those in plants that were collected prior to reservoir impoundment. During the Project's environmental assessment, the four plant species/groups selected by members of the Keeyask Mercury and Human Health Technical Working Group for monitoring were Labrador tea (*Rhododendron groenlandicum*), northern Labrador tea (*Rhododendron tomentosum*), blueberries (*Vaccinium* spp.) and sweet flag (*Acorus americanus*), which is called Wihkis in Cree.

The objectives of this study are to:

- Evaluate pre-impoundment mercury levels in the selected terrestrial plant species; and,
- Evaluate if there are changes in mercury levels in the selected terrestrial plant species during Project operation.

To date, monitoring during the construction period prior to impoundment was conducted in 2017 and 2018. This report presents the results from the monitoring conducted in 2018.

# 2.0 LITERATURE OVERVIEW

Mercury is a naturally occurring metal that exists in elemental, inorganic and organic forms in the environment (Research Triangle Institute 1999). Mercury is naturally introduced into the environment through the weathering of minerals in rocks and soils and through volcanic activity. Human activities, such as mining and fossil fuel burning have increased the amounts of mercury in the global environment (Fitzgerald et al. 1998). There is some evidence that suggests that hydroelectric reservoirs may increase mercury concentrations in land plants that are very close to the reservoir (Zhang et al. 1995). As these authors did not test the potential pathways for mercury being transferred from the reservoir to the plants, they speculated on two explanations for difference. One possible explanation related to the absorption of gaseous mercury emitted from water or soil surfaces. Another possibility was that mercury was being taken up by plant roots from groundwater that was hydrologically connected to the reservoir.

Vascular and non-vascular plants have a large capacity to take up and store mercury in their tissues (e.g. Siegel et al. 1987, Will-Wolf et al. 2005). As such, they may be an important sink for atmospheric or soil mercury. It has been suggested that the mercury concentration in foliage largely represents the accumulation of atmospheric mercury through the growing season, while mercury taken up from the soil is largely stored in roots (Rea et al. 2002, Ericksen et al. 2003).

Studies identifying safe levels for consumption of country food plants in local diets were not found. Plant mercury concentrations from this study will be provided to the toxicologist undertaking the Project's Human Health Risk Assessment (HHRA) for further analysis.

For general context, Table 2-1 provides literature-reported mean total mercury concentration values for plant species from studies conducted in Canada. Four of these studies are from the Experimental Lakes Area in northwestern Ontario (St. Louis et al. 2001, Hall and St. Louis 2004, Hall et al. 2005, Mailman and Bodaly 2005), one is from southern Ontario (Rasmussen et al. 1991), one is from Quebec (Zhang et al. 1995) and one is from the Southern Indian Lake area in Manitoba (Bodaly et al. 1987).

These studies found that mean total mercury concentration values for various plant species ranged from 4.9 ng/g up to 39.3 ng/g, with mercury concentrations being higher than 10.0 ng/g for most species (Table 2-1). Total mercury concentration values measured in species from the Southern Indian Lake area, which is the closest location to the Keeyask region, are similar to values recorded in other studies.

Mercury concentrations in plants growing in the Keeyask region are likely different from the mean values reported in Table 2-1 for a variety of reasons. The most important of these are differences in species are studied, plant parts sampled, site conditions, proximity to human emission sources, time sampled in the growing season and time in the life of the individual plant.

Regarding differences in species, plant species differ in their capacity to bioaccumulate mercury. One mining site, species differences in total mercury accumulation ranged from 100 to

1,000 ng/g (Bailey and Gray 1997). Within a particular plant, total mercury concentrations are different in the fruit, leaf, stem and root of the same species (Schwesig and Krebs 2003). Site conditions can have an important influence through factors such as local bedrock geology (AMAP 1998) or groundwater (Zhang et al. 1995). The natural accumulation of mercury in plant parts is a function of time, occurring over the growing season and the life of the individual plant. Mercury concentrations in leaves tend to be highest near the end of the growing season (Rasmussen 1995; Schwesig and Krebs 2003).

