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FINAL REPORT

Chapter 7.0 Fish Health and Tissue Chemistry

2021 Marine Environmental Effects Monitoring Program (MEEMP) and Non-Indigenous Species / Aquatic Invasive Species (AIS) Monitoring Program

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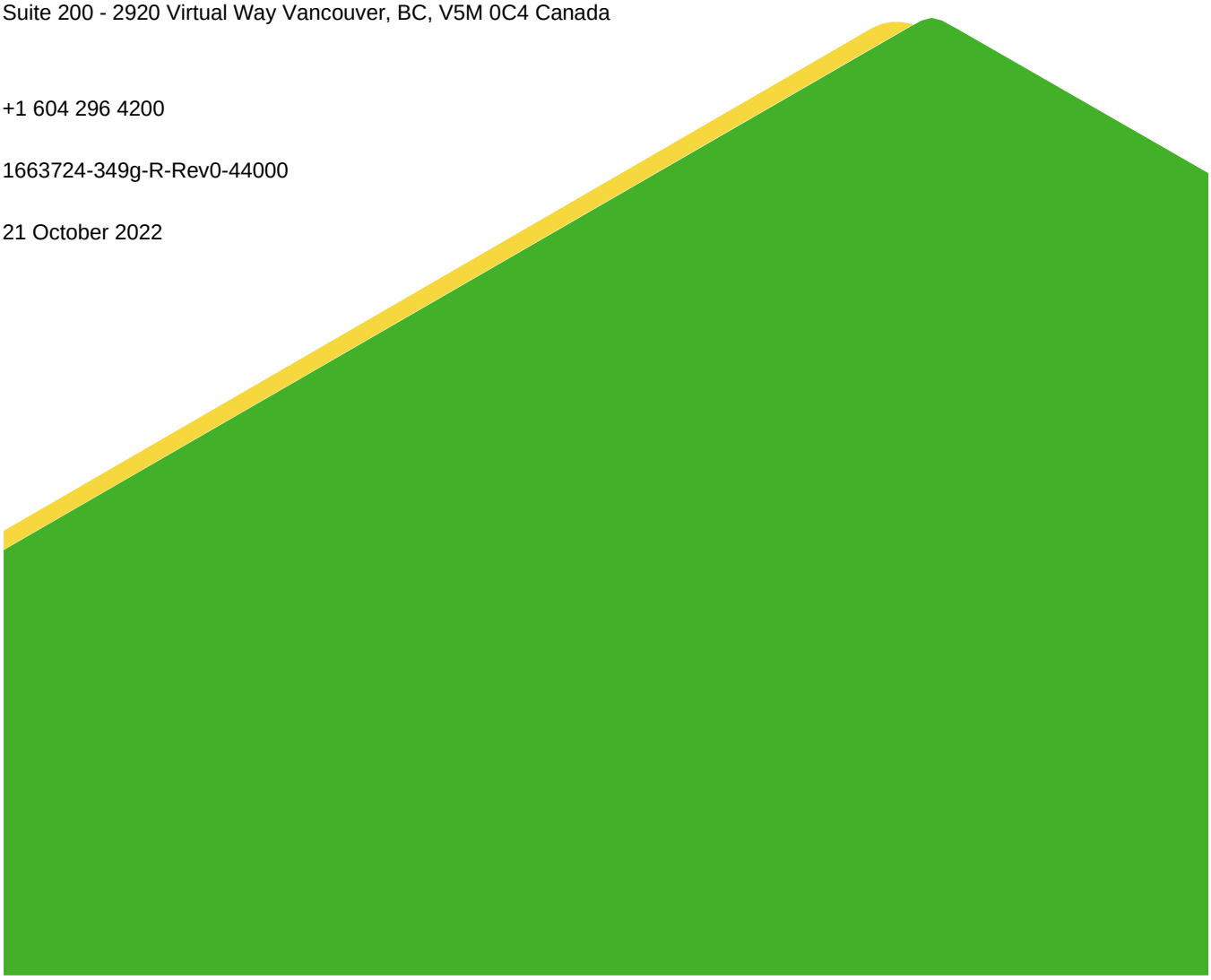

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ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Definition
ANCOVA	analysis of covariance
ANOVA	analysis of variance
BC MOE	British Columbia Ministry of Environment
Biologica	Biological Environmental Services Ltd.
BV labs	Bureau Veritas Laboratories
COC	chain of custody
COPCs	contaminants of potential concern
CRC ICPMS	collision reaction cell inductively coupled plasma mass spectrometry
DL	detection limit
Dw	dry weight
EEM	Environmental Effects Monitoring
ERP	Early Revenue Phase
FEIS	2012 Final Environmental Impact Statement
G	gram
GSI	gonadosomatic index
Km	kilometre
LSI	liver somatic index
MDMER	Metal and Diamond Mining Effluent Regulations
MEEMP	Marine Environmental Effects Monitoring Program
mg/kg	milligrams per kilogram
Mm	milligram
Min	minimum
Max	maximum
N	sample size
PAH	polycyclic aromatic hydrocarbons
PC	Project Certificate
P-value	probability value
QA/QC	quality assurance and quality control
ROV	Remote operated vehicle
RPD	relative percent differences
SD	Standard Deviation
SE	Standard Error
SR	studentized residuals
Ww	wet weight
Y	year

7.0 FISH HEALTH AND TISSUE CHEMISTRY

7.1 Introduction

This chapter presents the results of the 2021 fish health and tissue chemistry monitoring program, a component of the larger Marine Environmental Effects Monitoring Program (MEEMP) conducted in Milne Inlet during the 2021 open-water season. The fish health and tissue chemistry component was developed in consideration of the potential Project-related impacts to the marine environment as identified in the 2012 Final Environmental Impact Statement (FEIS) and subsequent addendums, as well as monitoring requirements outlined in the Project Certificate (PC) Conditions described in Chapter 1.0, Table 1-2. Those related to the monitoring of Fish Health include PC Conditions No. 76, 83 (a), 99 (a), 99 (b) (ii), 99 (c), 113, and 114.

7.1.1 Objectives

Objectives for the overall MEEMP program are outlined in Section 1.3 of Chapter 1.0 (Program Overview). Objectives specific to the fish health and tissue chemistry component are as follows:

- Better align the MEEMP with the Metal and Diamond Mining Effluent Regulations (MDMER) Environmental Effects Monitoring (EEM) program (Government of Canada 2002) through the selection of sentinel species and measurements of additional health indicators to monitor for effects from the Project.
- Evaluate the health of the sentinel species Fourhorn Sculpin (*Myoxocephalus quadricornis*) and wrinkled rock-borer (*Hiatella arctica*), hereafter referred to as (*H. arctica*), through the assessment of established endpoints (see Section 7.2), length frequency distributions, length-weight relationships, and visual assessment of internal and external abnormalities.
- Compile current and historic tissue chemistry data for Arctic Char (*Salvelinus alpinus*), Fourhorn Sculpin, and *H. arctica* and assess concentrations of contaminants of potential concern (COPCs).

7.2 Study Design

The 2014 to 2021 MEEMP study design was designed to monitor for potential Project-related impacts and changes to fish health and communities through collection of fish population data using a combination of active and passive fishing methods, and through analysis of fish health parameters in incidental mortalities. During baseline and early MEEMP surveys, fish tissue sampling was limited to incidental Arctic Char mortalities, the numbers of which fluctuated from year to year and did not always yield adequate samples to support a meaningful statistical analysis.

In 2018, a local shellfish species, *H. arctica,* was added to the MEEMP as an additional effects indicator for the fish sampling program. *Hiatella arctica* is a resident species in the Project area, easily identifiable and measurable in the field, and abundant in the study area (Golder 2018). Measurement endpoints for *H. arctica* in 2018 and 2019 included age and tissue chemistry analysis.

In 2020, in anticipation of future regulatory requirements under the MDMER that may apply to monitoring if Baffinland's Phase 2 Proposal was approved, changes to the fish health and tissue chemistry program were implemented to better align the MEEMP with the MDMER EEM program (Government of Canada 2002). Fourhorn Sculpin and *H. arctica* were selected as sentinel species to monitor for effects from the Project. Lethal target

sample sizes were established for Fourhorn Sculpin and *H. arctica* as part of the 2020 fish health program. Fish health effect indicators included measures of energy use (i.e., growth, reproduction), energy storage (i.e., condition) and survival (i.e., age), in addition to supporting endpoints (as appropriate for each species) such as length, body weight, the prevalence of external and internal abnormalities, organ weights, stomach fullness, parasite presence/absence, sex, life stage, and state-of-maturity (Section 7.4.1; Appendix 7B).

For fish tissue chemistry, concentrations of total metals[1] and polycyclic aromatic hydrocarbons (PAHs) were measured (Section 7.4.2; Appendix 7C) for the three species (i.e., Arctic Char, Fourhorn Sculpin, and *H. arctica*) and compared to MEEMP data from previous years, where possible. Historic data available for comparison varied for each species, with data extending back to 2010 for Arctic char intermittently, and for Fourhorn Sculpin and *H. arctica* to 2018.

7.2.1 Modifications to the Program (2021)

In 2021, a reconnaissance survey was undertaken near the Tugaat River estuary during the August field program, in an effort to identify a suitable reference area for the fish health and tissue chemistry component of the MEEMP, should one be required in future years. Water quality, sediment quality and fish community sampling were completed as part of the reconnaissance survey; a summary of the methods and results of the reconnaissance survey is provided in Appendix 7A. Other than the addition of the Tugaat River estuary, no significant modifications were made to the Fish Health or Fish Chemistry program in 2021.

7.3 Materials and Methods

7.3.1 Field Methods

Fish community sampling was conducted at various locations near Milne Port, approximately 80 km Northwest of the Mary River Project (17W 503687m E, 7976357m N) from 2 to 19 August 2021 (Figure 6-1 to Figure 6-3). Fishing effort included both active (i.e., angling, seine, trawling) and passive (i.e., Fukui traps, hoop nets, and gill netting) capture methods. Captured fish were enumerated and measured for length and weight. Capture methods are described in detail in Section 6.3.1 in Chapter 6.0—Fishing Efforts and Catch Data. A subsample of 40 Fourhorn Sculpin were retained for fish health sampling to meet target sample sizes of 20 adult males and 20 adult females. All other fish were released alive back into Milne Inlet. Incidental mortalities of Arctic Char were retained for analysis of age, stomach contents, and tissue metals concentrations.

The primary method of capture for Fourhorn Sculpin in 2021 was angling. Changes to angling methods implemented in 2020 were also used in 2021. These changes included targeted fishing efforts along coarse rock substrate at the Ore Dock following observations of high numbers of this species during habitat offset monitoring (Golder 2020b). In Remotely Operated Vehicle (ROV) footage, Fourhorn Sculpin were observed in relatively high abundances along the western and eastern sides in coarse rock habitat at depths between 1 m and 5 m. Angling (i.e., jigging) efforts were focussed on these locations, fishing from a stationary position, with two to five rods and lines deployed from the field vessel anchored adjacent to the riprap. Hooks or spoon lures (i.e., flashers) were lowered into the riprap at the target depth, then flicked upward to attract fish within the coarse rock habitat.

[1] Includes metals, metalloids, and non-metals. Metals are broadly defined as elements which are good conductors of electricity and heat, which form cations by loss of electrons, and which yield basic oxides and hydroxides (Wood et al. 2012). Metalloids share some but not all properties of metals, while non-metals mostly lack characteristics of metals.

The *H. arctica* specimens were collected opportunistically from benthic infauna samples, with a target subsample of 40 individuals retained for fish health and tissue chemistry sampling. Collection methods for benthic infauna are described in Section 4.3.1 in Chapter 4.0—Benthic Infauna. Each benthic sample was checked for the presence of *H. arctica.* Samples to be retained for the fish health and tissue chemistry program were obtained from benthic grab samples collected from the northwestern, western, eastern, and northeastern transects (Figure 3-1), with the majority of collections occurring from the western and eastern transects. In benthic grab samples where *H. arctica* numbers were greatest, a maximum of five individuals were selected. Specimens were selected for processing if the shell was intact, greater than 15 mm in length, and had no indications of damage to the umbo or hinge area.

7.3.2 Fish Processing

Fourhorn Sculpin retained for fish health sampling were held live in aerated 70 litre totes containing water from Milne Inlet until they were lethally processed at Milne Port. Both external and internal assessments were completed on lethally sampled fish following standardized procedures consistent with MDMER EEM program requirements (Environment Canada 2012). Total lengths (± 1 mm) and total body weights (± 0.001 g) of the fish were documented, and external observations of fish features (i.e., body form, eyes, skin, thymus, opercula, gills, pseudobranchs, fins, vent, and parasites) were recorded. Abnormal features (e.g., wounds, tumours, parasites, fin fraying, gill parasites, or lesions) were described in detail and photographed. Fish were sacrificed by a concussive blow to the head followed by cervical dislocation (i.e., cutting the spinal cord behind the head). Each fish was handled using new nitrile gloves and dissected on a cutting board covered in a clean sheet of plastic wrap that was changed between fish. Dissecting equipment was washed between fish in phosphate-free soap and rinsed with 10% nitric acid followed by deionized water. The condition of the internal organs (e.g., liver, spleen, gall bladder, and kidneys) was assessed immediately after opening the body cavity and documented. Any abnormalities in size, shape, or colouration of the internal organs were documented. Liver weight and an estimate of percent mesenteric fat were recorded. The gonads of each fish were removed, weighed (± 0.001 g), and photographed before assigning sex and maturity stage, based on the macroscopic features described in Table 7-1. Parasite presence and predominance were recorded, and parasite weight was documented if large parasites (e.g., tapeworms) were observed in the body cavity.

Stomachs and ageing structures (i.e., otoliths[2]) were collected from Fourhorn Sculpin and incidental mortalities of Arctic Char. Sagittal otoliths were extracted as the primary aging structure, wrapped in parchment paper, and stored dry in individually labelled coin envelopes until aging analysis. Stomach fullness was recorded, and the stomachs were removed, placed in individually labelled Nalgene containers and preserved with 10% formalin. For Fourhorn Sculpin and Arctic Char, one muscle sample (> 10 g) without skin was collected from the left dorsal side of each fish using a fillet knife rinsed with 10% nitric acid then deionized ultrafiltered water. The fillets were weighed (± 0.001 g), placed on ice in individually labelled Ziploc bags, and stored frozen until submission for metals analysis. A second muscle sample (> 10 g) without skin was collected from the right dorsal side of each fish using a fillet knife rinsed with acetone then deionized ultrafiltered water. The fillets were weighed (± 0.001 g) on tared aluminum foil, wrapped in aluminum foil, placed on ice in individually labelled Ziploc bags, and stored frozen until PAH analysis.

[2] Otoliths are a pair of bony structures located behind the eyes in fish. Counting the annual growth rings on the otoliths is a common technique in estimating the age of many fish species.

Those *H. arctica* retained for health sampling were selected based on the external condition of the shell (i.e., > 15 mm long with intact valves and no visible damage to the umbo). Individuals were measured along the largest axis (± 1 mm) and weighed (± 0.001 g), and then placed on ice in individually labelled Ziploc bags and stored frozen until further processing and tissue chemistry analysis.

Table 7-1: Gonad Maturity Stages for Male and Female Fish Used During the Fish Health Assessment, 2021

Sex	Stage	Code	Macroscopic features
Female	Unknown stage	10	Unable to determine stage.
	Immature	11	Small ovaries, often clear, blood vessels indistinct.
	Early Stage Development	12	Enlarging ovaries, blood vessels more distinct. Granular in appearance.
	Late Stage Development	13	Large ovaries filling the body cavity, prominent blood vessels. Individual oocytes visible.
	Ripe	14	Eggs released with gentle pressure on abdomen.
	Spent	15	Deflated ovaries, blood vessels prominent.
	Reabsorbing	16	Small atretic oocytes throughout the ovaries, which are hard and white.
	Resting	17	Small ovaries, blood vessels reduced but present.
Male	Unknown stage	20	Unable to determine stage.
	Immature	21	Small testes, often clear and threadlike.
	Early Stage Development	22	Small testes, semi-translucent, but easily identified.
	Late Stage Development	23	Testes large, firm and lobate. White to purplish in colour. Granular appearance.
	Ripe	24	Milt released with gentle pressure on abdomen.
	Spent	25	Small and deflated testes. Blood vessels obvious. Violet-pink in colour.
	Reabsorbing	26	Not typically observed in males.
	Resting	27	Small testes, often threadlike.

Notes:
Table modified from Brown-Peterson et al. (2011).

7.3.3 Laboratory Methods

Samples of all fish and *H. arctica* were submitted for further laboratory analysis. Arctic Char and Fourhorn Sculpin tissue samples were submitted for tissue chemistry analysis, and stomachs were submitted for contents analysis. Ageing structures of both species were submitted for age determination. Collected *H. arctica* were sent to a laboratory specialized in marine invertebrates for additional processing and subsequent submission of tissues for tissue chemistry analysis.

7.3.3.1 Bivalve Processing

Frozen *H. arctica* were processed by Biologica Environmental Services Ltd. (Biologica; Victoria, BC). *Hiatella arctica* were measured for total length, as well as wet weight (ww) of the whole organism, shells, soft tissues, and gonads. Shell dry weight (dw) was also measured. Tissue dw was estimated using a tissue moisture conversion factor of 0.369 (Brey 2001). Ages of *H. arctica* was determined using shells (Section 7.3.3.2).

7.3.3.2 Age

Otoliths extracted from Fourhorn Sculpin and Arctic Char were examined by North/South Consultants Inc. (Winnipeg, MB) to determine the age of the fish. Whole otoliths from individual fish were mounted on microscope slides to estimate age based on the number of annuli (i.e., growth rings) visible under a dissecting microscope.

For *H. arctica* ageing, each shell was sectioned through the umbo-rim axis using a lapidary saw with a diamond-impregnated blade and polished using progressively finer grit sandpaper. Polished shells were etched in a solution of 1% hydrochloric acid for one minute, rinsed with tap water, and dried. An acetate peel of the polished umbo surface was mounted on a slide and examined using a dissecting microscope. Distinct, continuous growth lines were counted to determine the age of the shell.

To verify that data quality objectives were met, 10% of both fish and *H. arctica* age estimates were independently verified by a second qualified biologist.

7.3.3.3 Stomach Contents

Enumeration and taxonomic identification of stomach contents for Arctic Char and Fourhorn Sculpin were conducted by Biologica. Percent fullness and percent digestion of each stomach was recorded before dissection and identification based on the professional judgement of the taxonomist. Prey items were identified to the lowest practical taxonomic level (e.g., species when possible) using published methods and taxonomic references. Digested and unidentifiable materials were categorized (e.g., unidentified insect parts, digested tissue, non-food, and others). The taxonomic composition within each stomach was determined as percentages of major invertebrate groups by abundance.

7.3.3.4 Tissue Chemistry

Tissue samples collected from eight Arctic Char (muscle), eight Fourhorn Sculpin (muscle), and eight *H. arctica* (composite soft tissue samples) were submitted to Bureau Veritas Laboratories (BV Labs; Burnaby, BC) for tissue chemistry analyses (Appendix 7C, Table 7C-1). *Hiatella arctica* composites were composed of two to three individuals in order to satisfy weight requirements (Table 7-2). Moisture content and metals concentrations for fish and *H. arctica* were measured in percent and milligrams per kilogram (mg/kg) ww, respectively, by oven drying and collision reaction cell inductively coupled plasma mass spectrometry (CRC ICPMS), respectively. Concentrations of PAHs for fish and *H. arctica* were measured in mg/kg ww by gas chromatography mass spectrometry. Achieved detection limits (DL) for fish and *H. arctica* are presented in Appendix 7C, Tables 7C-2 to 7C-7. Certificate of analysis forms are provided in Appendix 7E.

Table 7-2: Summary of *Hiatella arctica* Samples Sent to Bureau Veritas Laboratory for Tissue Chemistry Analysis, 2021

Composite Sample	Chemistry	Fish Identification Numbers	Number of Individuals
BAFF21UMLNHTARCOMP1	Metals	BAFF21UMLNHTAR1508	3
		BAFF21UMLNHTAR1518	
		BAFF21UMLNHTAR1530	
BAFF21UMLNHTARCOMP2	Metals	BAFF21UMLNHTAR1504	2
		BAFF21UMLNHTAR1520	
BAFF21UMLNHTARCOMP3	Metals	BAFF21UMLNHTAR1510	2
		BAFF21UMLNHTAR1528	
BAFF21UMLNHTARCOMP4	Metals	BAFF21UMLNHTAR1516	2
		BAFF21UMLNHTAR1526	
BAFF21UMLNHTARCOMP5	Metals	BAFF21UMLNHTAR1512	2
		BAFF21UMLNHTAR1532	
BAFF21UMLNHTARCOMP6	Metals	BAFF21UMLNHTAR1506	2
		BAFF21UMLNHTAR1534	
BAFF21UMLNHTARCOMP7	Metals	BAFF21UMLNHTAR1502	2
		BAFF21UMLNHTAR1514	
BAFF21UMLNHTARCOMP8	Metals	BAFF21UMLNHTAR1522	2
		BAFF21UMLNHTAR1524	
BAFF21UMLNHTARCOMP9	PAHs	BAFF21UMLNHTAR1501	2
		BAFF21UMLNHTAR1519	
BAFF21UMLNHTARCOMP10	PAHs	BAFF21UMLNHTAR1513	3
		BAFF21UMLNHTAR1515	
		BAFF21UMLNHTAR1534	
BAFF21UMLNHTARCOMP11	PAHs	BAFF21UMLNHTAR1509	2
		BAFF21UMLNHTAR1529	
BAFF21UMLNHTARCOMP12	PAHs	BAFF21UMLNHTAR1507	2
		BAFF21UMLNHTAR1527	
BAFF21UMLNHTARCOMP13	PAHs	BAFF21UMLNHTAR1505	2
		BAFF21UMLNHTAR1511	
BAFF21UMLNHTARCOMP14	PAHs	BAFF21UMLNHTAR1521	2
		BAFF21UMLNHTAR1531	
BAFF21UMLNHTARCOMP15	PAHs	BAFF21UMLNHTAR1525	2
		BAFF21UMLNHTAR1533	
BAFF21UMLNHTARCOMP16	PAHs	BAFF21UMLNHTAR1503	3
		BAFF21UMLNHTAR1517	
		BAFF21UMLNHTAR1523	

PAHs = Polycyclic aromatic hydrocarbons.