**Table 2-1: Mean total dry weight mercury concentrations for plant species found in Keeyask region, as reported by studies conducted in various provinces**

| Plant Species Name | | Tissue Tested | Total Mercury (ng/g)[1] | Source |
|---|---|---|---|---|
| **Scientific** | **Common** | | | |
| *Alnus viridis* | Green alder | Foliage, small branches | 8.2 | Hall and St Louis 2004[2]; Mailman and Bodaly 2005 |
| *Alnus incana* | Speckled alder | Foliage | 34.0 | St Louis et al. 2001 |
| *Alnus* spp. | Alders | Foliage, bark, wood, small branches | 11.8 | Bodaly et al. 1987[2] |
| *Betula papyrifera* | White birch | Foliage, bark, wood, small branches | 12.5 | Bodaly et al. 1987[2]; Hall and St Louis 2004[2]; Hall et al. 2005[2]; Mailman and Bodaly 2005 |
| *Chamaedaphne calyculata* | Leather-leaf | Foliage, small branches | 20.4 | Mailman and Bodaly 2005; St Louis et al. 2001 |
| *Cornus canadensis* | Bunchberry | Foliage and stem | 9.8 | Hall and St Louis 2004[2] |
| *Kalmia polifolia* | Bog-laurel | Foliage, small branches | 10.5 | Mailman and Bodaly 2005 |
| *Larix laricina* | Tamarack | Foliage, small branches | 19.7 | Mailman and Bodaly 2005; Rasmussen et al. 1991 |
| *Ledum groenlandicum* | Labrador-tea | Foliage, small branches | 18.1 | Bodaly et al. 1987[2]; Hall and St Louis 2004[2]; Mailman and Bodaly 2005 |
| *Picea glauca* | White spruce | Foliage | 13.9 | Rasmussen et al. 1991 |
| *Picea mariana* | Black spruce | Foliage, wood, small branches | 39.32 | Bodaly et al. 1987[2]; Mailman and Bodaly 2005; Zhang et al. 1995[2] |
| *Pinus banksiana* | Jack pine | Foliage, wood, small branches | 20.4 | Bodaly et al. 1987[2]; Friedli et al. 2007; Hall and St Louis 2004[2]; Hall et al. 2005[2] |
| *Populus balsamifera* | Balsam-poplar | Foliage, bark, wood, small branches | 13.5 | Bodaly et al. 1987[2] |
| *Populus tremuloides* | Trembling aspen | Foliage, bark, wood, small branches | 10.3 | Bodaly et al. 1987[2]; Friedli et al. 2007 |
| *Prunus pensylvanica* | Pin-cherry | Foliage, small branches | 4.9 | Mailman and Bodaly 2005 |
| *Salix* spp. | Willows | Foliage, bark, wood, small branches | 10.4 | Bodaly et al. 1987[2]; Mailman and Bodaly 2005 |
| *Vaccinium* spp. | Blueberry | Foliage, small branches | 8.4 | Hall and St Louis 2004[2]; Mailman and Bodaly 2005 |

Notes: [1] Values are the average across the studies listed in the Source column. [2] Includes samples growing near a reservoir.

# 3.0 METHODS

Section 7.2.3 of the TEMP details the methods for this study. The following section summarizes the monitoring activities conducted during 2018.

## 3.1 SAMPLE COLLECTION

Plant tissue was collected within two different zones: the “Project Effects” zone and the “Reference” zone. The Project Effects zone was a 50 m wide band adjacent to the future reservoir shoreline. The “Reference” zone provided data from unaffected areas for comparison with samples from the Project Effects zone. The Reference zone included areas that were at least 1 km away from the future reservoir shoreline or other human features that might influence mercury levels in plant tissue (Map 3-1).

Preliminary aerial surveys were conducted in 2017 to identify the portions of the Project Effects zone that would be suitable for plant tissue collection. These surveys determined that there were no suitable collection areas in the Project Effects zone north of the Nelson River because the area had burned in 2013. A recent burn would introduce confounding factors for evaluating reservoir effects on mercury. This happens because mercury is readily volatilized from organic matter consumed during burning, with the amounts being highly influenced by the amount of peat and other organic material present in the surface soil layer (Turetsky et al. 2006). The amount of mercury released can vary greatly with fire parameters such as burn intensity and severity. Additionally, the plants regenerating in burned areas may have varied uptake rates while maturing.

Most of the Project Effects zone south of the Nelson River fell within areas that had burned in 2005. In these areas, sufficient time had passed for the large pulse of released mercury to work its way through the local ecosystems and for the burned plants of the target species to fully regenerate. The potential reference areas were selected from those that burned in 2005.

General areas meeting the selection criteria described above were surveyed by helicopter for potential sample locations in 2017. Potential sample locations included a habitat patch of a type that often supports one or more of the target plant species. When potentially sample locations were found, they were marked from the air with a GPS unit (Garmin Map78 or Map62).

Each potential sample location was then visited on the ground to confirm that suitable tissue collection locations existed. A location was suitable if there appeared to be a sufficient number of plants to conduct mercury analysis over six sample collection years. To economize helicopter use, effort was also made to find a location such that as many of the target species as possible was within walking distance of each other.