7.3.4 Data Analysis

Descriptive statistics (i.e., sample size, mean, median, standard deviation [SD], standard error [SE], minimum, and maximum values) were calculated for fish health and tissue chemistry data collected in 2021, as well as fish health endpoints and tissue concentrations of metals and PAHs in Arctic Char, Fourhorn Sculpin, and *H. arctica* available from 2018 to 2021.

Fish health indices for Fourhorn Sculpin were calculated as follows:

$$Condition\ factor = \left(\frac{body\ weight}{total\ length^3}\right) \times 100{,}000$$

$$Gonadosomatic\ index\ (GSI) = \left(\frac{gonad\ weight}{body\ weight}\right) \times 100$$

$$Liver\ somatic\ index\ (LSI) = \left(\frac{liver\ weight}{body\ weight}\right) \times 100$$

Fish health indices for *H. arctica* were calculated as follows:

$$Condition\ factor = \left(\frac{total\ wet\ weight}{total\ length^3}\right) \times 10{,}000$$

$$Mantle\ somatic\ index\ (MSI) = \left(\frac{gonad\ wet\ weight}{tissue\ wet\ weight - gonad\ wet\ weight}\right) \times 100$$

Wet weights were used to calculate condition factors for *H. arctica* because individual dw could not be obtained (i.e., fresh tissue samples were required to prepare composite samples for laboratory analyses of metals and PAHs). Weight and length measurements were reported in units of grams (g) and millimetres (mm), respectively.

7.3.4.1 Fish Health Endpoints

Fish health endpoints were compared using statistical methods for Fourhorn Sculpin and *H. arctica*. For Fourhorn Sculpin, comparisons were conducted separately by sex for endpoints presented in Table 7-3, to detect potential differences between 2020 and 2021. Differences in age were assessed using analysis of variance (ANOVA). Differences in mean size-at-age, condition, relative liver weight, and relative gonad weight among years were assessed using analysis of covariance (ANCOVA). Data analyzed by ANCOVA were $\log_{10}$ transformed prior to analysis if it increased the coefficient of determination (R^2). Significant differences between years were determined using an alpha (α) of 0.1.

Table 7-3: Statistical Procedures Used to Evaluate Fourhorn Sculpin Health

Indicator	Endpoint	Response Variable (y)	Covariate (x)	Statistical Procedure
Survival	Age	Age	n/a	ANOVA
Growth	Size-at-Age	Total Length	Age	ANCOVA
Condition	Condition	Total Weight	Total Length	ANCOVA
	Relative Liver Weight	Liver Weight	Total Weight	ANCOVA
Reproduction	Relative Gonad Weight	Gonad Weight	Total Weight	ANCOVA

ANOVA = analysis of variance; ANCOVA = analysis of covariance.

For *H. arctica*, comparisons were conducted for fish health endpoints presented in Table 7-4 to detect potential differences between 2020 and 2021. The differences in length-frequency distributions between years were assessed using the non-parametric two-sample Kolmogorov-Smirnov (K-S) test. The K-S test compares the cumulative relative distributions of total length between years by comparing the maximum percent difference between the two cumulative relative frequency distributions to a critical value. The test assesses whether the maximum percent difference is large enough to indicate that the two distributions are from different populations. Differences in total weight (i.e., whole animal ww) were assessed using ANOVA. Differences in condition were assessed using ANCOVA. Differences in relative gonad weights could not be assessed as gonad tissues were not weighed in 2020. Similar to Fourhorn Sculpin, data analyzed by ANCOVA were $\log_{10}$ transformed prior to analysis if it increased the coefficient of determination (R^2). Significant differences between years were determined using an α of 0.1.

Table 7-4: Statistical Procedures Used to Evaluate *Hiatella arctica* Health

Indicator	Endpoint	Response Variable (y)	Covariate (x)	Statistical Procedure
Survival	Length Frequency	Total Length	n/a	K-S test
Growth	Total Weight (whole animal wet weight)	Total Weight	n/a	ANOVA
Condition	Condition	Total Weight	Total Length	ANCOVA

K-S test = Kolmogorov-Smirnov test; ANOVA = analysis of variance; ANCOVA = analysis of covariance; n/a = not applicable.

7.3.4.2 Tissue Chemistry

Differences in tissue concentrations of contaminants of potential concern (COPCs), including aluminum, iron, magnesium, mercury, and selenium were compared among years (i.e., 2018, 2019, 2020, and 2021). Values below DL were substituted with half the DL and included in statistical comparisons, as per standard practice. These COPCs were identified based on the primary constituents of the Project iron ore (i.e., aluminum, magnesium, and iron), as well as metals with existing regulatory guidelines for fish tissue (i.e., mercury and selenium).

Aluminum, magnesium, and iron were compared among years using analysis of variance (ANOVA). Differences in relative body weight and tissue concentrations of mercury and selenium in Arctic Char and Fourhorn Sculpin were compared among years using analysis of covariance (ANCOVA), with length as a covariate. For *H. arctica,* length was not a significant predictor of tissue concentrations of mercury and selenium (i.e., the linear regression relationship was not significant), therefore, comparisons were made among years using ANOVA. Significant differences between years were determined using an α of 0.1.

Tissue chemistry data were presented visually using boxplots, where the median value was indicated within each box and the first and third quartiles were represented by the lower and upper bounds of each box, respectively. Lower and upper whiskers were calculated as 1.5 times the interquartile range beyond the first and third quartile. Observations outside the fences were plotted as individual points. Whiskers were extended to the minimum and maximum values within the dataset that fell within the fences. Detection limits were indicated on boxplots, and any values below a DL were not included.

7.3.4.3 Testing Assumptions for Statistical Analysis

The assumptions of ANOVA and ANCOVA are that the residuals of the data, after being fit to the model, are normally distributed and have equal variance among groups. The assumption of normality was assessed using the Shapiro-Wilk test, while Levene's test was used to assess equality of variances. Significant differences in assumptions were evaluated using an α of 0.01. If the assumptions of normality and equality of variance were not met, the data were $\log_{10}$-transformed and the assumptions were re-assessed. When the assumptions of ANOVA could not be met using a $\log_{10}$ transformation, the nonparametric Kruskal-Wallis test was used and post hoc pairwise comparisons made using Dunn's Test with Holm's *P*-value adjustment for multiple comparisons. When the assumptions of ANCOVA could not be met using $\log_{10}$ transformation, the non-parametric rank ANCOVA test was used and post hoc pairwise comparisons were made using a Tukey Honest Significant Difference test on rank metals concentrations.

In addition to the assumptions of normality and equality of variance, ANCOVA has the additional assumption that the parameter regression slopes are parallel among sampling areas. To test this assumption, the ANCOVA was conducted by first fitting separate regression models for each sampling area using a general linear model that included an interaction term between the sampling area and covariate:

Full ANCOVA model: $y = \beta_0 + \beta_1(x) + \beta_2(Year) + \beta_3(x) \times (Year) + \varepsilon$

where y is the response variable, x is the covariate, $Year$ is the sampling area indicator variable, and ε is the error term. If the coefficient β_3 of the $(x) \times (Year)$ interaction term was not significant (i.e., p > 0.01), then the slopes were considered parallel and the ANCOVA proceeded by testing the significance of the coefficient β_2 of the $(Year)$ term in the reduced ANCOVA model that fits separate regressions for each area, but with a common regression slope:

Reduced ANCOVA model: $y = \beta_0 + \beta_1(x) + \beta_2(Year) + \varepsilon.$

When a significant interaction was observed, the regression slopes were considered significantly different. When the covariate was a strong predictor of the response variable, and the ANCOVA had a high coefficient of determination ($R^2 > 0.8$), the test for parallel slopes had high power to detect a difference that may not be practically significant. In this case, when the interaction term in the full ANCOVA model was significant, the slopes were fixed as parallel by fitting the reduced ANCOVA model (because the reduced model explained almost as much [i.e., within 2%] of the variability in the response variable as the full model). In this case, the ANCOVA proceeded under the assumption that the regression slopes between groups were practically similar (Barrett et al., 2010).

Statistical outliers were evaluated using studentized residuals (SR) from the ANOVA and ANCOVA models. A magnitude of 3.5 for the SR was used to identify unusual observations. When an outlier was detected, the validity of the value was examined. If the outlier was determined to be the result of data entry error, the error was corrected; if the outlier was not the result of data entry error and could not be resolved otherwise, the outlier was removed from the analysis and documented.

If significant differences were detected based on the ANOVA or ANCOVA models, pairwise comparisons were made among years using a Tukey Honest Significant Difference test.

7.3.4.4 Relative Percent Difference

The relative percent differences (RPDs) in effect endpoints between years were calculated when significant differences in endpoints were observed, by expressing the difference as a percentage of the mean as follows:

$$Relative\ Percent\ Difference\ (RPD) = \frac{\bar{x}_{Year1} - \bar{x}_{Year2}}{\bar{x}_{(Year1+Year2)}} * 100$$

where $\bar{x}$ is the mean of the endpoint, and $Year_1$ and $Year_2$ refers to the years being compared.

If the statistical comparison was conducted on log_{10}-transformed data, then the RPD was calculated using geometric means. For effect endpoints analyzed using ANCOVA, RPDs were calculated using least squares means. In the instance where a rank ANCOVA model was used, RPDs were calculated using least squares means (not rank means). To confirm that differences in tissue concentrations between years were real and less likely to be attributed to low concentrations of target contaminants, analytical variability, and spatial and temporal variation, a RPD of 100% was used to differentiate stochastic differences from those of potential biological importance (Environment Canada 2012).

7.3.4.5 Power Analysis

Power analyses were performed to determine the minimum detectable difference of fish health end points and future tissue chemistry comparisons using the existing 2020 to 2021 fish health dataset and 2018 to 2021 tissue chemistry dataset. Target sample sizes for fish health endpoints were 20 Fourhorn Sculpin of each sex (40 total) and 40 *H. arctica*, and a total of eight samples for tissue chemistry for each fish species (i.e., Arctic Char, Fourhorn Sculpin, *H. arctica*). These values were then used to calculate the sensitivity of future comparisons by expressing the minimum detectable difference as a percent change in the mean. Type I (α) and Type II (β) error rates were set to 0.1 (Environment Canada 2012). Power analyses were conducted using the power and sample size function in G*Power 3.1 (Faul et al., 2007).

7.3.5 Guideline Comparison

Fish tissue concentrations of mercury and selenium for Arctic Char, Fourhorn Sculpin, and *H. arctica* sampled from 2018 to 2021 were compared to applicable tissue quality guidelines. Mercury concentrations were compared to Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015). Selenium concentrations were compared to the British Columbia Ministry of Environment (BC MOE) fish tissue guidelines of 4 mg/kg dw (BC MOE 2014).

7.3.6 Quality Assurance/Quality Control

The field and laboratory quality assurance and quality control (QA/QC) procedures were implemented at each stage of the fish survey, including sampling, data entry, sample shipment, data analyses, laboratory analyses, and report preparation, to produce technically sound and scientifically defensible results.

7.3.6.1 Field QA/QC Procedures

As part of practices for field operations for this program, the following QA/QC procedures were undertaken:

- Detailed specific work instructions outlining each field task were provided to the field personnel prior to the field programs.

- A pre-field meeting with the field crew and project team lead was conducted to review the specific work instructions so that procedures were understood.
- Samples were collected by experienced personnel and were labelled, preserved and shipped according to laboratory instructions described in Golder TP 8.1-3, Fish Inventory Methods (Golder, unpublished information) and TP 8.16-0, Fish Health Assessment – Metals (Golder, unpublished information).
- Fish identification was recorded to species, where possible, with identifications verified using fish field guides.
- Field equipment (e.g., electronic scales and water quality meters) were regularly calibrated according to manufacturer's recommendations.
- Detailed field notes were recorded in pencil in waterproof field notebooks, on waterproof pre-printed field data sheets, or directly entered electronically into an excel spreadsheet.
- Field data (i.e., datasheets, notebook, and electronic spreadsheets) were checked at the end of each day for completeness and accuracy.

Samples were documented and tracked using chain of custody (COC) forms and receipt of samples by the analytical laboratory was confirmed. Field crews were responsible for managing sample shipment to the analytical laboratories. Prior to sample shipment, field crews confirmed the following:

- Required samples were collected and accounted for.
- COC and analytical request forms were completed and correct.
- Proper sample labelling and documentation procedures were followed.

7.3.6.2 QA/QC of Field and Laboratory Data

Field-collected data, datasheets, and field notebooks were reviewed for completeness and unexpected values or trends. At least 10% of the field data entered electronically were verified by a second person to identify transcription errors. Results of statistical data analyses were reviewed by an independent biologist with appropriate technical qualifications. Tables containing data summaries and statistical results were reviewed and values were verified by a second, independent individual.

7.3.6.2.1 Tissue Chemistry

The fish tissue chemistry dataset was visually assessed for outliers using scatterplots, and erroneous values were corrected, if possible (i.e., if values were identified as data entry errors). Statistical analyses and data summary tables were independently reviewed and verified by a second individual with appropriate technical qualifications. Internal laboratory QA/QC at BV Labs included analysis of duplicates to evaluate the variance in the measurement, matrix spikes to evaluate sample matrix interference, method blanks to identify laboratory contamination, reagent blanks to determine any analytical contamination, spiked blanks to evaluate method accuracy, surrogates to evaluate extraction efficiency, and QC standards used as an independent check of method accuracy. Upon receipt of the tissue chemistry data from BV Labs, standard checks were performed to screen for potential data quality issues by:

- Confirming that each requested variable was analyzed.

- Reviewing the units.
- Reviewing any hold time exceedances.
- Reviewing internal laboratory QA/QC results.

Most results met the laboratory quality acceptance criteria for representativeness (e.g., no detected concentrations in procedural blanks) and accuracy (e.g., spiked blanks, containing a known amount of analyte, within acceptable range), with the following exceptions:

- QC standards for lead were below acceptance criteria due to digestion limitations specific to certified reference materials completed when analyzing Arctic Char and Fourhorn Sculpin. This limitation does not affect results for tissue samples.
- Control limits for barium were exceeded for *H. arctica* by 15%. However, other quality control parameters were met and therefore barium data were considered acceptable.

Overall, the fish tissue chemistry data were considered reliable and representative of site conditions at the time of sampling.

7.4 Results

7.4.1 Fish Health

In 2021, fish health data were collected for Fourhorn Sculpin and *H. arctica* to supplement the existing dataset for these species in the Milne Port area. Fish health endpoints were compared between 2021 and similar data collected in 2020 to evaluate interannual variability. Fish health data collected in 2021 are provided in Appendix 7B, Tables 7B-1 to 7B-3.

7.4.1.1 Fourhorn Sculpin

A total of 40 Fourhorn Sculpin were processed from the Milne Port area during the 2021 fish health assessment, including 20 females and 20 males. Summary statistics for processed fish are provided in Table 7-5. Length-frequency distributions for Fourhorn Sculpin were left-skewed and bimodal for both female and male fish (Figure 7-1). At the time of sampling, female Fourhorn Sculpin were longer (RPD 5%) and heavier (RPD 23%) than male Fourhorn Sculpin, showing greater energy stores but lower reproductive investment, based on comparisons of median LSI (RPD 63%) and GSI (RPD 14%). Both sexes had median ages of 6, with females ranging from 3 to 10 years and males ranging from 3 to 12 years. Female Fourhorn Sculpin ranged in length from 205 mm to 344 mm and in weight from 79.0 g to 352 g. Female condition factor ranged from 0.82 to 1.14, LSI ranged from 2.48 to 7.45, and GSI ranged from 1.78 to 24.38. Male Fourhorn Sculpin ranged in length from 209 mm to 281 mm and in weight from 74.0 g to 197 g. Male condition factor ranged from 0.71 to 1.01, LSI ranged from 1.49 to 5.53 and GSI ranged from 2.51 to 6.40. Female Fourhorn Sculpin had a significantly greater relative weight compared with male Fourhorn Sculpin (*P*-value = 0.058; Figure 7-2).

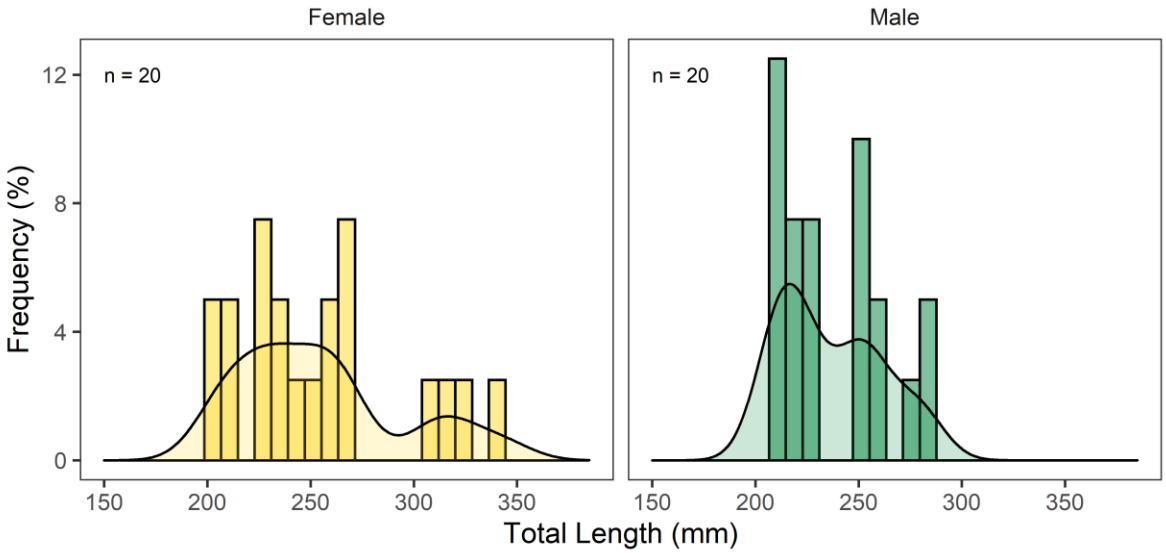


Figure 7-1: Length-Frequency Distributions of Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2021

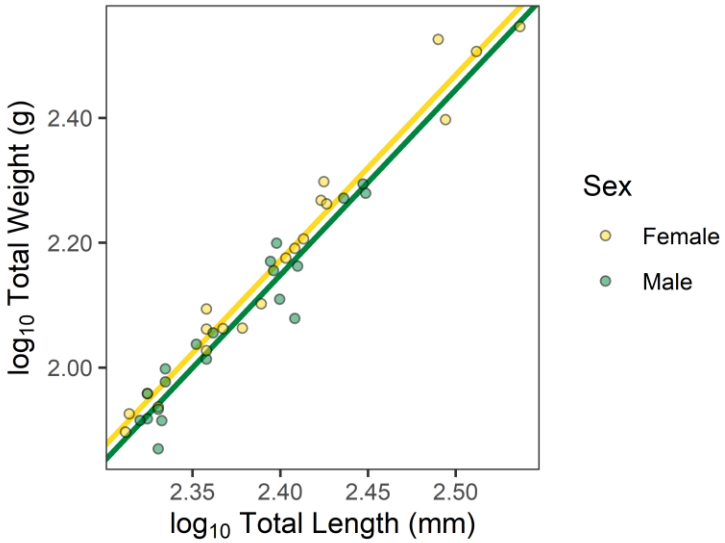


Figure 7-2: Length-Weight Relationship for Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2021

Table 7-5: Descriptive Statistics for Fourhorn Sculpin Fish Health Endpoints Processed from the Milne Port Area, 2020 – 2021

Parameter	2020							2021						
	n	Min	Max	Median	Mean	SD	SE	*n*	Min	Max	Median	Mean	SD	SE
Female														
Total Length (mm)	22	194	310	216	226	32	6.9	20	205	344	249	255	40	9.0
Total Weight (g)	22	65.3	380	89.4	123	77.7	16.5	20	78.8	351	138	166	84.9	18.9
Carcass Weight (g)	22	54.2	238	72.6	94.5	50.0	10.6	20	49.6	234	86.1	102	51.0	11.4
Condition Factor	22	0.75	1.28	0.96	0.97	0.12	0.03	20	0.82	1.14	0.93	0.94	0.08	0.02
Liver Weight (g)	22	0.84	16.3	2.36	4.37	4.08	0.87	20	1.95	23.9	5.82	6.83	5.05	1.13
LSI	22	1.29	5.09	2.76	3.11	1.16	0.25	20	2.48	7.45	3.88	3.89	1.05	0.24
Gonad Weight (g)	22	1.05	16.3	3.26	4.52	3.84	0.82	20	1.40	81.8	4.71	10.3	17.6	3.94
GSI	22	1.33	4.99	3.53	3.38	1.09	0.23	20	1.78	24.38	3.67	4.76	4.80	1.07
Age (y)	22	4	8	5	5.4	1.1	0.2	20	3	10	6	6.2	2.0	0.5
Male														
Total Length (mm)	21	189	276	215	214	21	4.6	20	209	281	229	237	24	5.5
Total Weight (g)	21	65.4	230	89.1	98.2	37.7	8.24	20	74.0	196	111	121	38.8	8.67
Carcass Weight (g)	21	54.5	169	70.0	78.3	28.0	6.12	20	47.0	146	72.6	80.8	30.0	6.71
Condition Factor	21	0.82	1.19	0.95	0.96	0.10	0.02	20	0.71	1.01	0.90	0.89	0.08	0.02
Liver Weight (g)	21	0.607	8.08	2.14	2.54	1.67	0.37	20	1.11	8.75	2.23	2.85	1.77	0.40
LSI	21	0.86	4.09	2.56	2.47	0.87	0.19	20	1.49	5.53	2.02	2.27	0.93	0.21
Gonad Weight (g)	21	1.42	10.7	3.84	4.06	2.30	0.50	20	2.07	10.1	4.76	5.17	2.19	0.49
GSI	21	2.02	5.88	4.09	4.03	1.27	0.28	20	2.51	6.40	4.24	4.23	1.14	0.25
Age (y)	21	4	9	5	5.6	1.5	0.3	20	3	12	6	6.6	2.1	0.5

n = sample size; Min = minimum; Max = maximum; SD = standard deviation; SE = standard error; GSI = gonadosomatic index; LSI = liver somatic index