Plant tissue was first collected by ECOSTEM staff in 2017 (see ECOSTEM 2018 for details). The volunteer collection program for members of the partner First Nations also began in 2017,

with a detailed sampling protocol developed to help achieve consistency across sampling by different individuals.

To maximize seasonal mercury accumulation, the timing for when tissue was collected varied by species group. Blueberry collection was conducted when the berries were ripe. Labrador tea leaf collection was done later in the growing season. To date, sweet flag/Wihkis has not been found during EIS or construction monitoring studies.

In 2018, the locations sampled in 2017 were revisited on August 17, 18 and 22 for blueberry species, and on September 12 and 13 for Labrador tea. The tissue samples were taken from the same plants sampled previously. Three new locations were added for blueberry in 2018.

The following tasks were completed the first time that tissue was collected at a site (i.e., the specific place within a location where tissue was collected). Geographic coordinates for the site were obtained from a handheld GPS unit. The site was marked with a pin flag and flagging tape so it could be relocated. Information recorded about the collection location and sampled plants included:

- Species sampled
- Habitat type, including dominant tree species, shrub species and ground cover
- Soil type (organic or mineral) and soil moisture regime (water, very wet, moist, dry)
- Plant condition, including health and size
- Growing conditions (full sun, partial shade, shade)
- Approximate age of collected tissue
- Photos of plant and location

When a site was resampled in subsequent years, information pertaining to the last four of the above bullets was collected. Information pertaining to the second and third bullets was also collected if there was a noticeable change from the previous sample year.

A sufficient amount of tissue to conduct mercury analysis in the lab was obtained at each collection point. A minimum of 1/5$^{th}$ of a cup of berries, and 1/3$^{rd}$ of a cup of leaves or roots was gathered.

Tissue samples were collected and handled in a manner that minimized potential contamination. This included wearing a new pair of sterile vinyl gloves, using clean tools, placing the tissue in a new sealable freezer bag, sealing it, and then placing the first sealed bag into a second labelled and sealed bag. The samples were kept in a cooler with ice packs, until they could be transferred into a freezer for storage at the end of each day. Plant tissue samples were kept frozen until they were analyzed.

## 3.2 LABORATORY ANALYSIS

Plant tissue samples collected in 2018 were submitted for mercury analysis to ALS Environmental in Winnipeg, Manitoba on September 25, 2018. Total dry weight mercury content was measured on November 5, 2018 using cold-vapor atomic absorption spectroscopy (CVAAS; method reference: EPA 200.3/EPA 1631E (modified)). Prior to CVAAS analysis, tissue samples underwent hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide, followed by cold-oxidation using bromine monochloride prior to reduction with stannous chloride. The detection limit for mercury with this method was 5 ng/g. Appendix 1 presents the full methodology and analysis results provided by ALS Environmental.

The analytical methodology used by ALS Environmental differed slightly in 2017 and 2018 in terms of detectors and digestion. The differences were not expected to be a significant factor in comparing year to year results because testing with reference materials has shown that both detectors have excellent mercury recovery. The testing used a cold-vapor atomic fluorescence (CVAF) detector in 2017 and a cold vapour atomic absorption (CVAA) detector in 2018. According to the Environmental Chemistry manager at ALS Environmental (Pers. Comm. 2019), the chemistry and reference method of the analysis are the same for both the 2017 and 2018 methods, and both detectors are listed in the same reference method. Both detectors have had validation work done on the same reference materials, and the recoveries for both are excellent.

For the hotblock digestion, a lower acid concentration was used in 2018. The digestion method was changed to conform to the national ALS standard. According to ALS Environmental (Pers. Comm. 2018), the lower acid concentration allowed the use of single-use plastic digestion vessels, as opposed to quartz tubes that had to be cleaned and re-used. This reduced the risk of sample contamination.

Wet weight concentration was not an essential metric for this study for several reasons. First, all of the relevant mercury concentration values for terrestrial plants reported in the literature were provided on a dry weight basis (Section 2.0). Second, there would be challenges standardizing wet weight concentrations. The water content of blueberries can vary considerably, depending on when they are picked during the fruiting period (see below for results from a previous year). In fact, dry weight concentrations are often three to 10 times higher than wet weight (Pers. Comm. Dr. Ross Wilson). Also, it may be the case that the tissues are consumed after losing a portion of their water content (e.g., Labrador tea leaves are dried, blueberries dry out on the counter or in a freezer). Third, a high percentage of the measured concentrations were already below the detection limit (Section 1.0), so there would be no difference in the measured concentration as wet weight concentrations are lower than dry weight.