Table 7-6: Statistical Comparisons Between 2020 and 2021 for Fourhorn Sculpin, Milne Port Area

Sex	Effect Indicator	Endpoint[a]	Statistical Test	*n* Outlier	*n*		LSM		MSE	Interaction *P*-value	*P*-value	RPD (%)	Power Analysis	
					2020	2021	2020	2021					Minimum Detectable Difference	Sensitivity
Female	Survival	Age	$ANOVA_{log10}$	0	22	20	0.73	0.77	0.013	n/a	0.198	nc	1.54	27%
	Growth	Size-at-Age	ANCOVA	0	22	20	234	246	334.62	0.117	**0.035**	5%	17.27	7%
	Condition (Energy Storage)	Condition	$ANCOVA_{log10}$	0	22	20	2.113	2.090	0.002	0.011	0.118	nc	12.41	9%
		Relative Liver Weight	ANCOVA	1	22	19	5.11	5.10	1.253	**0.003**[b]	0.981	nc	1.83	33%
	Reproduction	Relative Gonad Weight	$ANCOVA_{log10}$	1	22	19	0.620	0.608	0.017	0.308	0.783	nc	2.01	37%
Male	Survival	Age	$ANOVA_{log10}$	0	21	20	0.73	0.79	0.016	n/a	0.126	nc	1.79	30%
	Growth	Size-at-Age	ANCOVA	0	21	20	219	232	265.92	0.869	**0.013**	6%	15.38	7%
	Condition (Energy Storage)	Condition	$ANCOVA_{log10}$	0	21	20	0.397	0.333	0.023	0.691	0.203	nc	9.56	9%
		Relative Liver Weight	ANCOVA	1	20	19	2.87	2.17	0.569	0.016	**0.008**	28%	1.01	38%
	Reproduction	Relative Gonad Weight	ANCOVA	0	21	20	4.62	4.58	1.671	0.332	0.934	nc	1.22	26%

Notes:
Statistically significant values are indicated in **bold**. Statistical outliers are provided in Appendix 7B, Table 7B-6.
(a) For model components, please see Table 7-3.
(b) The difference in R^2 values between the full model (R^2 = 0.932) and the reduced model (R^2 = 0.913) was less than the threshold (0.019 < 0.020) for assuming slopes are practically parallel (Barrett et al., 2010).
n = sample size; LSM = least squares mean; MSE = mean square error; RPD = Relative Percent Difference; log_{10} = log_{10}-transformed data; ANOVA = analysis of variance; ANCOVA = analysis of covariance; n/a = not applicable; nc = not calculated.

Survival – Age

Ages of Fourhorn Sculpin were compared between 2020 and 2021. Ages of both male and female Fourhorn Sculpin captured in 2020 and 2021 were similar (Table 7-5; Figure 7-3). Mean ages did not different significantly between years for either sex (Table 7-6). Female ages ranged from 4 to 8 years in 2020 and from 3 to 10 years in 2021. Male ages ranged from 4 to 9 years in 2020 and from 3 to 12 years in 2021.

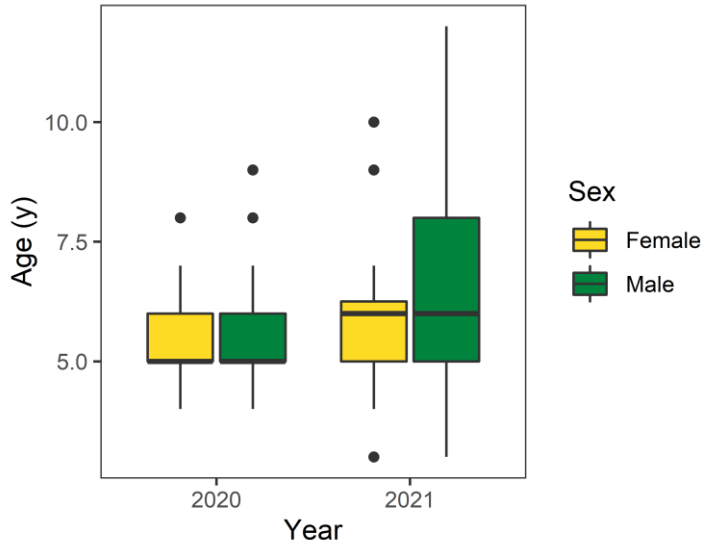


Figure 7-3: Boxplots of Ages of Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2020 – 2021

Growth – Size-at-Age

Size-at-age was compared between 2020 and 2021 using total length-at-age (Figure 7-4). For both male and female Fourhorn Sculpin, size-at-age was greater in 2021 than in 2020 (Table 7-6). Male size-at-age differed between years by 5% while female size-at-age differed by 6%.

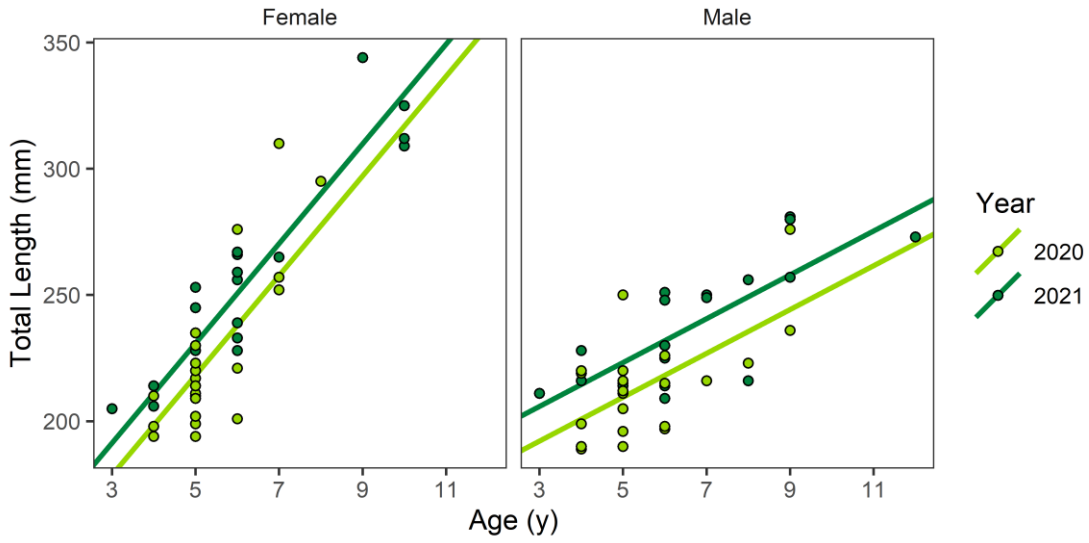


Figure 7-4: Size-at-Age Relationships for Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2020 – 2021

Condition

Condition of Fourhorn Sculpin was compared between 2020 and 2021 using weight-at-length and relative liver weight (as liver weight-at-total weight). Weight-at-length did not differ significantly between years for either sex (Table 7-6; Figure 7-5). Condition factor, calculated as a ratio of total weight to total length, for females ranged from 0.75 to 1.28 in 2020 and 0.82 to 1.14 in 2021, and for males ranged from 0.82 to 1.19 in 2020 and 0.71 to 1.01 in 2021 (Table 7-5). Relative liver weight did not differ significantly between years for female Fourhorn Sculpin. Relative liver weight was, however, significantly lower in 2021 compared with 2020 for male Fourhorn Sculpin (Table 7-6; Figure 7-6). The relative percent difference between years for male Fourhorn Sculpin was 28%.

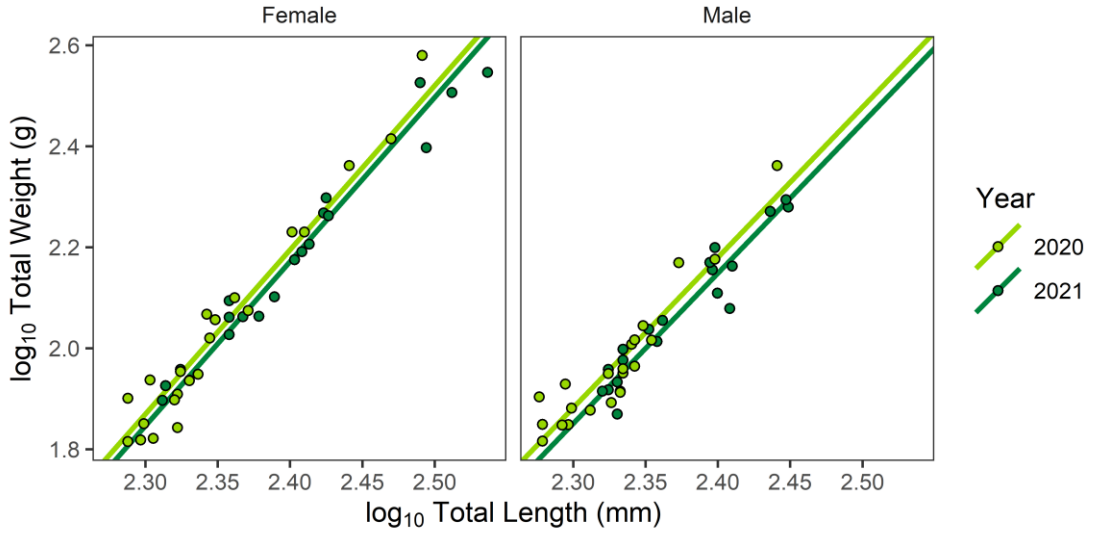
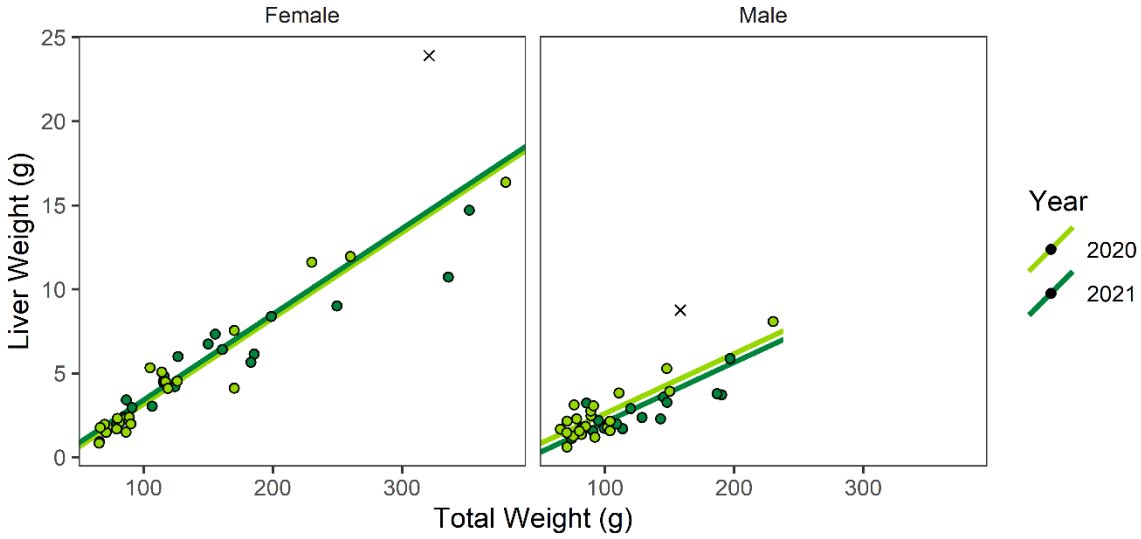


Figure 7-5: Weight-at-Length Relationships for Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2020 – 2021.

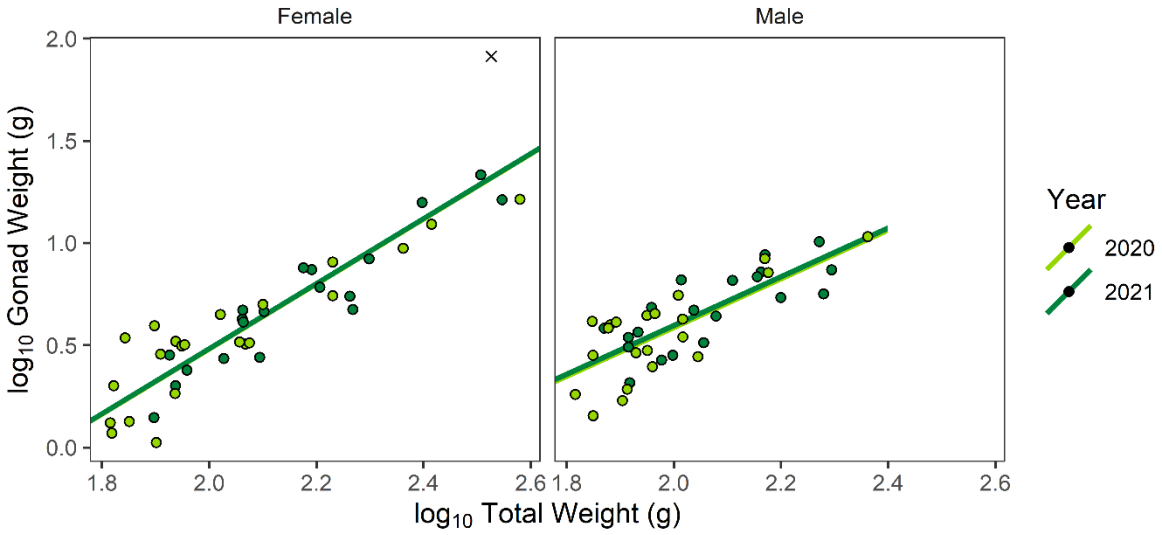


x = outlier.

Figure 7-6: Relative Liver Weight for Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2020 – 2021.

Reproduction

Relative gonad weights were compared between 2020 and 2021 using relationships between gonad weight and total weight in male and female Fourhorn Sculpin (Figure 7-7). No significant difference in relative gonad weight was found for female or male Fourhorn Sculpin (Table 7-6).



x = outlier.

Figure 7-7: Relative Gonad Weight for Female and Male Fourhorn Sculpin Sampled from the Milne Port Area, 2020 – 2021.

Abnormalities

Few abnormalities were observed in Fourhorn Sculpin sampled from the Milne Port area (Table 7-7). No external abnormalities or parasites were observed on any individuals. Internal abnormalities primarily consisted of variation in liver colour, with light or pale coloured livers observed for seven females and 18 males. Liver colour, however, is closely tied to perfusion (i.e., fresh circulating blood) and time elapsed between sacrifice and observation and is subject to observer bias. Liver colour is, therefore, considered a less reliable indicator of changes in fish health relative to other observations and is therefore not considered further herein. Internal parasites observed in Fourhorn Sculpin consisted of cysts embedded within the body cavity, including on the heart, stomach, and intestines, and were present in one female and nine males.

Table 7-7: Number and Description of External and Internal Abnormalities Observed in Fourhorn Sculpin Sampled from the Milne Port Area, 2021

Parameter	Female	Male	Description
External			
Body Deformity	0	0	-
Eyes	0	0	-
Skin	0	0	-
Thymus	0	0	-
Opercula	0	0	-
Gills	0	0	-
Pseudobranchs	0	0	-
Fins	0	0	-
Vent	0	0	-
Parasitization	0	0	-
Internal			
Liver	7	18	Pale colouration[(a)]
Spleen	0	0	-
Gall bladder	0	0	-
Gonad	0	0	-
Kidney	0	0	-
Parasitization	1	9	Cysts on organs or within body cavity

(a) Pale liver colouration is typically associated with a lack of perfusion following sacrifice and cessation of the heart beating; pale livers were noted and documented but are not considered further.

- = not applicable.

7.4.1.2 *Hiatella arctica*

Hiatella arctica were collected from the Milne Port area in 2018, 2019, 2020, and 2021. In 2018 and 2019, samples were submitted for tissue chemistry analysis, but supporting biological data were not recorded for individuals (with the exception of age in 2019). In 2020 and 2021, *H. arctica* were processed for fish health endpoints, including length, weight, and age, with a subset of samples submitted for tissue analysis (Section 7.4.2.3). While gonad weights were not recorded in 2020, these data were recorded in 2021. Biological data for *H. arctica* are summarized in Table 7-8.

In 2021, a total of 36 *H. arctica* were processed for fish health endpoints. The collected individuals ranged in length from 17.5 mm to 35.1 mm and ranged in total weight from 0.480 g to 8.12 g. Length data were approximately bimodal and left skewed (Figure 7-8) and exhibited a strong relationship with total weight ($p < 0.001$; $R^2 = 0.90$). Gonad weights ranged from 0.00230 g to 0.0798 g, with a median value of 0.0360 g; MSI ranged from 0.90 to 6.13 with a median value of 1.97. *Hiatella arctica* sampled from the Milne Port area ranged in age from 1 to 39 years, with a median age of 19. Median condition factor in 2021 was 1.41.

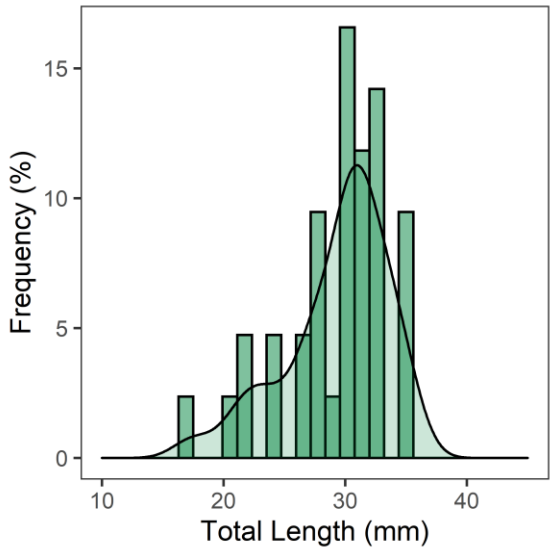


Figure 7-8: Length-Frequency Distributions of *Hiatella arctica* Sampled from the Milne Port Area, 2021

Table 7-8: Descriptive Statistics for *Hiatella arctica* Fish Health Endpoints Processed from the Milne Port Area, 2020 – 2021

Parameter	2020							2021						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Shell Length (mm)	50	25.36	34.54	29.09	29.20	2.30	0.32	35	17.47	35.07	30.45	29.33	4.25	0.72
Total Weight (g)	50	2.75	6.39	4.06	4.32	1.07	0.151	35	0.480	8.12	3.98	4.02	1.75	0.297
Shell ww (g)	50	0.799	3.30	1.52	1.65	0.533	0.0750	35	0.218	5.13	2.06	2.21	1.16	0.197
Shell dw (g)	50	0.747	3.18	1.43	1.56	0.516	0.0730	35	0.114	4.72	1.79	1.90	1.03	0.174
Tissue ww (g)	5	1.21	4.01	2.56	2.67	0.680	0.0960	35	0.235	2.87	1.90	1.78	0.703	0.118
Tissue dw (g)	5	0.243	0.782	0.471	0.497	0.122	0.0170	35	0.0868	1.06	0.703	0.658	0.259	0.0439
Condition factor	50	1.13	2.54	1.70	1.73	0.34	0.05	35	0.90	2.25	1.41	1.48	0.30	0.05
Gonad ww (g)	-	-	-	-	-	-	-	35	0.00230	0.0798	0.0360	0.0365	0.0181	0.0031
GSI	-	-	-	-	-	-	-	35	0.90	6.13	1.97	2.23	1.20	0.20
Age (y)	50	10	49	23	25	12	1.6	35	1	39	17	19.2	8.1	1.4

ww = wet weight; dw = dry weight; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error - = not collected/not measured.

Table 7-9: Statistical Comparisons Between 2020 and 2021 for Hiatella arctica, Milne Port

Species	Effect Indicator	Endpoint	Statistical Test	*n* Outliers	*n*		LSM		MSE	Interaction *P*-value	Levene's Test	Shapiro-Wilk	*P*-value	RPD (%)	Power Analysis	
					2020	2021	2020	2021							Minimum Detectable Difference	Sensitivity
Hiatella arctica	Survival	Length Frequency	K-S Test	0	50	36	n/a	n/a	n/a	n/a	n/a	n/a	1.000	nc	n/a	n/a
	Growth	Whole Animal Wet Weight	K-W Test	0	50	36	45	42	n/a	n/a	n/a	n/a	0.443	nc	1.16	29%
	Condition (Energy Storage)	Condition	$ANCOVA_{log10}$[(b)]	0	50	29	0.645	0.605	0.006	0.220	0.862	0.701	**0.047**	9%	0.55	13%

Notes:
Statistically significant values are indicated in **bold**. Power analysis was completed assuming normality. For K-W Test, LSM are mean ranks.
(a) For model components, please see Table 7-4.
(b) ANCOVA completed only in range of overlapping total length between years (25 – 36 mm) following Section A1.7 in Environment Canada (2012). See Appendix 7B Table 7B-7 for full model details, and Figure 7-9 for *H. arctica* length-frequency distributions in 2020 and 2021.
n = sample size; LSM = least-squares means; MSE = mean square error; RPD = Relative Percent Difference; log_{10} = log_{10}-transformed data; K-S Test = Kolmogorov-Smirnov test; K-W Test = Kruskal-Wallis test; ANOVA = analysis of variance; ANCOVA = analysis of covariance; n/a = not applicable; nc = not calculated.