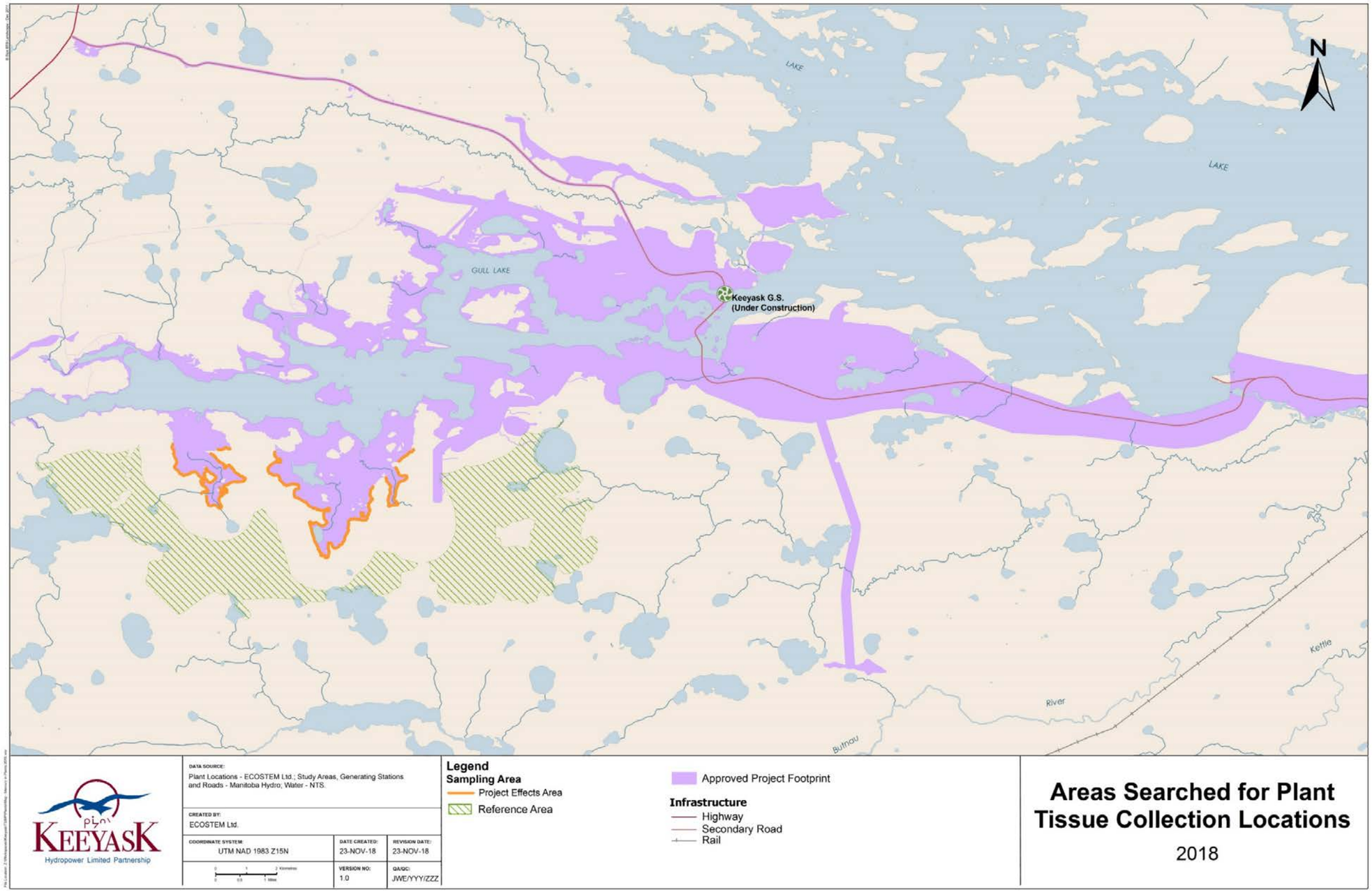
There would be a logistical challenge to providing wet weight mercury concentrations. Separate lab analyses are required for mercury and percent moisture because the maximum drying temperature for the mercury analysis is much lower (60° C) than that required to obtain an accurate percent moisture result (100° C). Because separate analyses are required, twice the amount of tissue must be gathered from each site. As the tissue samples are collected while staff are in the area conducting other monitoring, the quantity of berries remaining on plants can

be limited (due to animal browsing or berries falling on the ground). Also, tissue is collected from the same plants each year, it is preferable to minimize the amount of tissue removed. Wet weight concentrations could potentially be estimated using moisture content values from the literature or values obtained by this study in 2017.