Survival – Age

Length frequencies of *H. arctica* were compared between 2020 and 2021 (Figure 7-9). Results of the Kolmogorov-Smirnov test indicate there was no significant difference between years for *H. arctica* (Table 7-9); however, the range of lengths was greater in 2021 than in 2020 (Table 7-8), with more individuals less than 25 mm being collected.

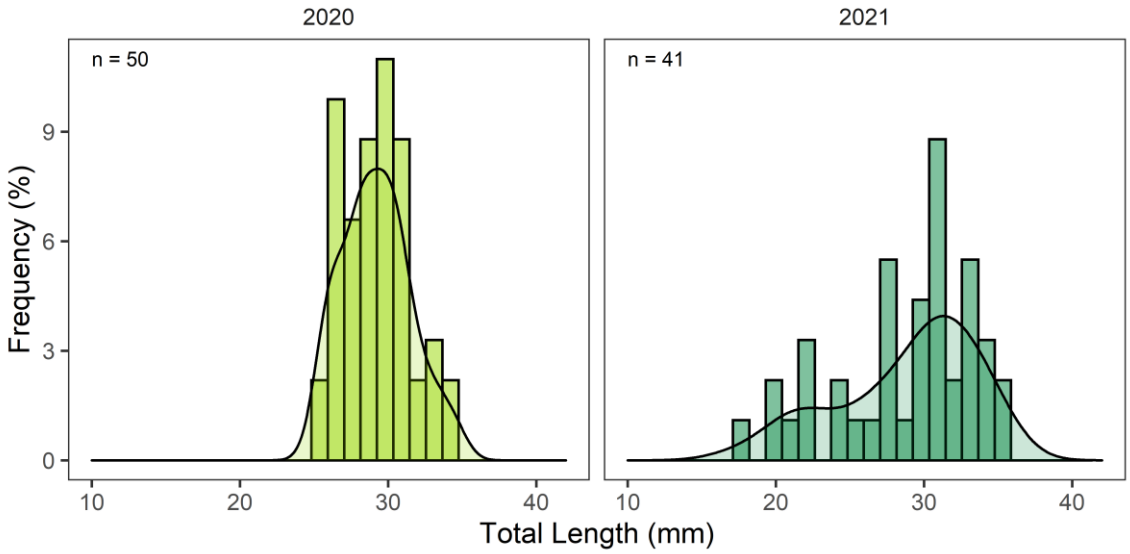


Figure 7-9: Length-Frequency Distribution for Hiatella arctica Captured from the Milne Port Area, 2020 – 2021.

Growth

Total weight was compared between 2020 and 2021 for *H. arctica* (Figure 7-10). While the range of weights was greater in 2021 compared with 2020 (Table 7-8), there was no significant difference between years (Table 7-9)

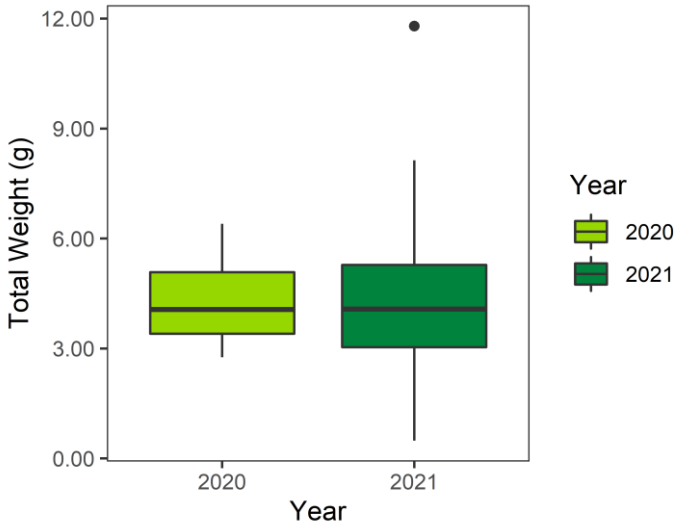
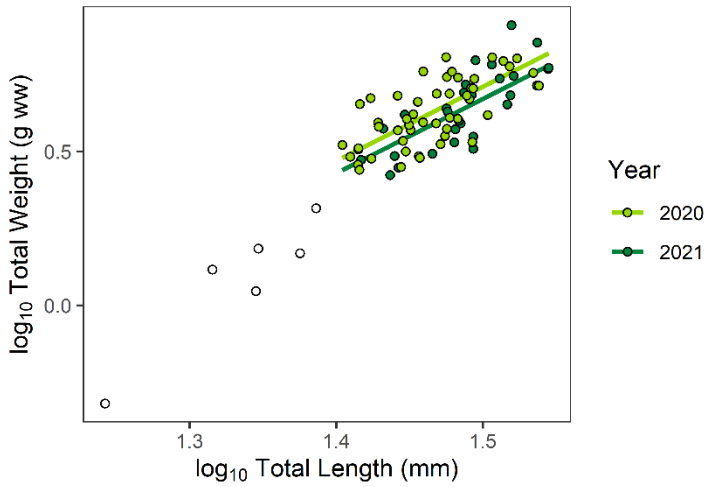


Figure 7-10: Boxplot of Total Weight of Hiatella arctica Captured from the Milne Port Area, 2020 – 2021.

Condition

Condition of *H. arctica* was compared between 2020 and 2021 using relative weight (total weight-at-length). Given the differences in the range of total length of *H. arctica* between years (Figure 7-9), differences in relative weight were evaluated over the shared range of lengths (Environment Canada 2012; Figure 7-11). Relative weight was significantly lower in 2021 relative to 2020 (Table 7-9), with an RPD of 9%.



○ = omitted from ANCOVA (2021 data).

Figure 7-11: Relationships between Total Weight and Total Length of Hiatella arctica Captured from the Milne Port Area, 2020 – 2021.

7.4.2 Fish Tissue Chemistry

A total of 357 fish tissue samples have been submitted for metals analysis and 63 fish tissue samples have been submitted for PAH analysis from the Mile Port Area from 2010 to 2021. A summary of sample sizes by species and year are provided in Appendix 7C; Table 7C-1.

In 2021, a total of 24 samples from three species were submitted for tissue chemistry analysis, supplementing data from recent years (i.e., 2018 [n = 50], 2019 [n = 187]), and 2020 [n = 24]). These 285 samples (i.e., total samples collected from 2018 to 2021) were analyzed for metals and were from Arctic Char (n = 89), Fourhorn Sculpin (n = 46), indeterminate sculpin (n = 30), and *H. arctica* (n = 120). An additional 24 samples were analyzed for PAHs in 2021 and were from Arctic Char (n = 8), Fourhorn Sculpin (n = 8), and *H. arctica* (n = 8). Results for individual species are described in the following sections.

7.4.2.1 Arctic Char

From 2010 to 2021, a total of 346 Arctic Char were analyzed for metals from the Milne Port area. Summary statistics for metals concentrations from Arctic Char collected from 2018 to 2021 are provided in Table 7-10 and data from all years are presented visually in Appendix 7D (Figures 7D-1 to 7D-36). Statistical comparisons for COPCs (i.e., aluminum, iron, magnesium, mercury, and selenium) among years (i.e., 2018 to 2021) are provided in Table 7-11, and outliers removed from the analyses are provided in Table 7-12.

From 2018 to 2021, concentrations of metals were mostly similar among years with some exceptions. Some metals demonstrated inter-annual variability (e.g., copper, iron, selenium, and zinc; Appendix 7D, Figures 7D-1 to 7D-36). Among COPCs, significant differences were observed among years for aluminum, magnesium, and selenium (Table 7-11):

- Aluminum concentrations were lowest in 2018, then increased by 108% to 2019, before declining 126% from 2019 to 2021.
- Magnesium concentrations were significantly lower in 2018 when compared to 2019 (7%) and 2021 (10%) but did not differ among other years. The RPDs for magnesium concentration among years were comparatively small and concentrations were similar to those observed from 2010 and 2017 (Figure 7D-17).
- Concentrations of selenium decreased with fish length and were significantly greater in 2019 when compared to 2018 (19%) and 2020 (21%) and significantly greater in 2021 when compared to 2018 (24%) and 2020 (26%) but did not differ among other years (Figure 7-12; Figure 7C-25).

No significant differences were observed among years for iron or mercury, with mercury concentrations decreasing with fish length (Figure 7-12). While this relationship between mercury and fish length was inconsistent when compared to many other piscivorous species, where mercury generally increases with fish size, this inverse relationship has been previously documented for anadromous Arctic Char, whose mercury concentrations are related to freshwater residency time (i.e., mercury concentrations decrease once fish migrate into the marine environment; Riget and Aastrup 2000). A power analysis for COPCs indicated that target sample sizes of eight fish of mixed sex per sampling area would be sufficient to detect differences in effect sizes ranging from 13% for magnesium to 134% for aluminum.

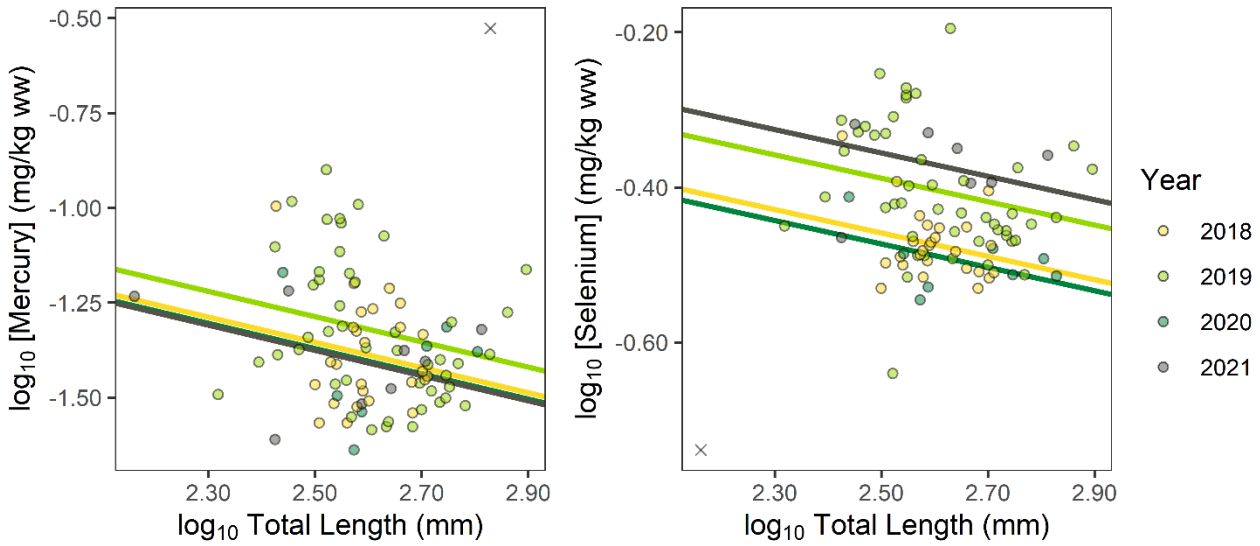
Polycyclic aromatic hydrocarbons were below DL for all parameters analyzed in Arctic Char (Appendix 7C, Table 7C-5).

One Arctic Char sampled in 2021 had tissue concentrations of several metals which were notably different than other Arctic Char sampled in the same year. This Arctic Char had elevated COPC concentrations of aluminum, iron, and magnesium, as well as numerous other metals including chromium, lead, and nickel (Appendix 7C, Table 7C-2). Compared to the other Arctic Char sampled in 2021, this individual was the youngest (age = 4 years) and smallest (total length = 145 mm, total weight = 24.5 g) from the sampled population in 2021 (Appendix 7B, Table 7B-1). Stomach contents for this individual fish were also notably different from other Arctic Char, being composed entirely of freshwater insect taxa, including larval/juvenile chironomids (genus *Hydrobaenus*), blackflies (Family Simuliidae), craneflies (Family Tipulidae), and mayflies (Order Ephemeroptera; Appendix 7B, Table 7B-4 and 7B-5), indicating this individual had been feeding in freshwater prior to being captured in Milne Port. Given the small size and young age of this Arctic Char, it is possible that it was a smolt that had just undertaken its first migration to the marine environment. The diet of smolt and freshwater resident Arctic Char have been shown to

be similar, comprised mainly of zooplankton, surface insects, and chironomid pupae (Rikardsen et al. 2003; Rikardsen et al. 2005). Characteristic differences in water chemistry, including metals concentrations, between freshwater and marine environments may explain the abnormal metals concentrations in this individual Arctic Char. A recent study of tissue metals burdens in Arctic Char from the Nunavik region of western Canada found that concentrations of chromium, lead, and nickel were significantly higher in muscle tissue samples from Arctic Char in the post-winter period before they returned to the ocean when compared with Arctic Char caught in the ocean in the summer (Martyniuk et al. 2020). Given this individual Arctic Char had elevated concentrations of chromium, lead, and nickel, and its stomach contents were comprised entirely of freshwater insects, it is likely that this individual was a first-year smolt that had migrated from a lake upstream of Milne Port. The elevated concentrations of metals, including some COPCs, may be attributable to differences in water chemistry between its originating lake and Milne Inlet.

Mercury concentrations for all Arctic Char sampled from 2018 to 2021 were below Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015). Selenium concentrations for Arctic Char were also below the BC MOE fish tissue guidelines of 4 mg/kg dw (BC MOE 2014), with tissue concentrations in Arctic Char from the Milne Port area ranging from 0.730 to 2.2 mg/kg dw from 2018 to 2021.

Tissue chemistry results were within FEIS predictions, which indicated the potential for non-significant, low magnitude effects on Arctic Char fish health and condition.



x = outlier; g = grams; mg = milligram; kg = kilogram; ww = wet weight.

Figure 7-12: Concentrations of Mercury and Selenium in Relation to Total Length for Arctic Char Sampled from the Milne Port Area, 2018 – 2021.

Table 7-10: Descriptive Statistics for Arctic Char Tissue Chemistry Data Analyzed from 2018 to 2021.

Parameter	2018 (*n* = 26)							2019 (*n* = 47)						
	>DL (%)	Min	Max	Median	Mean	SD	SE	>DL (%)	Min	Max	Median	Mean	SD	SE
Aluminum	31	<0.20	0.81	<0.20	0.20	0.18	0.04	96	<0.20	9.48	0.41	0.66	1.36	0.20
Antimony	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Arsenic	100	0.305	1.150	0.461	0.527	0.218	0.043	100	0.329	2.850	0.811	0.799	0.374	0.055
Barium	4	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	34	<0.010	0.036	<0.010	<0.010	<0.010	<0.010
Beryllium	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	4	<0.20	0.21	<0.20	<0.20	<0.20	<0.20	0	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium	96	<0.0010	0.0207	0.0030	0.0062	0.0059	0.0012	96	<0.0010	0.0235	0.0052	0.0062	0.0052	<0.0010
Calcium	100	43	248	76	87	45	9	100	57	791	147	164	118	17
Chromium	50	<0.010	0.050	<0.010	0.014	0.013	<0.010	75	<0.010	0.043	0.012	0.014	<0.010	<0.010
Cobalt	100	0.0030	0.0111	0.0047	0.0049	0.0015	0.0003	100	0.0024	0.0130	0.0043	0.0049	0.0022	0.0003
Copper	100	0.347	0.688	0.500	0.508	0.088	0.017	100	0.285	0.739	0.394	0.414	0.090	0.013
Iron	100	3.02	5.77	4.36	4.36	0.74	0.14	100	2.30	20.60	3.95	4.49	2.74	0.40
Lead	38	<0.0010	0.0026	<0.0010	<0.0010	<0.0010	<0.0010	85	<0.0010	0.0054	0.0016	0.0018	<0.0010	<0.0010
Magnesium	100	263	310	285	282	12	2	100	257	366	301	303	22	3
Manganese	100	0.067	0.134	0.090	0.093	0.015	0.003	100	0.060	0.316	0.092	0.101	0.038	0.006
Mercury	100	0.0271	0.1010	0.0379	0.0431	0.0159	0.0031	100	0.0260	0.1260	0.0423	0.0522	0.0246	0.0036
Molybdenum	0	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Nickel	81	<0.010	0.037	0.014	0.015	<0.010	<0.010	79	<0.010	0.024	0.013	0.013	<0.010	<0.010
Phosphorus	100	2820	3210	3000	2992	105	21	100	2490	3300	2900	2877	187	27
Potassium	100	4030	4660	4390	4411	159	31	100	2960	4920	4060	3978	438	64
Selenium	100	0.295	0.464	0.330	0.338	0.037	0.007	100	0.229	0.638	0.375	0.401	0.080	0.012
Silver	8	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium	100	360	796	489	501	96	19	100	313	1240	700	711	233	34
Strontium	100	0.079	0.637	0.176	0.196	0.114	0.022	100	0.139	1.720	0.433	0.480	0.264	0.039
Thallium	100	0.00211	0.00644	0.00294	0.00311	0.00082	0.00016	100	0.00124	0.00600	0.00216	0.00246	0.00102	0.00015
Tin	4	<0.020	0.036	<0.020	<0.020	<0.020	<0.020	9	<0.020	0.032	<0.020	<0.020	<0.020	<0.020
Titanium	100	0.085	0.154	0.125	0.125	0.016	0.003	100	0.416	0.574	0.486	0.489	0.034	0.005
Uranium	4	<0.00040	0.00058	<0.00040	<0.00040	<0.00040	<0.00040	13	<0.00040	0.00091	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium	0	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc	100	4.50	7.74	5.48	5.66	0.91	0.18	100	4.43	15.10	6.95	7.63	2.84	0.41

mg/kg = milligram per kilogram wet weight; > = greater than; DL = detection limit; SD = Standard deviation; SE = standard error.

Table 7-10 (continued): Descriptive Statistics for Arctic Char Tissue Chemistry Data Analyzed from 2018 to 2021.

Parameter	2020 (n = 8)							2021 (n = 8)						
	>DL (%)	Min	Max	Median	Mean	SD	SE	>DL (%)	Min	Max	Median	Mean	SD	SE
Aluminum	100	0.28	0.62	0.43	0.42	0.11	0.04	38	<0.20	8.11	<0.20	1.14	2.81	<0.20
Antimony	13	<0.0010	0.0094	<0.0010	0.0016	0.0032	0.0011	50	<0.0010	0.0045	<0.0010	0.0013	0.0014	<0.0010
Arsenic	100	0.389	33.200	0.830	4.875	11.449	4.048	100	0.101	5.540	2.765	2.556	1.975	0.698
Barium	63	<0.010	0.068	0.017	0.024	0.024	<0.010	13	<0.010	0.123	<0.010	0.020	0.042	0.015
Beryllium	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0013	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	13	<0.20	0.27	<0.20	0.12	0.06	0.02
Cadmium	100	0.0012	0.0171	0.0032	0.0062	0.0061	0.0021	63	<0.0010	0.0020	0.0015	0.0013	<0.0010	<0.0010
Calcium	100	39	506	113	219	193	68	100	60	425	145	197	137	49
Chromium	75	<0.010	1.520	0.030	0.217	0.527	0.186	38	<0.010	0.111	<0.010	0.020	0.037	0.013
Cobalt	100	0.0029	0.0057	0.0035	0.0038	0.0010	0.0004	100	0.0030	0.0171	0.0039	0.0059	0.0048	0.0017
Copper	100	0.165	0.347	0.326	0.305	0.059	0.021	100	0.299	0.607	0.397	0.425	0.097	0.034
Iron	100	2.39	16.80	4.71	5.92	4.50	1.59	100	3.11	87.15	3.97	14.50	29.37	10.38
Lead	100	0.0012	0.0052	0.0023	0.0024	0.0013	0.0005	75	<0.0010	0.0624	0.0029	0.0107	0.0211	0.0074
Magnesium	100	219	348	303	300	37	13	100	270	377	309	314	32	11
Manganese	100	0.056	0.180	0.125	0.115	0.045	0.016	100	0.060	0.579	0.084	0.148	0.175	0.062
Mercury	100	0.0230	0.2970	0.0425	0.0728	0.0916	0.0324	100	0.0245	0.0604	0.0408	0.0421	0.0129	0.0046
Molybdenum	13	<0.0040	0.0105	<0.0040	<0.0040	<0.0040	<0.0040	13	<0.0040	0.0122	<0.0040	0.0033	0.0036	<0.0040
Nickel	63	<0.010	0.029	0.014	0.015	0.010	<0.010	25	<0.010	0.052	<0.010	0.013	0.017	<0.010
Phosphorus	100	2350	3950	3125	3206	471	167	100	2980	3370	3140	3141	153	54
Potassium	100	4190	5360	4655	4696	433	153	100	4030	5010	4535	4551	286	101
Selenium	100	0.285	0.387	0.315	0.320	0.031	0.011	100	0.183	0.480	0.421	0.396	0.096	0.034
Silver	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0013	<0.0010	<0.0010	<0.0010	<0.0010
Sodium	100	242	633	332	367	119	42	100	235	422	282	296	59	21
Strontium	100	0.088	1.590	0.344	0.585	0.553	0.196	100	0.103	1.120	0.259	0.348	0.328	0.116
Thallium	100	0.00071	0.00324	0.00203	0.00203	0.00071	0.00025	100	0.00149	0.00868	0.00238	0.00323	0.00231	0.00082
Tin	75	<0.020	0.038	0.028	0.026	<0.020	<0.020	13	<0.020	0.069	<0.020	<0.020	0.021	<0.020
Titanium	100	0.119	0.167	0.143	0.144	0.018	0.007	100	0.423	1.050	0.442	0.517	0.216	0.076
Uranium	25	<0.00040	0.00112	<0.00040	<0.00040	<0.00040	<0.00040	13	<0.00040	0.00774	<0.00040	0.00114	0.00266	0.00094
Vanadium	0	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc	100	3.78	5.54	4.62	4.57	0.70	0.25	100	4.39	9.82	4.83	5.56	1.83	0.65

mg/kg = milligram per kilogram wet weight; > = greater than; DL = detection limit; SD = Standard deviation; SE = standard error.

Table 7-11: Inter-annual Comparison of Chemicals of Potential Concern in Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Samples Collected from the Milne Port Area from 2018 to 2021.

Species	Parameter	Test	Sample Size				*n* Outliers	*P*-value	Error (MSE)	LS Mean				Post-hoc *P*-value						RPD (%)						Power Analysis	
			2018	2019	2020	2021				2018	2019	2020	2021	2018* 2019	2018* 2020	2018* 2021	2019* 2020	2019* 2021	2020* 2021	2018* 2019	2018* 2020	2018* 2021	2019* 2020	2019* 2021	2020* 2021	Min Detectable Difference	Sensitivity[(b)]
Arctic Char	Aluminum	$ANOVA_{rank}$	26	47	8	7	1	**0.000**	633.439	0.20	0.66	0.42	0.15	**<0.001**	**0.008**	1.000	0.977	**0.001**	**0.013**	-108%	72%	nc	nc	-126%	-95%	0.48	134%
	Iron	$ANOVA_{rank}$	26	47	8	7	1	0.461	1036.028	4.36	4.49	5.92	4.12	-	-	-	-	-	-	-	-	-	-	-	-	3.78	83%
	Magnesium	$ANOVA_{log}$	26	47	7	8	1	**0.000**	0.001	282	302	311	313	**0.002**	0.286	**0.006**	0.956	0.647	0.573	-7%	nc	10%	nc	nc	nc	38	13%
	Mercury	$ANCOVA_{log}$[(a)]	26	47	7	8	1	0.199	0.026	0.0408	0.0477	0.0393	0.0389	-	-	-	-	-	-	-	-	-	-	-	-	0.0324	68%
	Selenium	$ANCOVA_{rank}$[(a,b)]	26	45	8	7	1	**0.000**	758.095	0.334	0.403	0.327	0.426	**<0.001**	0.938	**<0.001**	**0.001**	0.556	**0.001**	-19%	nc	24%	-21%	nc	26%	0.1080	29%
Fourhorn Sculpin	Aluminum	$ANOVA_{log}$	-	30	8	8	0	**0.000**	0.092	-	2.16	0.31	0.50	-	-	-	**<0.001**	**<0.001**	0.385	-	-	-	-149%	-125%	nc	2.73	150%
	Iron	$ANOVA_{log}$	-	30	8	8	0	**0.044**	0.030	-	8.99	6.31	6.82	-	-	-	**0.076**	0.198	0.920	-	-	-	-35%	nc	nc	5.29	62%
	Magnesium	ANOVA	-	29	8	8	1	0.594	1120.699	-	276	290	277	-	-	-	-	-	-	-	-	-	-	-	-	51	18%
	Mercury	$ANCOVA_{log}$[(a)]	-	30	8	8	0	**0.094**	0.014	-	0.1329	0.1264	0.1680	-	-	-	0.893	0.104	0.133	-	-	-	nc	nc	nc	0.0937	64%
	Selenium	ANCOVA[(a)]	-	30	8	8	0	**0.014**	0.004	-	0.510	0.444	0.465	-	-	-	**0.026**	0.167	0.792	-	-	-	-14%	nc	nc	0.1197	24%
Hiatella arctica	Aluminum	$ANOVA_{log}$	24	79	8	8	1	**0.000**	0.030	476	860	668	769	**<0.001**	0.246	**0.044**	0.513	0.954	0.920	-57%	nc	47%	nc	nc	nc	528.17	66%
	Iron	$ANOVA_{log}$	24	79	8	8	1	**0.000**	0.035	1233	2169	1909	2176	**<0.001**	**0.098**	**0.016**	0.925	0.999	0.941	-55%	43%	55%	nc	nc	nc	1467.80	70%
	Magnesium	$ANOVA_{log}$	24	80	8	8	0	**0.000**	0.026	2444	3855	3089	3312	**<0.001**	0.421	0.198	0.384	0.693	0.982	-45%	nc	nc	nc	nc	nc	2187	60%
	Mercury	$ANOVA_{rank}$	24	80	8	8	0	0.132	3171.174	0.0272	0.0317	0.0321	0.0305	-	-	-	-	-	-	-15%	17%	11%	1%	-4%	-5%	0.0184	60%
	Selenium	$ANOVA_{rank}$	24	80	8	8	0	**0.001**	1081.851	1.172	1.394	1.261	1.396	**0.001**	0.865	0.599	**0.081**	0.731	0.558	-17%	nc	nc	-10%	nc	nc	0.3877	29%

Note: Significant differences indicated in **bold**.
(a) Length was included as a covariate for ANCOVA.
(b) One data point was removed due to high leverage (Figure 7-12; Appendix 7D, Figure 7D-37). See Appendix 7C, Table 7C-8 for model results including this point.
(c) Sensitivity is the minimum detectable difference expressed as a percent change in the least squares mean.
P-value = probability value; LS = Least Squares; RPD = relative percent difference; Min = minimum; ANOVA = analysis of variance; ANCOVA = analysis of covariance; log = log_{10}-transformed data; rank = rank-transformed data; nc = not calculated.

Table 7-12: Outliers Omitted from Statistical Comparisons of Tissue Chemistry

Species	Parameter	Year	Age (y)	Length (mm)	Weight (g)	Concentration (mg/kg ww)	Studentized Residuals
Arctic Char	Aluminum	2021	4	145	24.5	8.11	4.2
	Iron	2021	4	145	24.5	87.15	31.6
	Magnesium	2020	9	674	3910	219	-4.9
	Mercury	2020	9	674	3910	0.297	4.4
	Selenium	2021	4	145	24.5	0.1825	-[(a)]
Fourhorn Sculpin	Magnesium	2019	4	156	2.36	414	4.1
Hiatella arctica	Aluminum	2019	21	-	-	109	-5.1
	Iron	2019	21	-	-	374	-4.0

(a) Value removed due to high leverage (Appendix 7D, Figure 7D-37 for leverage plot).

7.4.2.2 Fourhorn Sculpin

A total of 46 Fourhorn Sculpin samples were analyzed for metals from the Milne Port area from 2019 to 2021, including 30 samples in 2019, eight in 2020, and eight in 2021. Summary statistics for metals concentrations are provided in Table 7-13 and presented visually in Appendix 7D, Figures 7D-1 to 7D-36. Statistical comparisons for COPCs among years are provided in Table 7-11, and outliers removed from the analyses are provided in Table 7-12.

Concentrations of metals in Fourhorn Sculpin were generally more variable when compared to Arctic Char. For COPCs, significant differences were observed among years for aluminum, iron, mercury, and selenium (Table 7-11). Aluminum and iron concentrations decreased significantly from 2019 to 2020 by 149% and 35%, respectively, and aluminum concentrations decreased significantly from 2019 to 2021 by 125%. Concentrations of mercury and selenium increased with fish length (Figure 7-13). Selenium concentrations were significantly lower in 2020 when compared to 2019 (14%; Figure 7-13) but did not differ significantly among other years. No post hoc significant differences were found among years in mercury concentration (Table 7-11). No significant differences were observed among years for magnesium concentrations in Fourhorn Sculpin. A power analysis for COPCs indicated that target sample sizes of eight fish per sampling area would be sufficient to detect differences in effect sizes ranging from 18% for magnesium to 150% for aluminum.

Polycyclic aromatic hydrocarbons were below DL for all parameters analyzed in Fourhorn Sculpin (Appendix 7C, Table 7C-6).

Mercury concentrations for all Fourhorn Sculpin sampled from 2019 to 2021 were below Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015). Selenium concentrations for Fourhorn Sculpin were also below BC MOE fish tissue guidelines of 4 mg/kg dw (BC MOE 2014), with tissue concentrations in Fourhorn Sculpin from the Milne Port area ranging from 0.345 to 2.487 mg/kg dw from 2019 to 2021.

Tissue chemistry results were within FEIS predictions, which indicated the potential for non-significant, low magnitude effects on fish health and condition.

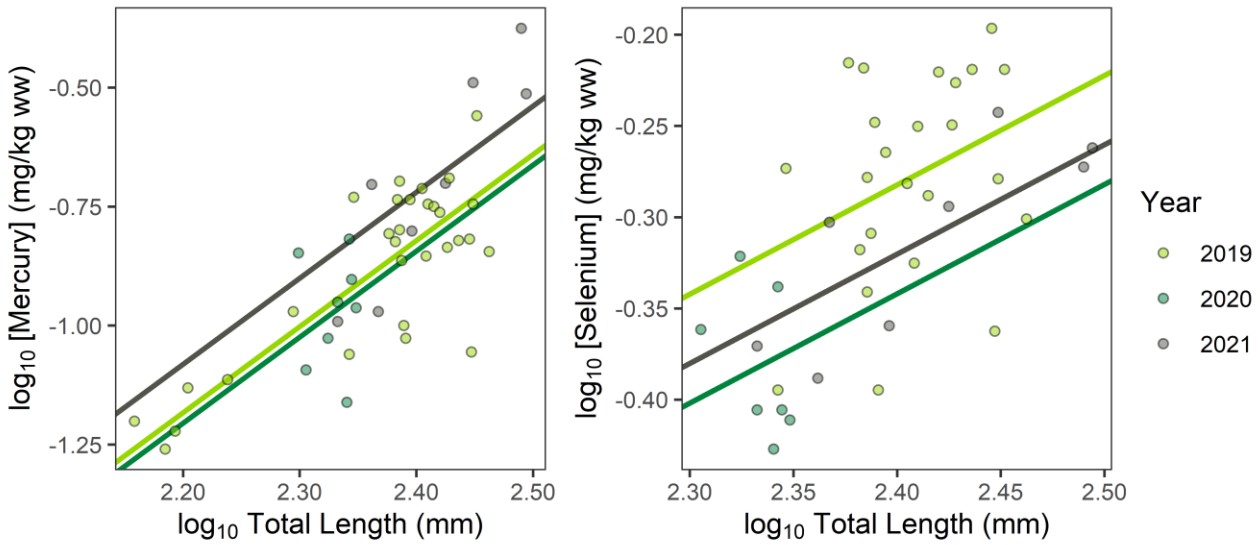


Figure 7-13: Concentrations of Mercury and Selenium in Relation to Total Length for Fourhorn Sculpin Sampled from the Milne Port Area, 2019 to 2021.

Table 7-13: Descriptive Statistics for Fourhorn Sculpin Tissue Chemistry Data Analyzed from 2019 to 2021

Parameter	2019 (*n* = 30)							2020 (*n* = 8)							2021 (*n* = 8)						
	>DL (%)	Min	Max	Median	Mean	SD	SE	>DL (%)	Min	Max	Median	Mean	SD	SE	>DL (%)	Min	Max	Median	Mean	SD	SE
Aluminum	100	0.75	11.40	1.92	2.85	2.41	0.44	88	<0.20	1.23	0.29	0.40	0.35	<0.20	100	0.28	1.25	0.53	0.56	0.31	0.11
Antimony	50	<0.0020	0.0030	<0.0020	<0.0020	<0.0020	<0.0020	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	88	<0.0010	0.0028	0.0013	0.0014	<0.0010	<0.0010
Arsenic	100	0.510	6.630	1.780	1.800	1.080	0.200	100	1.700	3.310	2.190	2.370	0.620	0.220	100	2.070	4.890	3.635	3.400	1.029	0.364
Barium	100	0.030	0.400	0.145	0.146	0.087	0.016	100	0.027	0.086	0.057	0.054	0.021	0.007	88	<0.010	0.060	0.031	0.031	0.021	<0.010
Beryllium	0	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	87	<0.0013	0.0052	0.0029	0.0027	<0.0013	<0.0013	63	<0.0010	0.0052	0.0014	0.0018	0.0016	<0.0010	88	<0.0010	0.0031	0.0019	0.0019	<0.0010	<0.0010
Boron	77	<0.20	0.60	0.24	0.23	<0.20	<0.20	0	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	25	<0.20	0.54	<0.20	<0.20	<0.20	<0.20
Cadmium	100	0.0055	0.1300	0.0246	0.0367	0.0338	0.0062	88	<0.0010	0.0088	0.0023	0.0028	0.0026	<0.0010	100	0.0041	0.0095	0.0055	0.0058	0.0017	0.0006
Calcium	100	472	4290	2245	2234	1205	220	100	612	907	708	757	114	40	100	188	1190	485	540	370	131
Chromium	70	<0.025	0.163	0.031	0.040	0.035	<0.025	100	0.023	0.496	0.158	0.202	0.170	0.060	88	<0.010	0.038	0.020	0.021	0.011	<0.010
Cobalt	100	0.0045	0.0239	0.0123	0.0122	0.0041	0.0007	100	0.0048	0.0080	0.0062	0.0061	0.0010	0.0004	100	0.0065	0.0119	0.0078	0.0083	0.0019	0.0007
Copper	100	0.278	1.030	0.557	0.590	0.207	0.038	100	0.315	1.010	0.427	0.496	0.227	0.080	100	0.445	0.708	0.467	0.509	0.089	0.031
Iron	100	3.56	24.40	8.97	9.91	4.63	0.84	100	3.74	10.20	6.31	6.59	2.05	0.73	100	5.37	9.16	6.66	6.93	1.36	0.48
Lead	100	0.0055	0.0544	0.0148	0.0185	0.0115	0.0021	100	0.0013	0.0047	0.0018	0.0022	0.0011	0.0004	100	0.0037	0.0134	0.0054	0.0063	0.0031	0.0011
Magnesium	100	189	414	273	281	45	8	100	263	304	295	290	14	5	100	236	308	284	277	28	10
Manganese	100	0.149	0.870	0.337	0.365	0.157	0.027	100	0.255	0.409	0.302	0.315	0.049	0.017	100	0.182	0.347	0.263	0.265	0.053	0.019
Mercury	100	0.0550	0.2760	0.1510	0.1430	0.0530	0.0100	100	0.0690	0.1520	0.1110	0.1100	0.0290	0.0100	100	0.1020	0.4210	0.1985	0.2270	0.1133	0.0401
Molybdenum	13	<0.0080	0.0124	<0.0080	<0.0080	<0.0080	<0.0080	63	<0.0040	0.0104	0.0053	0.0049	<0.0040	<0.0040	0	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0040
Nickel	100	0.014	0.054	0.030	0.031	0.010	0.002	75	<0.010	0.020	0.015	0.013	<0.010	<0.010	100	0.015	0.079	0.023	0.028	0.021	0.007
Phosphorus	100	1750	4280	2645	2784	698	127	100	2560	2930	2780	2741	130	46	100	2030	2690	2450	2408	215	76
Potassium	100	2210	3640	2900	2860	344	63	100	3860	4260	4055	4034	123	44	100	3420	3870	3680	3639	162	57
Selenium	100	0.344	0.636	0.525	0.510	0.080	0.015	100	0.374	0.477	0.412	0.419	0.037	0.013	100	0.409	0.572	0.503	0.491	0.061	0.021
Silver	10	<0.0013	0.0023	<0.0013	<0.0013	<0.0013	<0.0013	0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	13	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010
Sodium	100	885	1680	1280	1262	197	36	100	481	736	546	567	89	32	100	546	1010	748	755	157	56
Strontium	100	2.390	30.200	13.800	13.990	8.210	1.500	100	2.400	5.020	3.500	3.650	0.880	0.310	100	0.905	7.340	2.400	2.881	2.255	0.797
Thallium	97	<0.00040	0.00227	0.00087	0.00095	0.00043	<0.00040	100	0.00063	0.00143	0.00083	0.00090	0.00024	0.00009	100	0.00050	0.00104	0.00076	0.00075	0.00015	0.00005
Tin	63	<0.020	1.410	0.027	0.101	0.256	0.047	0	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	50	<0.020	0.190	0.025	0.042	0.061	0.021
Titanium	100	0.270	1.000	0.450	0.480	0.160	0.029	100	0.168	0.223	0.211	0.205	0.018	0.007	100	0.300	0.516	0.369	0.371	0.065	0.023
Uranium	100	0.00045	0.02010	0.00352	0.00446	0.00405	0.00074	75	<0.00040	0.00142	0.00072	0.00067	<0.00040	<0.00040	63	<0.00040	0.00141	0.00077	0.00067	0.00044	<0.00040
Vanadium	0	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	0.010	0.010	0.010	0.010	0.000	0.000	13	<0.020	0.056	<0.020	<0.020	<0.020	<0.020
Zinc	100	12.20	26.70	16.80	17.99	3.92	0.72	100	9.62	18.40	11.75	12.80	3.27	1.15	100	9.59	26.10	17.80	16.91	5.86	2.07

Notes: Fourhorn Sculpin were not collected in 2018.

mg/kg = milligram per kilogram wet weight; > = greater than; < = less than; DL = detection limit; n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error.

7.4.2.3 Hiatella arctica

A total of 120 *H. arctica* samples were analyzed for metals from the Milne Port area from 2018 to 2021, including 24 samples in 2018, 80 in 2019, eight in 2020, and eight in 2021. Summary statistics for *H. arctica* metals concentrations are provided in Table 7-14 and presented visually in Appendix 7D, Figures 7D-1 to 7D-36. Statistical comparisons for COPCs among years are provided in Table 7-11, and outliers removed from analysis are provided in Table 7-12.

Concentrations of metals in *H. arctica* tissue were generally similar among years with a few exceptions, such as chromium, nickel and tin which exhibited more variability. Greater concentrations of most metals were observed for *H. arctica* when compared to Arctic Char and Fourhorn Sculpin (Appendix 7D, Figures 7D-1 to 7D-36). Differences in species-specific bioaccumulation processes (e.g., filter feeder versus non-filter feeder) and tissue type (i.e., whole body versus muscle) likely contributed to the interspecies differences in tissue concentrations observed, with molluscs typically accumulating greater concentrations of some metals compared to fish (Bonsignore et al. 2018). For COPCs, significant differences were observed among years for aluminum, iron, magnesium, and selenium (Table 7-11). Concentrations of these metals were significantly greater in 2019, when compared to 2018. Differences were only observed between 2018 and 2020 for iron, which was significantly greater in 2020 when compared to 2018. Concentrations of aluminum and iron were also significantly greater in 2021 when compared with 2020 but did not differ significantly among other years. Selenium concentrations were also significantly lower in 2020 compared with 2019 but did not differ significantly among other years. A power analysis for COPCs indicated that target sample sizes of eight specimens per sampling area would be sufficient to detect differences in effect sizes ranging from 29% for selenium to 70% for iron.

Polycyclic aromatic hydrocarbons were below DL for all parameters analyzed in *H. arctica* (Appendix 7C, Table 7C-7).

Concentrations of mercury and selenium in *H. arctica* were compared with fish tissue guidelines. While these guidelines are not intended for bivalves, comparisons with guidelines can provide relevant context for tissue chemistry results. Mercury concentrations for all *H. arctica* sampled from 2018 to 2021 were below Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015). Selenium concentrations for *H. arctica* exceeded BC MOE fish tissue guidelines of 4 mg/kg dw (BC MOE 2014) in 94% of samples, with tissue concentrations in *H. arctica* from the Milne Port area ranging from 2.236 to 11.235 mg/kg dw from 2018 to 2021.

Tissue chemistry results were within FEIS predictions, which indicated the potential for non-significant, low magnitude effects on fish health and condition.

Table 7-14: Descriptive Statistics for *Hiatella arctica* Tissue Chemistry Data Analyzed from 2018 to 2021.