Percent moisture content of the tissue samples was measured in 2017 in the event there was a desire to estimate wet weight concentrations. While more than the minimum amount of tissue had been collected for each sample, the quantity of tissue submitted that year was not sufficient to perform separate mercury and percent moisture analyses on every sample. To illustrate the natural variability in moisture content, the measured values for 26 blueberry samples ranged from 73.6% to 97.4% (see ECOSTEM (2018) for individual percent moisture values).

## 3.3 DATA ANALYSIS

A statistical comparison of the means for samples from the “Project Effects” zone compared with the “Reference” zone was not performed for the annual reports for several reasons. In the case of blueberries, all of the concentrations to date were below the detection limit. For Labrador tea leaves, 15% and 62% of the lab measured concentrations were below the detection limit in 2017 and 2018, respectively. Specialized statistical methods are used for data with values below a laboratory detection limit. A variety of such methods exist, along with controversy as to which is the most appropriate (Ogden 2010). The choice of a method was deferred to the construction monitoring synthesis report when all of the relevant data would be available. Deferring the statistical comparisons of mercury concentrations was not considered to be a limitation for the annual reports because all of the measured concentrations were either below or close to the detection limit, and because these concentrations appear to be well below those reported in the relevant literature (Section 2.0).




**Map 3-1: Areas within the Project zones (Project Effects and Reference) that were searched for suitable plant tissue collection areas in 2018**

# 4.0 RESULTS

Labrador tea, velvet-leaf blueberry (*Vaccinium myrtilloides*) and bog-bilberry (*Vaccinium uliginosum*) were the target species sampled in 2018 (Photo 4-1 to Photo 4-3). Locations for the other two target species, northern Labrador tea and sweet flag/Wihkis were not found in the search areas. Sweet flag/Wihkis has not been found during any of the technical science studies conducted for the TEMP to date, or for the EIS.

**Photo 4-1: Labrador tea**

**Photo 4-2: Velvet-leaf blueberry**

**Photo 4-3: Bog bilberry**

In 2018, plant tissue was sampled at 56 locations across both of the Project zones, including 24 in the Project Effects zone and 32 in the Reference zone (Table 4-1; Map 4-1, Map 4-2). Ground searches found three additional locations for bog-bilberry tissue sampling, two of which were in the Project Effects zone, and one in the Reference zone (Map 4-1). All 53 of the locations sampled in 2017 were re-sampled in 2018.

**Table 4-1: Number of locations sampled in 2018 for each species found in the sample zones**

| Species | Project Effects Zone | Reference Zone | Both |
|---|---|---|---|
| Velvet-leaf blueberry | 5 | 6 | 11 |
| Bog-bilberry | 8 | 11 | 19 |
| Labrador tea | 11 | 15 | 26 |
| **Total locations** | 24 | 32 | 56 |

The laboratory analysis determined that the total dry weight mercury concentration of every berry sample from velvet-leaf blueberry or bog-bilberry was below the detection limit (<5 ng/g; Appendix: Table 7-2).

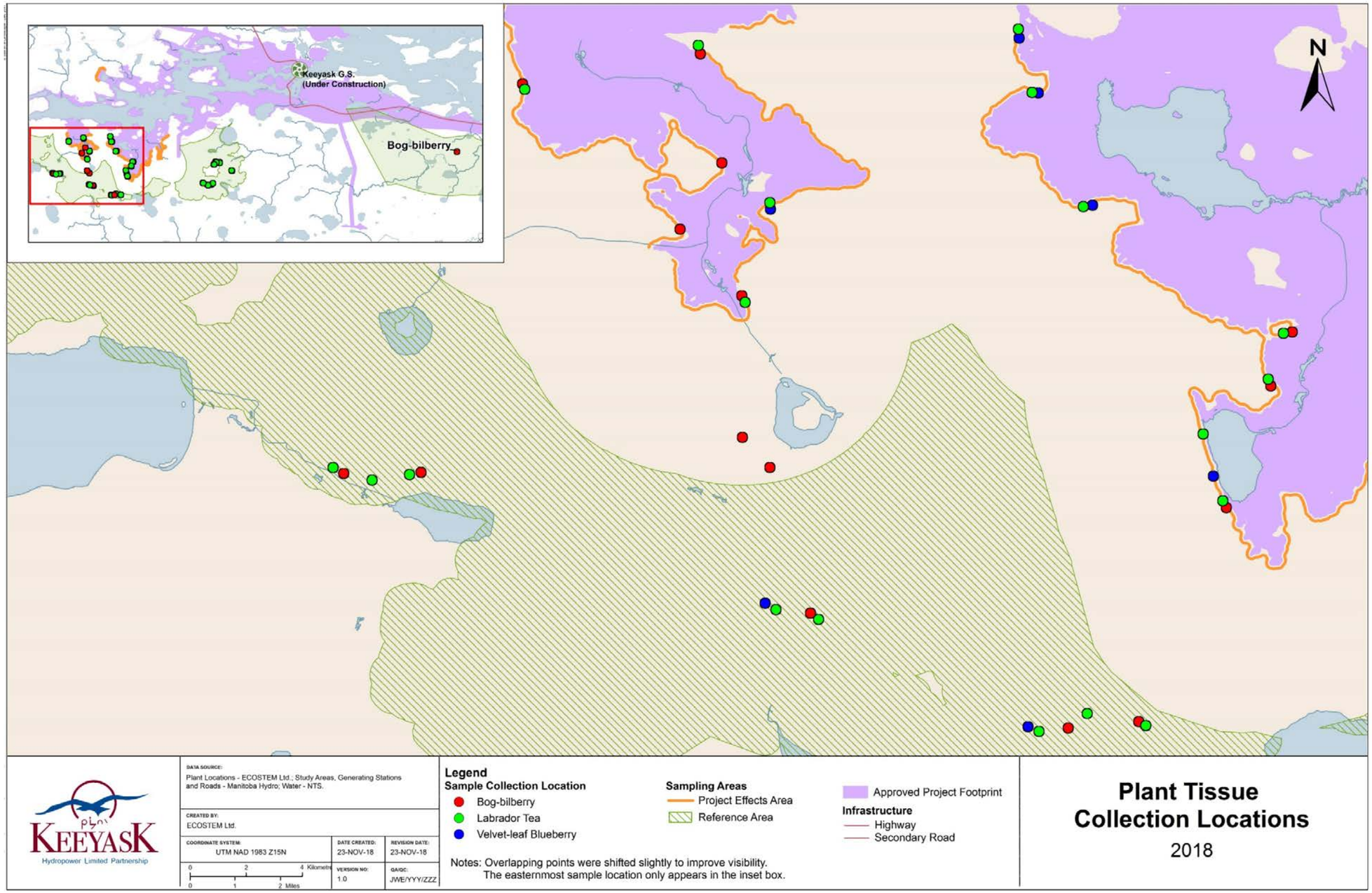
Ten of the 26 Labrador tea tissue samples had a total mercury dry weight mercury concentration that was slightly above the detection limit (Appendix: Table 7-2). These included eight of the 11 samples in the Project Effects zone, and two of the 15 samples in the Reference zone (Table 4-2).