Parameter	2018 (*n* = 30)							2019 (*n* = 8)							2020 (*n* = 8)							2021 (n = 8)						
	>DL (%)	Min	Max	Median	Mean	SD	SE	>DL (%)	Min	Max	Median	Mean	SD	SE	>DL (%)	Min	Max	Median	Mean	SD	SE	>DL (%)	Min	Max	Median	Mean	SD	SE
Aluminum	100	166.00	920.00	521.00	516.00	196.00	40.00	100	109.00	2370.00	894.00	909.00	355.00	40.00	100	333.00	1750.00	685.50	757.00	444.00	157.00	100	390.00	1500.00	825.50	854.25	411.12	145.35
Antimony	100	0.0039	0.0094	0.0066	0.0064	0.0016	0.0003	100	0.0043	0.0424	0.0175	0.0180	0.0060	0.0007	100	0.0085	0.0354	0.0198	0.0189	0.0082	0.0029	100	0.0105	0.0323	0.0165	0.0184	0.0077	0.0027
Arsenic	100	1.420	4.120	2.410	2.440	0.680	0.140	100	1.560	6.310	2.780	2.930	1.030	0.120	100	2.400	3.360	2.560	2.680	0.330	0.120	100	2.190	6.240	3.085	3.620	1.485	0.525
Barium	100	2.120	20.500	7.870	9.200	5.230	1.070	100	3.320	32.700	8.540	10.710	6.330	0.710	100	5.310	20.100	8.820	10.680	4.970	1.760	100	5.200	13.900	9.220	9.844	3.126	1.105
Beryllium	100	0.0120	0.0531	0.0328	0.0330	0.0112	0.0023	100	0.0072	0.1460	0.0498	0.0509	0.0199	0.0022	100	0.0213	0.0966	0.0407	0.0442	0.0236	0.0083	100	0.0209	0.0808	0.0433	0.0449	0.0217	0.0077
Bismuth	100	0.0029	0.0119	0.0068	0.0069	0.0022	0.0004	100	0.0032	0.0248	0.0115	0.0117	0.0035	0.0004	100	0.0050	0.0236	0.0088	0.0099	0.0059	0.0021	100	0.0055	0.0167	0.0095	0.0099	0.0040	0.0014
Boron	100	3.28	8.95	6.05	5.96	1.44	0.29	100	3.06	16.70	8.45	8.86	2.67	0.30	100	4.36	13.20	6.63	6.97	2.76	0.98	100	4.75	11.80	7.47	7.74	2.84	1.00
Cadmium	100	0.2690	2.4900	0.5600	0.6840	0.4740	0.0970	100	0.1560	1.2700	0.4480	0.5020	0.2170	0.0240	100	0.4320	0.7550	0.6060	0.6170	0.1030	0.0360	100	0.5240	1.0000	0.8975	0.7920	0.1986	0.0702
Calcium	100	2010	11800	5065	5570	2544	519	100	1390	27000	6985	7905	4261	476	100	4020	10600	5445	6031	2293	811	100	4050	12300	6590	7591	3418	1208
Cesium	100	0.0270	0.1650	0.0906	0.0915	0.0355	0.0072	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	100	0.610	2.580	1.490	1.530	0.550	0.110	100	0.410	7.340	2.530	2.660	1.030	0.120	100	5.900	64.000	30.550	27.950	18.030	6.380	100	1.150	4.500	2.265	2.451	1.268	0.448
Cobalt	100	0.2210	1.7200	0.7080	0.7850	0.3910	0.0800	100	0.2910	3.9600	0.9970	1.2220	0.7470	0.0830	100	0.7570	2.4600	1.4450	1.4560	0.5360	0.1900	100	0.5670	3.2500	1.1630	1.3550	0.8967	0.3170
Copper	100	1.480	3.290	2.020	2.110	0.400	0.080	100	1.420	4.490	2.230	2.320	0.550	0.060	100	1.760	4.020	2.810	2.890	0.820	0.290	100	1.610	3.910	2.350	2.523	0.788	0.279
Iron	100	511.00	2310.00	1280.00	1330.00	512.00	104.00	100	374.00	7000.00	2210.00	2338.00	1034.00	116.00	100	904.00	3910.00	1985.00	2101.00	961.00	340.00	100	969.00	5170.00	2030.00	2499.88	1421.39	502.54
Lead	100	0.2030	1.8400	0.6920	0.7390	0.3490	0.0710	100	0.1500	3.4200	1.2200	1.2640	0.4920	0.0550	100	0.4290	4.3300	0.9930	1.3610	1.2700	0.4490	100	0.5570	2.0600	1.1885	1.2105	0.5726	0.2024
Lithium	100	0.71	3.88	2.27	2.25	0.83	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium	100	1190	5500	2565	2640	1073	219	100	1190	11600	3870	4126	1625	182	100	2370	5030	2980	3198	951	336	100	2010	5720	3380	3574	1489	526
Manganese	100	4.800	327.000	71.300	89.600	74.800	15.300	100	14.300	634.000	87.800	136.900	136.100	15.200	100	73.900	271.000	141.500	155.600	72.300	25.500	100	54.900	611.000	163.000	193.588	178.284	63.033
Mercury	100	0.0110	0.0697	0.0227	0.0272	0.0145	0.0030	100	0.0150	0.0780	0.0300	0.0329	0.0138	0.0015	100	0.0220	0.0470	0.0305	0.0321	0.0087	0.0031	100	0.0230	0.0360	0.0305	0.0305	0.0039	0.0014
Molybdenum	100	0.1340	0.5180	0.2580	0.2630	0.1040	0.0210	100	0.1340	1.2700	0.2930	0.3720	0.1910	0.0210	100	0.2820	1.3000	0.7190	0.7080	0.3060	0.1080	100	0.2160	0.6810	0.3100	0.3575	0.1588	0.0561
Nickel	100	0.790	2.720	1.450	1.540	0.500	0.100	100	0.740	4.260	2.040	2.130	0.650	0.070	100	3.460	29.900	14.350	13.350	8.170	2.890	100	1.150	2.930	1.885	2.035	0.809	0.286
Phosphorus	100	726	2020	1190	1195	257	53	100	705	3160	1225	1395	546	61	100	1020	1570	1270	1289	205	72	100	1100	1700	1460	1453	198	70
Potassium	100	799	2120	1415	1432	268	55	100	871	1950	1200	1247	240	27	100	1260	1700	1445	1450	126	45	100	1250	2090	1580	1628	250	88
Rubidium	100	0.95	3.18	2.01	1.97	0.57	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium	100	0.650	1.430	1.210	1.170	0.170	0.030	100	0.740	2.010	1.400	1.390	0.270	0.030	100	1.050	1.560	1.240	1.260	0.170	0.060	100	1.200	1.680	1.370	1.396	0.156	0.055
Silver	-	-	-	-	-	-	-	100	0.0019	0.0219	0.0049	0.0058	0.0036	0.0004	100	0.0035	0.0083	0.0047	0.0048	0.0016	0.0006	100	0.0039	0.0413	0.0075	0.0113	0.0123	0.0044
Sodium	100	1890	6480	3955	4110	1246	254	100	1680	5660	4205	4159	869	97	100	3250	4490	3785	3771	456	161	100	2790	3860	3345	3328	410	145
Strontium	100	9.230	46.200	19.750	21.540	9.230	1.880	100	7.440	89.900	15.950	19.940	13.360	1.490	100	10.300	30.200	14.850	16.190	6.230	2.200	100	11.000	44.700	24.700	26.425	11.506	4.068
Tellurium	25	<0.0040	0.0052	<0.0040	<0.0040	<0.0040	<0.0040	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	100	0.00470	0.03770	0.01290	0.01360	0.00750	0.00150	100	0.00370	0.06360	0.02100	0.02280	0.01070	0.00120	100	0.01070	0.04220	0.01900	0.01980	0.01010	0.00360	100	0.01020	0.05470	0.01975	0.02444	0.01589	0.00562
Tin	83	<0.020	0.352	0.033	0.046	0.067	<0.020	100	0.010	0.529	0.060	0.071	0.059	0.007	100	0.086	0.360	0.160	0.184	0.086	0.030	100	0.053	0.123	0.074	0.079	0.026	0.009
Titanium	-	-	-	-	-	-	-	100	4.600	109.000	33.700	34.400	14.800	1.600	100	13.800	63.200	25.200	27.600	15.700	5.500	100	13.700	67.800	30.250	33.138	18.872	6.672
Uranium	100	0.08200	0.18500	0.12000	0.12500	0.03000	0.00600	100	0.09000	0.43500	0.19700	0.20300	0.07200	0.00800	100	0.08700	0.27700	0.14200	0.15300	0.05600	0.02000	100	0.10700	0.28100	0.15250	0.18000	0.06800	0.02404
Vanadium	100	0.800	3.960	2.420	2.410	0.900	0.180	100	0.830	7.540	3.760	3.910	1.320	0.150	100	1.880	6.940	3.380	3.430	1.570	0.550	100	1.760	5.420	3.345	3.549	1.548	0.547
Zinc	100	7.06	14.40	11.55	11.26	1.83	0.37	100	8.61	20.90	13.65	13.65	2.30	0.56	100	11.50	17.90	12.70	13.30	2.07	0.73	100	11.60	17.30	13.85	13.81	1.86	0.66
Zirconium	100	0.222	1.190	0.707	0.718	0.271	0.055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

mg/kg = milligram per kilogram wet weight; > = greater than; DL = detection limit; n = sample size; min = minimum; max = maximum; SD = Standard deviation; SE = standard error.

7.5 Discussion

Detailed fish health data were collected for Fourhorn Sculpin and *H. arctica* in 2020 and 2021 align the MEEMP with future monitoring programs with the MDMER EEM program. Based on internal and external examinations, Fourhorn Sculpin from the Milne Port area appeared to be healthy at the time of sampling with few abnormalities observed. Comparisons of fish health endpoints for Fourhorn Sculpin between 2020 and 2021 indicated that Fourhorn Sculpin were significantly larger in 2021 than in 2020, relative to their age. Additionally, female Fourhorn Sculpin had greater relative gonad size at the upper range of weights collected, while males had significantly lower relative liver size at the upper range of weights collected. Sample timing appeared to be appropriate for future assessments of reproductive endpoints for Fourhorn Sculpin, with all individuals assessed observed to be in the late stages of gonadal recrudescence.

Comparisons of health endpoints for *H. arctica* between 2020 and 2021 indicated that condition, as total weight relative to total length, was significantly lower in 2021 compared to 2020, differing by 9%. This indicates that *H. arctica* collected in 2021 had lower mass at length compared with those specimens collected in 2020, although the difference between years was comparatively small. Given the data currently available for *H. arctica* in Milne Inlet, it is unknown whether this difference represents typical variability within the species or indicates potential effects of localized stressors. Sample timing of *H. arctica* appears to be appropriate for assessing reproductive endpoints, as gonads were retrieved from collected samples in 2021. Timing of spawning for *H. arctica* may be associated with phytoplankton biomass and varies with geographical location (Brandner et al. 2017). Gonad development for this species may also be asynchronous, with multiple overlapping spawning events occurring throughout the year, potentially leading to a high degree of variability in gonad size regardless of sample timing. While MSI data from 2021 do not exhibit high variability, this is the only year from which these data are available. Additional data collected in future years will improve understanding of the variability in gonadal development and condition for *H. arctica*, thus improving the ability to draw conclusions regarding the optimal sampling time for *H. arctica*.

A total of 24 samples were submitted for tissue chemistry analysis of metals and PAHs in 2021, which included eight samples each for Arctic Char, Fourhorn Sculpin and *H. arctica*. Tissue concentrations of PAHs were below DL for all species analyzed in 2021, while metal concentrations were generally above DLs and more variable among species and years. Generally, concentrations of most COPCs were significantly different among years but with relatively small magnitudes of differences. Measured concentrations in 2021 remained within the range of historical variability for all species.

- Arctic Char: Significant differences were observed for aluminum, magnesium, and selenium. Aluminum concentrations have decreased from 2018 to 2021 by 27% while magnesium and selenium have increased by 10% and 24%, respectively. No differences were observed for iron or mercury.
- Fourhorn Sculpin: Significant differences were observed for aluminum, iron, mercury, and selenium. Aluminum concentrations in Fourhorn Sculpin decreased significantly from 2019 to 2021, while iron and selenium concentrations decreased significantly from 2019 to 2020 but did not differ between 2020 and 2021. Mercury concentrations did not differ significantly between years.
- *H. arctica*: Significant increases observed for aluminum, iron, magnesium, and selenium between 2018 and 2021. The RPDs for these metals were small, ranging from relative increases of 10% to 57%.

For all species, to confirm that differences in concentrations of metals between years were real and less likely to be attributed to low concentrations of target contaminants, analytical variability, or spatial and temporal variation, an effect size of 100% was used to differentiate stochastic differences from those of potential biological importance (Environment Canada 2012). Given this effect size, significant differences in concentrations of COPCs for Arctic Char, Fourhorn Sculpin and *H. arctica* between 2018 and 2021 appear to reflect natural variability and were not considered to be Project-related.

Tissue metals concentrations in *H. arctica* were consistently greater than those measured in Arctic Char and Fourhorn Sculpin, occasionally by orders of magnitude. This likely reflects species-specific differences in bioaccumulation processes and the tissue types analyzed (i.e., whole body versus muscle). *Hiatella arctica* is a long-lived, sedentary, filter feeding mollusc closely associated with the sediment. These life-history characteristics increase the potential of *H. arctica* for exposure and accumulation of metals, from both natural and anthropogenic sources, relative to fish; molluscs tend to accumulate some metals to greater degree compared to fish (Bonsignore et al. 2018).

All tissue samples for Arctic Char, Fourhorn Sculpin and *H. arctica* collected from 2018 to 2021 were below Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada 2015). All tissue samples for Arctic Char and Fourhorn Sculpin were also below BC MOE fish tissue guidelines of 4 mg/kg dw for selenium (BC MOE 2014). *Hiatella arctica* tissues were also compared with fish tissue guidelines to provide additional context, despite these guidelines not being intended for use with bivalve tissues. Nearly all (94%) of *H. arctica* tissue samples exceeded the BC MOE fish tissue selenium guideline.

Tissue chemistry results were within FEIS predictions, which indicated the potential for non-significant, low magnitude effects on marine fish health and condition.

7.6 Conclusions and Recommendations

The MEEMP has been designed to meet the objectives of the various conditions associated with PC 005 (Chapter 1.0, Table 1-2), as well as to provide results to help evaluate whether the marine environment has changed or will change over time. Original FEIS predictions indicated the potential for low magnitude changes in some ecological parameters, such as water quality and Arctic Char tissue chemistry, but characterised these changes as not significant. Monitoring data align with these predictions overall, as observed changes have been small and within established guidelines or consistent with baseline levels. Monitoring to date suggests that Project mitigation is functioning as intended and that Project activities are being managed in a way that has not adversely affected the marine ecosystem. Moving forward, continued monitoring of proposed MEEMP components is recommended to maintain continuity in established time series data for Arctic Char, and the collection of additional fish health and tissue chemistry for Fourhorn Sculpin and *H. arctica,* to provide a benchmark for comparisons in the future.

7.7 Closure

We trust this information is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact Rainie Sharpe, on behalf of the undersigned, at 587-879-8424.

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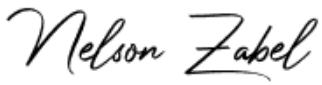

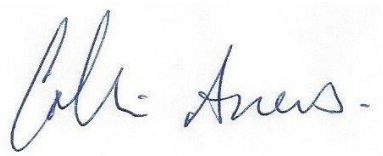

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7.8 References

Barrett T, Tingley M, Munkittrick K, Lowell R. 2010. Dealing with heterogeneous regression slopes in analysis of covariance: new methodology applied to environmental effects monitoring fish survey data. Environmental Monitoring and Assessment 166: 279-291.

Bonsignore M, Manta DS, Mirto S, Quinci EM, Ape F, Montalto V, Gristina M, Traina Anna, Sprovieri M. 2018. Bioaccumulation of heavy metals in fish, crustaceans, molluscs and echinoderms from the Tuscany coast. Ecotoxicology and Environmental Safety 162: 554-562.

Brandner MM, Stubner E, Reed AJ, Gabrielsen TM, Thatje S. 2017. Seasonality of bivalve larvae within a high Arctic fjord. Polar Biology 40: 263-276.

Brey, T. 2001. Population dynamics in benthic invertebrates. A virtual handbook. Version 01.2. http://www.thomas-brey.de/science/virtualhandbook.

British Columbia Ministry of Environment (BC MOE). 2014. Companion Document to: Ambient Water Quality Guidelines for Selenium Update. Water Protection and Sustainability Branch Environmental Sustainability and Strategic Policy Division British Columbia Ministry of Environment. 28pp.

Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. National EEM Office, Ottawa, ON, Canada.

Faul F, Erdfelder E, Lang A-G, Buchner A. 2007. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods 39: 175-191.

Golder (Golder Associates Ltd.). 2018. Mary River Project 2017 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. Golder Doc. No. 1663724-048R-Rev1; 9 April 2018. 504 p. https://www.baffinland.com/_resources/document_portal/1663724-048-r-rev0-meemp-2017-report-20feb18-2018-16-05-01-2018-09-07-11.pdf

Golder. 2020b. 2020 Milne Ore Dock Fish Offset Monitoring Report – *Fisheries Act* Authorization 14-HCAA-00525. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. Golder Doc. No. 1663724-250-R-Rev0; 21 December 2020. 71 p.

Golder. 2020a. Mary River Project. 2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program. Prepared for Baffinland Iron Mines Corporation, Oakville ON.

Government of Canada. 2002. Metal and Diamond Mining Effluent Regulations (current to 17 May 2020 and last amended on 25 June 2019). SOR/2002-222. Available at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/. Accessed: 8 June 2020.

Health Canada. 2015. Health Canada's Maximum Levels for Chemical Contaminants in Foods. Available at https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/chemical-contaminants/maximum-levels-chemical-contaminants-foods.html. Retrieved 12 February 2021.

Martyniuk, MAC, Couture, P, Tran, L, Beaupré, L, Urien, N, Power, M. 2020. A seasonal comparison of trace metal concentrations in the tissues of Arctic charr (*Salvelinus alpinus*) in Northern Québec, Canada. Ecotoxicology 29(9): 1327-1346. DOI: 10.1007/s10646-020-02248-7.

R Core Team. 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Riget F, Aastrup GAP. 2000. Mercury in Arctic char (*Salvelinus alpinus*) populations from Greenland. Science of the Total Environment 245: 161-172.

Rikardsen, AH, Amundsen, PA, Bodin, PJ. 2003. Growth and diet of anadromous Arctic charr after their return to freshwater. Ecology of Freshwater Fish 12(1): 74-80. DOI: 10.1034/j.1600-0633.2003.00001.x

Rikardsen, AH, Amundsen, PA, Bodin, PJ. 2005. Foraging behaviour changes of Arctic charr during smolt migration in northern Norway. Journal of Fish Biology 60(2): 489-491. DOI: 10.111/j.1095-8649.2002.tb00297.x

Weerarathne LA, Monk J, Barrett N. 2021. Sample-size requirements for accurate length-frequency distributions of mesophotic reef fishes from baited remote underwater stereo video. Ecological Indicators 122: 107262.

Wood CM, Farrell A P, Brauner CJ. 2012. Homeostasis and Toxicology of Essential Metals (Vol. 31A). New York: Elsevier.

APPENDIX 7A

Reference Area Reconnaissance Memo

TECHNICAL MEMORANDUM

DATE 21 October 2022 **Reference No.** 1663724-44000

TO Megan Lord-Hoyle, Vice-President, Sustainable Development
Baffinland Iron Mines Corp.

CC

FROM Rainie Sharpe **EMAIL rainie.sharpe@wsp.com**

PHASE 2 FISH HEALTH PROGRAM – 2021 REFERENCE AREA RECONNAISSANCE

1.0 INTRODUCTION

One of the monitoring objectives for the 2021 MEEMP included a reconnaissance survey to support selection of an appropriate reference area for the fish sampling program in the case it is determined a fishing reference would be beneficial in future years. To meet this objective, fish sampling as well as supporting water and sediment quality sampling was conducted in the area surrounding the Tugaat River Estuary, to evaluate whether this candidate area is suitable for use as a reference area for Milne Port. This stand-alone sampling program was completed concurrently with the 2021 MEEMP field program but does not represent an addition to the MEEMP study design at this time. Results are summarized in the sections below.

2.0 WATER QUALITY

Exploratory water quality sampling was completed on 15 August 2021 alongside the 2021 MEEMP field program. Field water quality measurements and water samples were collected at two locations: south of the mouth of the Tugaat River at TR-Ref1-21 and north of the mouth of the Tugaat River at TR-Ref2-21 (Figure 7A-1).

Sampling methods, quality assurance/quality control (QA/QC) measures, and results are summarized in the sections below.

2.1 Sampling Methods

A depth sounder was used to measure depth at each reference location prior to sampling. Field water quality measurements (i.e., pH, dissolved oxygen, salinity, conductivity, temperature, and turbidity) were taken just below the surface, mid-depth, and 1 metre from the bottom using a calibrated water quality meter. Water samples were collected just below the surface from a zodiac boat using a 2.0 L vertically oriented Kemmerer bottle sampler. The sampler was washed with laboratory-grade detergent and then rinsed with site-water prior to sample collection at each station, samples were preserved in the field according to laboratory instructions and samples for dissolved analyses were filtered in the field using 0.45 µm filters. All samples were kept refrigerated until they were shipped on ice in coolers to ALS Canada Ltd. (ALS), a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited analytical laboratory. Water samples were submitted for analysis of conventional parameters, major ions, nutrients, total and dissolved organic carbon, and total and dissolved metals. Samples were shipped within 48 hours of sample collection.

2.2 Data Analysis

Water quality data collected at TR-Ref1-21 and TR-Ref2-21 were screened against the applicable Canadian Council of Ministers of the Environment (CCME) water quality guidelines for the protection of marine aquatic life (AW-M) (CCME 1999, CCME 2002). A comparison was also made to water quality data collected at Milne Port in 2021.

2.3 Quality Assurance/Quality Control

Laboratory QA/QC reports were reviewed upon receipt to confirm adherence to sample hold times and laboratory data quality objectives (DQOs), and that the appropriate QA/QC information had been reported. Laboratory QA/QC included verification of recommended sample holding times and the analysis of laboratory control samples, laboratory duplicates, and spiked samples to assess precision and accuracy of analytical methods.

A duplicate water sample was collected from the Tugaat River Estuary (TR-Ref1-21) to assess potential variability introduced during sample collection and sample handling. The analysis of field QC samples involved review of field duplicates. Notable results were defined as those greater than five times the respective DL detected in the field blanks, in accordance with the BC Field Sampling Manual (BC MWLAP 2003). To assess variability between field duplicates, the Relative Percent Difference (RPD) was calculated as follows:

$$RPD = \left(\frac{sample - duplicate}{(sample + duplicate)/2}\right) \times 100$$

An RPD value of >20% was used to identify notable differences between original and duplicate samples. Values less than five times the DL were not included in the RPD calculations because analytical variability near the MDL is higher and does not provide a good measure of variability associated with the collection of field samples.

2.3.1 QA/QC Results

The 2021 water quality data for the exploratory reference sites samples were considered valid and of acceptable quality to address the reconnaissance study objective, according to the following rationale:

- Chemical analysis of water quality samples was completed within sample hold time requirements. The only exception was anions and nutrients (5 days vs. 3 days) which is commonplace for remote sampling locations. The assessment relied on field pH measurements.
- Data reported by the laboratory were considered reliable according to the accredited laboratory QA/QC assessment.
- There was low variability and high precision between duplicate samples (Table 7A-1).

2.4 Results and Discussion

Parameter concentrations measured in water quality samples collected near the Tugaat River Estuary were below CCME AW-F guidelines and within the concentration ranges documented for Milne Port in 2021 (see Table 1 in Appendix 2E). Similarly, dissolved oxygen, salinity, and temperature measurements at all depths at the Tugaat River Estuary stations were within ranges measured at MP05 and MP06 in Milne Port in 2021. Water quality near the Tugaat River Estuary can therefore be considered comparable to Milne Port water quality based on this evaluation of data collected during the 2021 open-water season.