**Table 4-2: Mercury analysis results for Labrador tea tissue samples collected in 2018**

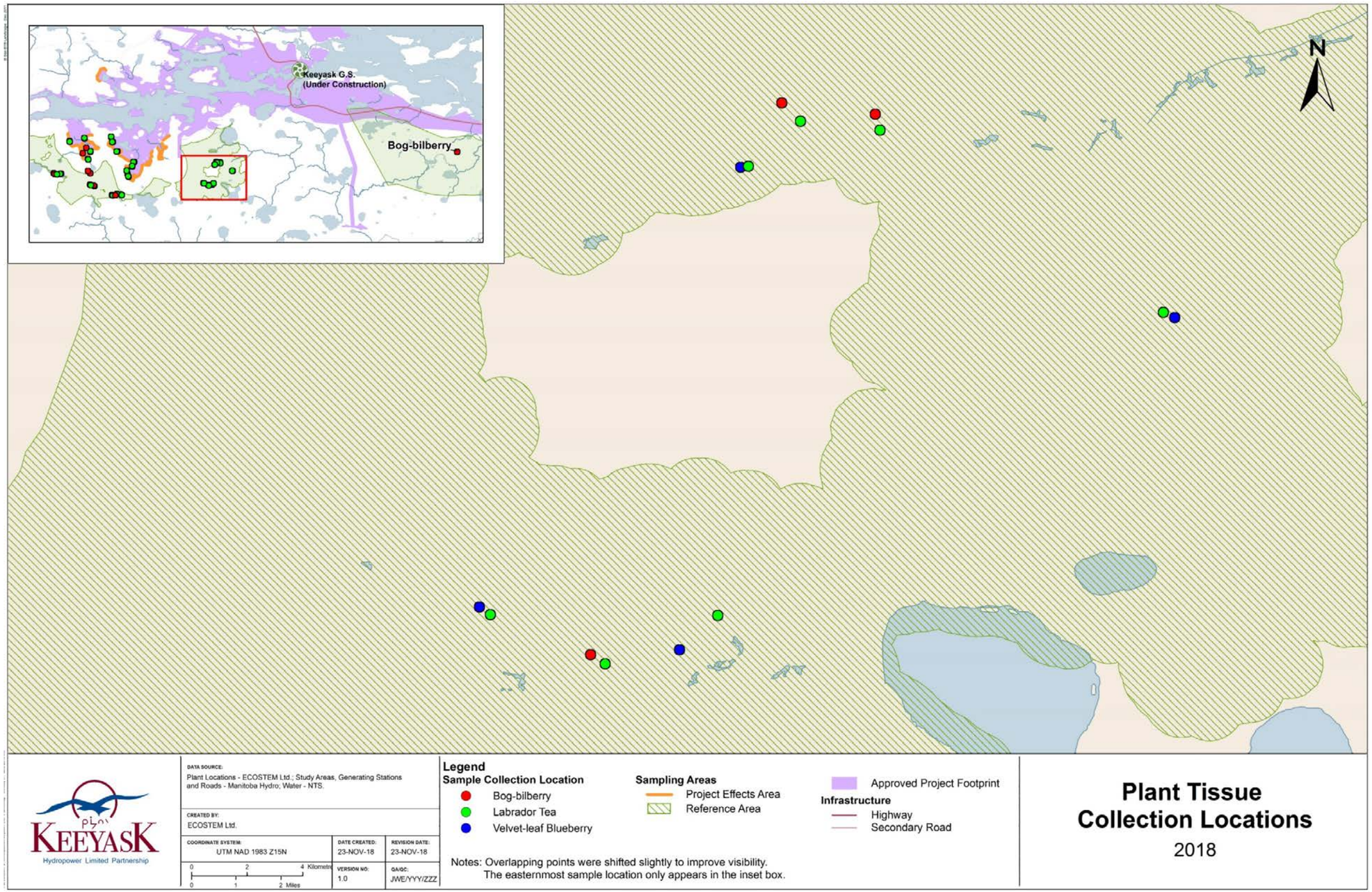
| Values | Project Effects Zone | Reference Zone | Both |
|---|---|---|---|
| Number of samples | 11 | 15 | 26 |
| Number of samples with mercury above detection limit | 8 | 2 | 10 |
| Average dry weight mercury concentration (ng/g)[1] | 5.2 | 4.0 | 4.5 |
| Standard deviation (ng/g)[1] | 1.0 | 0.6 | 1.0 |
| Maximum dry weight mercury concentration (ng/g) | 6.4 | 5.4 | 6.4 |

[1] Based on total number of samples, with samples below detection limit set to 75% of the detection limit.

Among the Labrador tea tissue samples that had a dry weight mercury concentration exceeding the detection limit, the highest concentrations were 6.4 ng/g for two samples in the Project Effects zone, and 5.4 ng/g in those from the Reference zone (Table 4-2).




**Map 4-1: Plant tissue collection locations in western portions of the search areas, 2018**




**Map 4-2: Plant tissue collection locations in eastern portions of the search areas, 2018**

# 5.0 DISCUSSION

In 2018, fewer of the collected samples had detectable mercury compared to 2017. It is uncertain if this difference reflected actual changes in mercury uptake, natural variability or if it was partially due to changes in the detector used by ALS Laboratories (Section 3.2). Given the testing conducted by ALS, it appears unlikely that it was due to the lab method. Natural variability will be examined in the construction synthesis report, which is when the multi-year comparisons will be undertaken. Regardless of the reason, the difference was very small (overall average mercury was approximately 1.2 ng/g lower in 2018), and mercury levels in both years were mostly below or only slightly above the detectable limit.

# 6.0 SUMMARY AND CONCLUSIONS

In 2018, plant tissue was collected for mercury analysis at 24 locations within the Project Effects zone and at 32 locations in the Reference zone. Blueberry berries were collected on August 17, 18 and 22, and Labrador tea leaves on September 12 and 13. Samples from the community voluntary collection program were not received in 2018.

Laboratory analysis determined that the total dry weight mercury concentration of every blueberry sample was below the instrument's detection limit (i.e., <5 ng/g).

Sixteen of the 26 Labrador tea tissue samples had a total dry weight mercury concentration that was below the instrument's detection limit. The highest mercury content in the leaf samples was 6.4 ng/g. Eight of the 10 samples with detectable mercury levels were from the Project Effects zone.