LEGEND

- 2021 ANGLING (JIGGING) SAMPLING LOCATION
- 2021 WATER QUALITY AND SEDIMENT QUALITY STATION
- 2021 ANGLING (TROLLING) SAMPLING LOCATION
- 2021 GILLNET SAMPLING LOCATION
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- WATERCOURSE
- WATERBODY

0 250 500
1:7,500 METRES

REFERENCE(S)

BATHYMETRY CREATED BY GOLDER FROM MULTIPLE DATA SOURCES. HYDROGRAPHY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. IMAGERY COPYRIGHT © 20190802 ESRI AND ITS LICENSORS. SOURCE: MAXAR VIVID. USED UNDER LICENSE, ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-02
DESIGNED	CA
PREPARED	AJA
REVIEWED	
APPROVED	

TITLE
EXPLORATORY SAMPLING LOCATIONS AT TUGAAT RIVER; MEEMP 2021

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	44000-04	0	7A-1

3.0 SEDIMENT QUALITY

Exploratory sediment quality sampling was completed on 15 August 2021 alongside the 2021 MEEMP field program. Sediment samples were collected at two locations: south of the mouth of the Tugaat River at TR-Ref1-21 and north of the mouth of the Tugaat River at TR-Ref2-21 (Figure 7A-1).

Sampling methods, QA/QC measures, and sediment quality results are summarized in the sections below.

3.1 Sampling Methods

Bottom sediment samples were collected using a Van Veen (0.1 m^2) grab sampler. At each sampling location, grab samples were collected to obtain a sufficient volume of surficial sediment for the laboratory analysis. Each grab sample was examined for acceptability based on the following criteria:

- The sampler was fully closed.
- There was adequate penetration depth (i.e., sediment volume greater than 25% full).
- The sample did not appear overfilled or disturbed, and the sample did not appear to have been collected on an angle.
- The sampler did not appear to be leaking sediment at a substantial rate (i.e., the top of the sediment profile did not appear to be sloping inwards).

Upon acceptance, the top 5 cm of sediment from each acceptable grab sample was removed from the center of the grab using a stainless-steel spoon and transferred to a stainless-steel bowl. Sediment samples from composite grabs were homogenized and aliquots of homogenized sediments from each station were transferred to clean, laboratory supplied containers. All samples were kept refrigerated until they were shipped on ice in coolers to ALS for analysis of particle size, moisture, total organic carbon [TOC]), total metals, volatile organic compounds (VOCs), hydrocarbons (F1-F4), and total polycyclic aromatic hydrocarbons (PAHs).

3.2 Data Analysis

Sediment quality data collected at TR-Ref1-21 and TR-Ref2-21 in the Tugaat River Estuary were screened against applicable CCME sediment quality guidelines (SQG) for the protection of marine aquatic life (CCME 1999, CCME 2002). Specifically, data were screened against Probable Effect Levels (PELs) and Interim Sediment Quality Guidelines (ISQGs). PELS were intended to represent concentrations above which adverse effects were predicted to occur frequently, based on a concurrence dataset with effects and concentrations from other sites. By comparison, the ISQG was intended to represent a concentration above which adverse biological effects may or may not occur (CCME 2002). Sediment samples from the Tugaat River Estuary were also qualitatively compared against sediment samples from similar depths (15 to 20 m) for the 2020 MEEMP sampling program.

3.3 Quality Assurance/Quality Control

Laboratory QA/QC reports were reviewed upon receipt to confirm adherence to sample hold times and laboratory DQOs, and that the appropriate QA/QC information had been reported. A duplicate sediment sample was collected from the Tugaat River Estuary (TR-Ref2-21) to assess potential variability introduced during sample collection and sample handling. To assess variability between field duplicates, the RPD was calculated as follows:

$$RPD = \left(\frac{sample - duplicate}{(sample + duplicate)/2}\right) \times 100$$

An RPD value of >35% was used to identify notable differences between original and duplicate samples. Values less than five times the DL were not included in the RPD calculations because analytical variability near the MDL is higher and does not provide a good measure of variability associated with the collection of field samples.

3.3.1 QA/QC Results

The 2021 sediment quality data for the exploratory reference sites samples were considered valid and of acceptable quality to address the objectives stated in Section 1.0, based on the following:

- Chemical analyses on sediment samples were completed within the sample hold time requirements.
- Data reported by the laboratory were considered reliable according to the accredited laboratory QA/QC assessment[1].
- Several metals had RPD DQO exceedances which were likely the result of sample heterogeneity, but all results were below applicable guidelines (Table 7A-2).

3.4 Results and Discussion

Tugaat River Estuary sediments were primarily composed of sand with some silt and low TOC, which was generally consistent with sediment samples most recently collected from the Milne Port area (Figure 3-3, Golder 2021a). Parameter concentrations measured in Tugaat River Estuary sediments were below the CCME PEL and ISQG with one exception (i.e., ISQG exceedance for copper at TR Ref 1). Exceedance of generic CCME ISQGs for sediment metals in Northern Canada is not uncommon under naturally occurring background conditions. Organic parameters (i.e., VOCs and PAHs) were not detected in the Tugaat River Estuary sediment samples.

There were a number of metals[2] in one or both 2021 Tugaat River Estuary samples (Table 7A-2) that had concentrations higher than maximum concentrations documented at Milne Port in 2020 (Appendix D, Golder 2021a). Iron was higher at TR Ref 1 (28,000 mg/kg) compared to the maximum (~16,400 mg/kg) reported from Milne Port in 2020 for samples collected at a similar depth (Appendix D, Golder 2021a). The iron concentration at TR Ref 2 (13,000 mg/kg) was, however, within the range documented at Milne Port in 2020. There appeared to be some variability in sediment metal concentrations within candidate reference area but, overall, the sediment quality at the Tugaat estuary is comparable to Milne Port and reflects the natural minerology of the area.

[1] Laboratory qualifiers did exist but were regarding laboratory duplicates not associated with the Tugaat River Estuary samples and several surrogate recoveries were outside of the laboratory data quality objectives but results were deemed to be unaffected by the accredited laboratory.
[2] Metals include aluminum, antimony, barium, chromium, cobalt, copper, iron, manganese, nickel, phosphorus, titanium, tungsten, uranium, vanadium, zinc and zirconium.

4.0 FISH HEALTH

Fishing was completed on 15 August 2021 in the area surrounding the Tugaat River Estuary (17W 522269m E 7996536m N; Figure 7A-1) in order to identify potential reference areas, should they be required or determined useful in the future. Target species for collection were Fourhorn Sculpin (*Myoxocephalus quadricornis*) and wrinkled rock-borer (*Hiatella arctica)*, a bivalve. This work was completed concurrently with the 2021 MEEMP field program. Methods, quality assurance/quality control measures and results are summarized in the sections below.

4.1 Sampling Methods

Fishing effort included both active (i.e., angling) and passive (i.e., gill netting) capture methods. Captured fish were enumerated and measured for length and weight. Fourhorn Sculpin were retained for fish health sampling. All other fish were released alive back into the Tugaat River Estuary. Fish processing methodology is described in Section 7.3.2 in Chapter 7.0 – Fish Health and Tissue Chemistry. Due to equipment malfunction in the field, no weights were recorded from fish collected from the Tugaat River Estuary. Tissue chemistry samples for Fourhorn Sculpin captured and processed from the Tugaat River Estuary were collected and archived for potential future analysis. No tissue samples were processed for metals concentrations in 2021.

The *H. arctica* specimens were collected from benthic infauna samples collected from Tugaat River Estuary. Collection methods for benthic infauna included a standard Van Veen sampler, as described in Section 4.3.1 of Chapter 4.0—Benthic Infauna. Each benthic sample was checked for the presence of *H. arctica.* Specimens were selected for processing if the shell was greater than 1.5 cm in length, was intact, and had no indications of damage to the umbo or hinge area. Processing methodology for *H. arctica* is described in Section 7.3.2 of Chapter 7.0.

4.2 Data Analysis

Fish health data analysis was completed following the methods described in Section 7.3.4 of Chapter 7.0 – Fish Health and Tissue Chemistry. Briefly, descriptive statistics (i.e., sample size, mean, median, standard deviation [SD], standard error [SE], minimum, and maximum values) were calculated for Fourhorn Sculpin and *H. arctica* biometrics (e.g., length, weight) as well as fish health endpoints for *H. arctica*. These indices included condition factor, shell condition factor, and gonadosomatic index for *H. arctica.* Note that no fish health endpoints for Fourhorn Sculpin were calculated due to missing weight data. Formulas for these indices are provided in Section 7.3.4 of Chapter 7.0.

4.3 Quality Assurance/Quality Control

The same field practices and operations used for the 2021 MEEMP field program were implemented for the fishing effort at the Tugaat River Estuary, detailed in Section 7.3.6 of Chapter 7.0. Field and laboratory QA/QC procedures were implemented at each stage of the fish survey, including sampling, data entry, sample shipment, data analyses, laboratory analyses, and report preparation, to produce technically sound and scientifically defensible results.

4.4 Results

4.4.1 Fish Capture Data

A total of 68 fish were captured and processed from the Tugaat River Estuary area, including 63 Arctic Char (*Salvelinus alpinus*), 3 Arctic Sculpin (*Myoxocephalus scorpioides*), and 2 Fourhorn Sculpin. In the Tugaat River Estuary, gill netting was the most successful method for capturing Fourhorn Sculpin, but CPUE was notably lower than in Milne Port (Table 7A-3). Angling was unsuccessful at capturing Fourhorn Sculpin at the Tugaat River Estuary.

Table 7A-3: Total Catch Per Unit Effort for Fish Captured from the Tugaat River Estuary Reference Area Reconnaissance Survey, 2021.

Site	Angling				Gill Nets			
	Effort (h/rod)	Species	# of Fish Captured	CPUE (# fish/h/rod)	Effort (h)	Species	# of Fish Captured	CPUE (# fish/h)
Tugaat River Estuary	3.07	ARCH	1	0.33	5.75	ARCH	62	10.78
		ARSC	3	0.98		ARSC	0	0.00
		FHSC	0	0.00		FHSC	2	0.35
Milne Port[(a)]	44.73	FHSC	150	3.35	60.85	FHSC	127	2.10

ARCH = Arctic Char; ARSC = Arctic Sculpin; FHSC = Fourhorn Sculpin; h = hour.

(a) Fish capture data for Milne Port shown for comparison. CPUE calculated as an index of total abundance.

4.4.1.1 Fourhorn Sculpin

Only two Fourhorn Sculpin were captured in the Tugaat River Estuary; both were processed for fish health endpoints and were identified as female (Table 7A-4). The two fish were below the mean total length of female Fourhorn Sculpin but within the range of total lengths from Milne Port. Similarly, with respect to age, the two fish were younger than the mean age of female Fourhorn Sculpin but within the range of ages reported from Milne Port.

4.4.1.2 Hiatella arctica

A total of six *H. arctica* were collected from the Tugaat River Estuary. Summary statistics are provided in Table 7A-5. The *H. arctica* collected in the Tugaat River Estuary were similar to those collected in Milne Port (Chapter 7.0 Table 7-7); all means for health endpoints were within one standard deviation of the mean of Milne Port health endpoints. All collected measurements and health endpoints determined for *H. arctica* from the Tugaat River Estuary were within the range of those determined for Milne Port.

Table 7A-4: Descriptive Statistics for Fourhorn Sculpin Fish Health Endpoints Processed from the Tugaat River Estuary and Milne Port, 2021.

Parameter	Reference Area							Milne Port						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Female														
Total Length (mm)	2	224	234	229	229	7.1	5.0	20	205	344	249	255	40.3	9.0
Age (y)	2	4	6	5	5.0	1.4	1.0	20	3	10	6	6.2	2.0	0.5
Male														
Total Length (mm)	0	-	-	-	-	-	-	20	209	281	229	237	24.4	5.5
Age (y)	0	-	-	-	-	-	-	20	3	12	6	6.6	2.1	0.5

n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error; mm = millimeters; y = years - = not applicable.

Table 7A-5: Descriptive Statistics for *Hiatella arctica* Fish Health Endpoints Processed from the Tugaat River Estuary and Milne Port, 2021.

Parameter	Tugaat River Estuary							Milne Port						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Shell Length (mm)	6	20.4	33.84	23.81	25.87	6.16	2.51	35	17.47	35.07	30.45	29.331429	4.25	0.72
Total Weight (g)	6	1.0499	5.6753	1.6434	2.7262	2.0521	0.8378	35	0.4805	8.1284	3.9825	4.0210	1.7575	0.2971
Shell ww (g)	6	0.3396	3.6655	0.6310	1.5594	1.5921	0.6500	35	0.2187	5.1394	2.0614	2.2152	1.1666	0.1972
Shell dw (g)	6	0.2600	3.3998	0.4867	1.3273	1.4421	0.5887	35	0.1145	4.7250	1.7991	1.9047	1.0324	0.1745
Tissue ww (g)	6	0.5619	2.0938	0.9937	1.1051	0.5464	0.2231	35	0.2351	2.8741	1.9059	1.7853	0.7031	0.1188
Tissue dw (g)	6	0.2073	0.7726	0.3667	0.4078	0.2016	0.0823	35	0.0868	1.0605	0.7033	0.6588	0.2595	0.0439
Condition factor	6	1.07	1.57	1.40	1.36	0.18	0.07	35	0.90	2.25	1.41	1.48	0.30	0.05
Gonad ww (g)	6	0.0046	0.0635	0.0119	0.0249	0.0256	0.0104	35	0.0023	0.0798	0.0360	0.0365	0.0181	0.0031
MSI	6	0.83	4.19	1.29	1.93	1.42	0.58	35	0.90	6.13	1.97	2.23	1.20	0.20
Age (y)	6	3	33	6	12.8	13.2	5.4	35	1	39	17	19.2	8.1	1.4

n = sample size; min = minimum; max = maximum; SD = standard deviation; SD = standard error; mm = millimeters; g = grams; ww = wet weight; dw = dry weight; MSI = Mantle somatic index; y = years.

4.5 Discussion

The Tugaat River Estuary does not appear to support an adequately large population of Fourhorn Sculpin to support target sample sizes for the MEEMP fish health program. Fourhorn Sculpin CPUE in the Tugaat River Estuary was notably lower than in Milne Port (Table 7A-3): angling in the Tugaat River Estuary was unsuccessful (CPUE: 0 fish/h/rod) while angling successfully captured Fourhorn Sculpin in Milne Port (CPUE: 76 fish/h/rod). Gillnetting in the Tugaat River Estuary was also less successful in capturing Fourhorn Sculpin than in Milne Port (CPUE: 0.04 and 16.04 fish/100m/h, respectively).

During the reconnaissance survey, it was observed that fish habitat also differed between Milne Port and the Tugaat River Estuary. Milne Port is in a relatively sheltered area in the southernmost portion of Milne Inlet, where habitats are relatively deep (ranging from 0 to more than 10 m) and have a relatively steep slope prior to dropping off to deeper waters. Substrates around the Milne Port are nearly entirely boulders with some cobbles. In contrast, the Tugaat River Estuary is located in the main body of Milne Inlet, approximately 28 km north of Milne Port.. Littoral habitats at the Tugaat River Estuary were generally shallow (0 to 1.5 m in most areas), with a long, gradual slope prior to dropping off to deeper waters. Substrates in the Tugaat River Estuary were composed of finer substrates, primarily cobbles and sand. Given the abundance of Fourhorn Sculpin in the Milne Port area and the observed differences in habitat composition and structure between the Milne Port and Tugaat River Estuary, it is likely that the Tugaat River Estuary does not include sufficient habitat for Fourhorn Sculpin to serve as a reference area of the MEEMP Fish Health program.

The bivalve *H. arctica* appears to be relatively abundant in the Milne Port area (see Chapter 4.0 – Benthic Infauna), and *H. arctica* were collected from the Tugaat River Estuary. Individuals were of similar size and condition to those collected from the Milne Port area (Table 7A-5; Chapter 7.0 Table 7-7). Therefore, while the Tugaat River Estuary likely supports a population of *H. arctica* large enough to support target sample sizes, *H. arctica* is also likely present throughout Milne Inlet in other areas where populations of Fourhorn Sculpin are also present and in sufficient numbers to support the MEEMP Fish Health program.

5.0 CONCLUSIONS

Population densities of Fourhorn Sculpin in the Tugaat River Estuary candidate reference area do not appear to be adequate to support sample size requirements for the MEEMP fish health and tissue chemistry programs, which suggests that this area may not be an appropriate reference area. Supporting water and sediment quality data suggest that the candidate reference area is broadly comparable to Milne Port, however, concentrations of some sediment metals within the candidate area were variable, despite comparable substrates at the locations sampled. Therefore, the 2021 sampling locations near Tugaat River are not recommended for use as a fish health reference area based on data collected during the 2021 reconnaissance survey.

6.0 CLOSURE

We trust this information is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact Marina Winterbottom, on behalf of the undersigned, at 604-296-7312.

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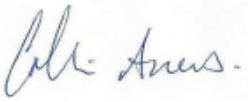

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https://golderassociates.sharepoint.com/sites/11206g/deliverables (do not use)/issued to client_for wp/300-399/1663724-349g-r-rev0/app/appendix 7a/appendix 7a - reference area reconnaissance survey1_mw-nz_pr.docx

7.0 REFERENCES

Bastrop R, Röhner M, Sturmbauer C, Jürss K. 1997. Where did *Marenzelleria* spp. (Polychaeta: Spionidae) in Europe Come From? Aquatic Ecology 31: 119-136.

Bastrop R, Blank M. 2006. Multiple Invasions – A Polychaete Genus Enters the Baltic Sea. Biological Invasions 8: 1195-1200.

Bick A. 2005. A New Spionidae (Polychaeta) from North Carolina, and a Redescription of *Marenzelleria wireni* Augner, 1913, from Spitsbergen, with a key for all species of *Marenzelleria*. Helgoland Marine Research 59: 265-272.

Blank M, Bastrop R. 2008. Phylogeny of the Mud Worm Genus *Marenzelleria* (Polychaeta, Spionidae) Inferred from Mitochondrial DNA Sequences. Zoologica Scripta.

Blank M, Bastrop R, Röhner M, Jürss K. 2004. Effect of Salinity on Spatial Distribution and Cell Volume Regulation in Two Sibling Species of Marenzelleria (Polychaeta: Spionidae). Marine Ecology Project Series 271:193-205.

Blank M, Laine AO, Jürss K, Bastrop R. 2008. Molecular Identification Key Based in PCR/RFLP for Three Polychaete Sibling Species of the Genus *Marenzelleria* and the Species Current Distribution in the Baltic Sea. Helgoland Marine Research 62: 129-141.

Brown TM, Edinger EN, Hooper RG, Belliveau K. 2011. Benthic Marine Fauna and Flora of Two Nearshore Coastal Locations in the Western and Central Canadian Arctic. Arctic 64(3): 281-301.

Casas-Monroy O, Linley RD, Adams JK, Chan FT, Drake DAR, Bailey SA. 2014. National risk assessment for introduction of aquatic nonindigenous species to Canada by ballast water. Canadian Science Advisory Secretariat Research Document 2013/128. VI + 73 p.

Chamberlin RV. 1920. The Polychaetes Collected by the Canadian Arctic Expedition, 1913-18. Report of the Canadian Arctic Expedition 1913-18. 9B:1-41.

Fofonoff, P.W., Ruiz, G.M., Steves, B., Simkanin, C., Carlton, J.T. 2021. National Exotic Marine and Estuarine Species Information System. [Accessed August 2021]. http://invasions.si.edu/nemesis/.

GBIF (Global Biodiversity Information Facility). 2021. Global Biodiversity Information Facility (GBIF). [Accessed August 2021]. https://www.gbif.org/

Golder (Golder Associates Ltd.). 2021a. Mary River Project 2020 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. Golder Doc. No. 1663724-281-R-RevB; 23 April 2021. 1517 p.

Golder. 2021b. Baffinland Milne Port Tide Gauge Data Collection – 2020 Ice Free Season. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. Golder Doc. No. 1663724-262-TM-RevA; 29 January 2021.

Green S. 2015. The Diet and Influence of the Spionid Polychaete *Marenzelleria* on Benthic Communities in Coastal Newfoundland. [MSc Thesis]. St. John's, NL. Memorial University of Newfoundland. 146 p.

ICES (International Council for the Exploration of the Sea). 2016. Report of the Working Group on Introductions and Transfers of Marine Organisms (WGITMO). 16-18 March 2016, Olbia, Italy. ICES CM 2016/SSGEPI: 10.

Kauppi L, Norkko A, Norkko J. 2015. Large Scale Invasion into a Low Diversity System: Spatial and Temporal Distribution of the Invasive Polychaetes *Marenzelleria* spp. in the Baltic Sea. Biological Invasions DOI 10.1007/s10530-015-0860-0.

Maximov AA, Eremina TR, Lange EK, Litvinchuk LF, Maximova OB. 2014. Regime Shift in the Ecsystem of the Eastern Gulf of Finland Caused by the Invasion of the Polychaete *Marenzelleria arctia*. Oceanology 54(1): 46-53.

Maximov A, Bonsdorff E, Eremina T, Kauppi L, Norkko A, Norkko J. 2015. Context-Dependent Consequences of *Marenzelleria* spp. (Spionidae: Polychaeta) Invasion for Nutrient Cycling in the Northern Baltic Sea. Oceanologica 57:342-348.

Miller R, Nozères C, Kennedy M. 2014. DFO Quebec Region MLI Museum Collection. Version 2. OBIS Canada Digital Collections. Published by OBIS. [Accessed February 2021]. http://ipt.iobis.org/obiscanada/resource?r=dfo_que_mli_museum

Molnar JL, Gamboa RL, Revenga C, Spalding MD. 2008. Assessing the global threat of invasive species to marine biodiversity. Frontiers in Ecology and the Environment. [Accessed August 2021] http://www.conservationgateway.org/ConservationPractices/Marine/Pages/marineinvasives.aspx

O'Reilly M, Nowacki S. 2019. First Record of the Non-Native Green Palpworm *Marenzelleria viridis* (Annelida: Spionidae) in the Clyde River Estuary. The Glasgow Naturalist 27(1).