No guidelines for safe levels of consumption of country food plants in local diets could be found during a literature search. The toxicologist undertaking the Project's Human Health Risk Assessment will evaluate the plant mercury concentrations from this study after several years of data are available.

In the meantime, studies from elsewhere in Canada provide an indication of what can be expected for mercury concentrations in boreal plants. Results from such studies found mean total mercury concentration values for 17 different native boreal species ranged from 4.9 ng/g up to 39.3 ng/g, with most being higher than 10.0 ng/g. For the 2018 TEMP samples, all of the blueberry concentrations were below the bottom end of this range and all of the Labrador tea leaf concentrations were either below or near the bottom end of the range.

## 6.1 NEXT STEPS

Monitoring fieldwork for the mercury in plants study will continue in 2019 to further capture year-to-year variability in mean mercury concentration. No other substantive changes to field methods are anticipated.

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# APPENDIX 1:
# ALS ENVIRONMENTAL RESULTS

**Table 7-1: ALS Environmental methodology for total mercury**

| | | | | | |
|---|---|---|---|---|---|
| Date Received | 25-Sep-2018 14:50 | | | | |
| Report Date | 6-Nov-2018 12:17 | | | | |
| **ALS Test Code** | **ALS Test Description** | **Lab Location** | **Matrix** | **Method Reference** | **Methodology Description** |
| **Total Mercury** | | | | | |
| HG-DRY-CVAA-WP | Mercury in Tissue by CVAAS, Dry Weight | Winnipeg | Tissue | EPA 200.3/EPA 1631E (mod) | Tissue samples undergo hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide, followed by cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS. |

**Table 7-2: ALS Environmental test results for dry weight mercury concentration in the individual samples**

| Sample Location | Project Zone | Species | Results (ng/g)[1] | Detection Limit (ng/g)[1] |
|---|---|---|---|---|
| LTPE1801 | Project Effects | *Rhododendron groenlandicum* | 5.8 | 5.0 |
| LTPE1802 | Project Effects | *Rhododendron groenlandicum* | 6.4 | 5.0 |
| LTPE1803 | Project Effects | *Rhododendron groenlandicum* | 6.1 | 5.0 |
| LTPE1804 | Project Effects | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTPE1805 | Project Effects | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTPE1806 | Project Effects | *Rhododendron groenlandicum* | 5.3 | 5.0 |
| LTPE1807 | Project Effects | *Rhododendron groenlandicum* | 5.3 | 5.0 |
| LTPE1808 | Project Effects | *Rhododendron groenlandicum* | 5.9 | 5.0 |
| LTPE1809 | Project Effects | *Rhododendron groenlandicum* | 5.2 | 5.0 |
| LTPE1810 | Project Effects | *Rhododendron groenlandicum* | 6.4 | 5.0 |
| LTPE1811 | Project Effects | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1812 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1813 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1814 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1815 | Reference | *Rhododendron groenlandicum* | 5.3 | 5.0 |
| LTRE1816 | Reference | *Rhododendron groenlandicum* | 5.4 | 5.0 |
| LTRE1817 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1818 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1819 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1820 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1821 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1822 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1823 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1824 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1825 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| LTRE1826 | Reference | *Rhododendron groenlandicum* | <5.0 | 5.0 |
| VUPE1801 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VURE1801 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VUPE1802 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMPE1803 | Project Effects | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VUPE1804 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMPE1805 | Project Effects | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VMPE1806 | Project Effects | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VUPE1807 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMPE1808 | Project Effects | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VUPE1809 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMPE1810 | Project Effects | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VMPE1810(VU) | Project Effects | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VUPE1811 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |

| Sample Location | Project Zone | Species | Results (ng/g)[1] | Detection Limit (ng/g)[1] |
|---|---|---|---|---|
| VURE1812 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VURE1813 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMRE1814 | Reference | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VMRE1815 | Reference | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VURE1816 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMRE1817 | Reference | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VMRE1818 | Reference | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VURE1819 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VURE1820 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VURE1821 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMRE1822 | Reference | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VURE1823 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VURE1824 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VMRE1825 | Reference | *Vaccinium myrtilloides* | <5.0 | 5.0 |
| VURE1826 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VUPE1860 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VUPE1861 | Project Effects | *Vaccinium uliginosum* | <5.0 | 5.0 |
| VURE1862 | Reference | *Vaccinium uliginosum* | <5.0 | 5.0 |

Notes: [1] Values are converted from mg/kg (the units used in the ALS report) to ng/g. Concentrations are in dry weight.