Quintana CO, Raymond C, Nascimento FJA, Bonaglia S, Forster S, Gunnarsson JS, Kristensen E. 2018. Functional Performance of Three Invasive *Marenzelleria* Species Under Contrasting Ecological Conditions Within the Baltic Sea. Estuaries and Coasts.

Radashevsky V. 2021. National Scientific Center of Marine Biology, Vladivostok, Russia. Artic Marenzelleria Verification. Email to MacDonald T, President/CEO, Biologica Environmental Services Ltd. 22 June 2021.

Sikorski A, Bick A. 2004. Revision of *Marenzelleria* Mesnil, 1896 (Spionidae, Polychaeta). Sarsia 89:1-24.

Steinerstauch S. 2019. Manager, Laboratory Operations, Biologica Environmental Services Ltd. Baffinland Epifauna and Fish Data. Email to Ospan A, Marine Biologist, Golder Associates Ltd. 17 May 2019.

Stewart PL, Pocklington P, Cunjak RA. 1985. Distribution, Abundance and Diversity of Benthic Macroinvertebrates on the Canadian Continental Shelf and Slope of Southern Davis Strait and Ungava Bay.

Table 7A-1: Milne Port Fish Health Reference Area
Water Quality Screening
North Baffin Island, Nunavut, 2021

Sample ID Date Sampled Lab Sample ID QAQC Parent Sample ID Parameter	CCME AW-M[1]	Lowest Detection Limit	Unit	TR Ref1 2021-08-15 VA21B7536 FDA	TR Ref2 2021-08-15 VA21B7536	DUP-D 2021-08-15 VA21B7536 FD TR Ref1	RPD %
Anions + Nutrients							
Alkalinity, Total as CaCO3		1000	µg/L	93400	93700	92400	1%
Bromide (Br)		5000	µg/L	44500	44600	42600	4%
Chloride (Cl)		50000	µg/L	13000000	13100000	12600000	3%
Fluoride (F)		200	µg/L	560	610	600	-
Nitrate (as N)		10	µg/L	< 10	< 10	18.0	-
Nitrite (as N)		10	µg/L	< 10	< 10	< 10	-
Ammonia (as N)		5	µg/L	< 5.0	< 5.0	< 5.0	-
Total Kjeldahl Nitrogen		50	µg/L	68.0	65.0	73.0	-
Sulfate (SO4)		3000	µg/L	1790000	1840000	1790000	-
Phosphorus, Total		2	µg/L	13.0	13.5	11.8	10%
Phosphorus, Dissolved			µg/L	< 50	< 50	< 50	-
Carbons							
Dissolved Organic Carbon		500	µg/L	1130.0	1100.0	950.0	-
Total Organic Carbon		500	µg/L	810.0	810.0	790.0	-
Field + Physical							
pH	**7.0 - 8.7**	0.1	pH units	7.9	7.9	7.9	-
Conductivity		2.0	µS/cm	36900	38100	37300	1%
Total Dissolved Solids		10000	µg/L	27600000	28000000	25600000	8%
Total Suspended Solids		2000	µg/L	< 2000	< 2000	< 2000	-
Turbidity		0.10	NTU	1.45	0.68	0.67	**74%**
Salinity		1.0	PSU	22.8	23.6	23.1	1%
Hardness, Calcium Carbonate		500	µg/L	4300000	4460000	4250000	1%
Metals, Dissolved							
Aluminum		5	µg/L	< 5.0	< 5.0	< 5.0	-
Antimony		1	µg/L	< 1.0	< 1.0	< 1.0	-
Arsenic	**12.5**	0.4	µg/L	1.07	1.11	1.00	-
Barium		1	µg/L	7.10	7.40	7.10	-
Beryllium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Bismuth		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Boron		300	µg/L	2860	2980	2890	1%
Cadmium	**0.12**	0.01	µg/L	0.028	0.029	0.022	-
Calcium		1000	µg/L	279000	288000	284000	2%
Cesium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Chromium	**1.50**	0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Cobalt		0.05	µg/L	< 0.050	< 0.050	< 0.050	-
Copper		0.2	µg/L	0.36	0.44	0.23	-
Gallium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Iron		10	µg/L	< 10	< 10	< 10	-
Lead		0.05	µg/L	< 0.050	< 0.050	< 0.050	-
Lithium		20	µg/L	122	125	120	2%
Magnesium		1000	µg/L	876000	908000	860000	2%
Manganese		0.1	µg/L	0.82	0.77	0.76	8%
Mercury	**0.016**	0.005	µg/L	< 0.0050	< 0.0050	< 0.0050	-
Molybdenum		0.1	µg/L	7.50	7.65	7.63	2%
Nickel		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Phosphorus		50	µg/L	< 50	< 50	< 50	-
Potassium		1000	µg/L	291000	304000	285000	2%
Rhenium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Rubidium		5	µg/L	79.0	82.7	77.4	2%
Selenium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Silicon		1000	µg/L	< 1000	< 1000	< 1000	-
Silver	**7.5***	0.1	µg/L	< 0.10	< 0.10	< 0.10	-
Sodium		2500	µg/L	6720000	7010000	6670000	1%
Strontium		10	µg/L	5300	5330	5270	1%
Sulphur (Colloidal)		5000	µg/L	702000	737000	726000	3%
Tellurium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Thallium		0.05	µg/L	< 0.050	< 0.050	< 0.050	-
Thorium-232		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Tin		1	µg/L	< 1.0	< 1.0	< 1.0	-
Titanium		5	µg/L	< 5.0	< 5.0	< 5.0	-
Tungsten		1	µg/L	< 1.0	< 1.0	< 1.0	-
Uranium		0.05	µg/L	2.15	2.19	2.16	-
Vanadium		0.5	µg/L	1.08	1.05	0.97	-
Yttrium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Zinc		1	µg/L	< 1.0	< 1.0	< 1.0	-
Zirconium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Metals, Total							
Aluminum		5	µg/L	16.10	35.30	17.10	-
Antimony		1	µg/L	< 1.0	< 1.0	< 1.0	-
Arsenic	**12.5**	0.4	µg/L	1.08	1.06	1.06	-
Barium		1	µg/L	7.80	7.80	7.90	1%
Beryllium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Bismuth		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Boron		300	µg/L	2950	3020	3020	2%
Cadmium	**0.12**	0.01	µg/L	0.031	0.030	0.030	-
Calcium		1000	µg/L	309000	324000	311000	1%
Cesium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Chromium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Cobalt		0.05	µg/L	< 0.050	< 0.050	< 0.050	-
Copper		0.5	µg/L	1.31	0.59	1.31	-
Gallium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Iron		10	µg/L	13.00	16.00	14.00	-
Lead		0.05	µg/L	< 0.050	< 0.050	< 0.050	-
Lithium		20	µg/L	138	142	137	1%
Magnesium		1000	µg/L	928000	942000	951000	2%
Manganese		0.2	µg/L	1.10	1.15	1.13	3%
Mercury	**0.016**	0.005	µg/L	< 0.0050	< 0.0050	< 0.0050	-
Molybdenum		0.1	µg/L	7.70	7.82	7.65	1%
Nickel		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Phosphorus		50	µg/L	< 50	< 50	< 50	-
Potassium		1000	µg/L	332000	349000	352000	6%
Rubidium		0.5	µg/L	85.40	86.30	89.90	5%
Rhenium		5	µg/L	< 0.50	< 0.50	< 0.50	-
Selenium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Silicon		1000	µg/L	< 1000	< 1000	< 1000	-
Silver	**7.5***	0.1	µg/L	< 0.10	< 0.10	< 0.10	-
Sodium		2500	µg/L	6820000	6970000	6710000	2%
Strontium		10	µg/L	5120	5440	5330	4%
Sulphur (Colloidal)		5000	µg/L	875000	896000	863000	1%
Tellurium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Thallium		0.05	µg/L	< 0.050	< 0.050	< 0.050	-
Thorium-232		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Tin		1	µg/L	< 1.0	< 1.0	< 1.0	-
Titanium		5	µg/L	< 5.0	< 5.0	< 5.0	-
Tungsten		1	µg/L	< 1.0	< 1.0	< 1.0	-
Uranium		0.05	µg/L	2.13	2.15	2.12	-
Vanadium		0.5	µg/L	1.12	1.16	1.17	-
Yttrium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-
Zinc		3	µg/L	< 3.0	< 3.0	< 3.0	-
Zirconium		0.5	µg/L	< 0.50	< 0.50	< 0.50	-

CCME = Canadian Council of Ministers for the Environment; FD = field duplicate; FDA = field duplicate available; QA/QC = quality assurance / quality control; RPD = relative percent difference; ug/L = micrograms per litre; % = percent, < = below detection limit; - = no data; > = greater than;
* = short-term exposure guideline for silver

Bold, outline and blue shaded Exceeds CCME AW-F guidelines for protection of marine aquatic life
Bold values indicate an exceedance of the acceptable RPD of 20%.
1. Canadian Council of Ministers of the Environment (CCME 1999, updated to 2019) water quality guidelines for the protection of marine aquatic life.

Table 7A-2: Milne Port Fish Health Reference Area
Sediment Quality Screening
North Baffin Island, Nunavut, 2021

Sample ID Date Sampled Time Sampled Lab Sample ID QA/QC Parent Sample ID	Lowest Detection Limit	Units	CCME ISQG Marine/Estuarine [1]	CCME PEL Marine/Estuarine [1]	TR Ref1 15-Aug-2021 15:45 VA21B7543-001	TR Ref2 15-Aug-2021 16:30 VA21B7543-002 FDA	DUP-B 15-Aug-2021 00:00 VA21B7543-003 FD TR Ref2	RPD%
Physical Tests								
moisture	0.25	%			24.6	39.7	39.6	0%
pH (1:2 soil:water)	0.10	pH units			8.37	8.22	8.21	0%
Particle Size								
clay (<0.004mm)	1.0	%			5.7	4.4	4.2	-
silt (0.063mm - 0.004mm)	1.0	%			26.7	21.9	22.4	2%
sand (2.0mm - 0.063mm)	1.0	%			57.4	68.3	71.1	4%
gravel (>2mm)	1.0	%			10.2	5.4	2.3	**81%**
Organic / Inorganic Carbon								
carbon, inorganic	0.050	%			0.524	0.355	0.378	6%
carbon, total	0.050	%			1.16	1.39	1.45	4%
carbon, total organic	0.050	%			0.636	1.04	1.07	3%
carbon, inorganic (CaCO3 equivalent)	0.40	%			4.37	2.96	3.15	6%
organic matter	0.10	%			1.10	1.79	1.84	3%
Metals								
aluminum	50	mg/kg			18400	6770	8260	20%
antimony	0.10	mg/kg			0.16	<0.10	<0.10	-
arsenic	0.10	mg/kg	7.24	41.6	2.63	2.60	2.66	2%
barium	0.50	mg/kg			48.6	32.7	32.0	2%
beryllium	0.10	mg/kg			0.22	0.51	0.52	2%
bismuth	0.20	mg/kg			<0.20	<0.20	<0.20	-
boron	5.0	mg/kg			<5.0	19.1	36.5	**63%**
cadmium	0.020	mg/kg	0.7	4.2	0.054	0.049	0.113	**79%**
calcium	50	mg/kg			11900	16100	9110	**55%**
chromium	0.50	mg/kg	52.3	160	51.6	15.6	14.6	7%
cobalt	0.10	mg/kg			10.3	3.59	3.97	10%
copper	0.50	mg/kg	18.7	108	39.5	5.03	9.10	**58%**
iron	50	mg/kg			28300	13000	12900	1%
lead	0.50	mg/kg	30.2	112	1.52	5.18	6.96	29%
lithium	2.0	mg/kg			4.9	16.1	17.7	9%
magnesium	20	mg/kg			6020	11400	8870	25%
manganese	1.0	mg/kg			414	109	91.2	18%
mercury	0.0050	mg/kg	0.13	0.70	<0.0050	0.0063	0.0064	-
molybdenum	0.10	mg/kg			2.11	0.80	1.70	**72%**
nickel	0.50	mg/kg			22.8	8.86	10.0	12%
phosphorus	50	mg/kg			365	662	410	47%
potassium	100	mg/kg			580	1730	2480	36%
selenium	0.20	mg/kg			<0.20	<0.20	<0.20	-
silver	0.10	mg/kg			<0.10	<0.10	<0.10	-
sodium	50	mg/kg			774	3190	5800	**58%**
strontium	0.50	mg/kg			42.8	21.9	26.0	17%
sulfur	1000	mg/kg			<1000	<1000	2400	-
thallium	0.050	mg/kg			<0.050	0.100	0.115	-
tin	2.0	mg/kg			<2.0	<2.0	<2.0	-
titanium	1.0	mg/kg			2260	340	257	28%
tungsten	0.50	mg/kg			11.9	<0.50	<0.50	-
uranium	0.050	mg/kg			0.253	2.13	1.82	16%
vanadium	0.20	mg/kg			95.3	22.4	21.2	6%
zinc	2.0	mg/kg	124	271	30.3	22.1	24.7	11%
zirconium	1.0	mg/kg			11.0	10.3	7.3	34%
Volatile Organic Compounds								
benzene	0.0050	mg/kg			<0.0050	<0.0050	<0.0050	-
ethylbenzene	0.015	mg/kg			<0.015	<0.015	<0.015	-
toluene	0.050	mg/kg			<0.050	<0.050	<0.050	-
xylene, m+p-	0.050	mg/kg			<0.050	<0.050	<0.050	-
xylene, o-	0.050	mg/kg			<0.050	<0.050	<0.050	-
xylenes, total	0.075	mg/kg			<0.075	<0.075	<0.075	-
Hydrocarbons								
F1 (C6-C10)	5.0	mg/kg			<5.0	<5.0	<5.0	-
F1-BTEX	5.0	mg/kg			<5.0	<5.0	<5.0	-
F2 (C10-C16)	30	mg/kg			<30	<30	<30	-
F3 (C16-C34)	50	mg/kg			<50	56	51	-
F4 (C34-C50)	50	mg/kg			<50	<50	<50	-
Polycyclic Aromatic Hydrocarbons								
acenaphthene	0.0050	mg/kg	0.00671	0.0889	<0.0050	<0.0050	<0.0050	-
acenaphthylene	0.0050	mg/kg	0.01	0.13	<0.0050	<0.0050	<0.0050	-
acridine	0.010	mg/kg			<0.010	<0.010	<0.010	-
anthracene	0.0040	mg/kg	0.05	0.25	<0.0040	<0.0040	<0.0040	-
benz(a)anthracene	0.010	mg/kg	0.0748	0.693	<0.010	<0.010	<0.010	-
benzo(a)pyrene	0.010	mg/kg	0.09	0.76	<0.010	<0.010	<0.010	-
benzo(b+j)fluoranthene	0.010	mg/kg			<0.010	<0.010	<0.010	-
benzo(b+j+k)fluoranthene	0.015	mg/kg			<0.015	<0.015	<0.015	-
benzo(g,h,i)perylene	0.010	mg/kg			<0.010	<0.010	<0.010	-
benzo(k)fluoranthene	0.010	mg/kg			<0.010	<0.010	<0.010	-
chrysene	0.010	mg/kg	0.108	0.846	<0.010	<0.010	<0.010	-
dibenz(a,h)anthracene	0.0050	mg/kg	0.01	0.14	<0.0050	<0.0050	<0.0050	-
fluoranthene	0.010	mg/kg	0.113	1.494	<0.010	<0.010	<0.010	-
fluorene	0.010	mg/kg	0.02	0.14	<0.010	<0.010	<0.010	-
indeno(1,2,3-c,d)pyrene	0.010	mg/kg			<0.010	<0.010	<0.010	-
methylnaphthalene, 1+2-	0.015	mg/kg			<0.015	<0.015	<0.015	-
methylnaphthalene, 1-	0.010	mg/kg			<0.010	<0.010	<0.010	-
methylnaphthalene, 2-	0.010	mg/kg	0.02	0.20	<0.010	<0.010	<0.010	-
naphthalene	0.010	mg/kg	0.0346	0.391	<0.010	<0.010	<0.010	-
phenanthrene	0.010	mg/kg	0.09	0.54	<0.010	<0.010	<0.010	-
pyrene	0.010	mg/kg	0.153	1.398	<0.010	<0.010	<0.010	-
quinoline	0.010	mg/kg			<0.010	<0.010	<0.010	-
B(a)P total potency equivalents [B(a)P	0.020	mg/kg			<0.020	<0.020	<0.020	-
PAHs, total (BC Sched 3.4)	0.040	mg/kg			<0.040	<0.040	<0.040	-
PAHs, total (EPA 16 - DAS)	0.140	mg/kg			-	-	<0.140	-
PAHs, total (EPA 16)	0.040	mg/kg			<0.040	<0.040	<0.040	-

CCME = Canadian Council of Ministers for the Environment; FD = field duplicate; FDA = field duplicate available; mg/kg = miligram per kilogram; PEL = probable effect level; QA/QC = quality assurance / quality control; % = percent, < = below detection limit; - = no data; > = greater than

1) Canadian Council of Ministers of the Environment (CCME). 1999. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. In: Canadian Environmental Quality Guidleines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB.

Blue Text	Exceeds CCME ISQG sediment quality guideline
Blue shading	Exceeds CCME PEL sediment quality guideline

Bold values indicate an exceedance of the acceptable RPD of 50%.

Table 7A-3: Catch Per Unit Effort for Fish Captured during the Reference Area Reconnaissance Survey, Tugaat River Estuary, and in Milne Port, MEEMP Survey, 2021.

Site	Angling				Gill Nets			
	Effort (h/rod)	Species	# of Fish Captured	CPUE (# fish/h/rod)	Effort (h/100 m)	Species	# of Fish Captured	CPUE (# fish/h/100 m)
Tugaat River Estuary	1.53	ARCH	1	1.36	52.49	ARCH	60	1.14
		ARSC	3	4.09		ARSC	0	0.00
		FHSC	0	0.00		FHSC	2	0.04
Milne Port	9.05	FHSC	150	76.44	170.22	FHSC	128	16.04

Table 7A-4: Descriptive Statistics for Fourhorn Sculpin Fish Health Endpoints Processed from the Milne Port Area, 2021.

Parameter	Reference Area							Milne Port						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Female														
Total Length (mm)	2	224	234	229	229	7.1	5.0	20	205	344	249	255	40.3	9.0
Age (y)	2	4	6	5	5.0	1.4	1.0	20	3	10	6	6.2	2.0	0.5
Male														
Total Length (mm)	0	-	-	-	-	-	-	20	209	281	229	237	24.4	5.5
Age (y)	0	-	-	-	-	-	-	20	3	12	6	6.6	2.1	0.5

n = sample size; min = minimum; max = maximum; SD = standard deviation; SE = standard error.

Table 7A-5: Descriptive Statistics for *Hiatella arctica* Fish Health Endpoints Processed from the Tugaat River Estuary and Milne Port, 2021.

Parameter	Tugaat River Estuary							Milne Port						
	n	Min	Max	Median	Mean	SD	SE	n	Min	Max	Median	Mean	SD	SE
Shell Length (mm)	6	20.4	33.84	23.81	25.87	6.16	2.51	35	17.47	35.07	30.45	29.331429	4.25	0.72
Total Weight (g)	6	1.0499	5.6753	1.6434	2.7262	2.0521	0.8378	35	0.4805	8.1284	3.9825	4.0210	1.7575	0.2971
Shell ww (g)	6	0.3396	3.6655	0.6310	1.5594	1.5921	0.6500	35	0.2187	5.1394	2.0614	2.2152	1.1666	0.1972
Shell dw (g)	6	0.2600	3.3998	0.4867	1.3273	1.4421	0.5887	35	0.1145	4.7250	1.7991	1.9047	1.0324	0.1745
Tissue ww (g)	6	0.5619	2.0938	0.9937	1.1051	0.5464	0.2231	35	0.2351	2.8741	1.9059	1.7853	0.7031	0.1188
Tissue dw (g)	6	0.2073	0.7726	0.3667	0.4078	0.2016	0.0823	35	0.0868	1.0605	0.7033	0.6588	0.2595	0.0439
Condition factor	6	1.07	1.57	1.40	1.36	0.18	0.07	35	0.90	2.25	1.41	1.48	0.30	0.05
Gonad ww (g)	6	0.0046	0.0635	0.0119	0.0249	0.0256	0.0104	35	0.0023	0.0798	0.0360	0.0365	0.0181	0.0031
MSI	6	0.83	4.19	1.29	1.93	1.42	0.58	35	0.90	6.13	1.97	2.23	1.20	0.20
Age (y)	6	3	33	6	12.8	13.2	5.4	35	1	39	17	19.2	8.1	1.4

ww = wet weight; dw = dry weight; n = sample size; min = minimum; max = maximum; SD = standard devision; SE = standard error.

APPENDIX 7B

Fish Health Data

Table 7B-1: Fish Health Data for Fourhorn Sculpin Lethally Sampled from the Milne Port Area, 2021

Date (d-m-y)	Effort Number	Fish Identification Number	Total Length (mm)	Total Weight (g)	Condition Factor	Sex	Life Stage	Maturity[(a)]	Age (y)	Liver Weight (g)	Gonad Weight (g)
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1001	265	185.34	1.00	F	Adult	12.00	7	6.14	4.73
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1002	256	155.28	0.93	F	Adult	12.00	6	7.33	7.40
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1003	281	190.31	0.86	M	Adult	23.00	9	3.72	5.64
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1004	273	186.74	0.92	M	Adult	23.00	12	3.78	10.15
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1005	228	103.20	0.87	M	Adult	23.00	4	2.07	6.60
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1006	266	198.63	1.06	F	Adult	12.00	6	8.38	8.37
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1007	205	78.87	0.92	F	Adult	12.00	3	1.96	1.40
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1008	267	182.93	0.96	F	Adult	12.00	6	5.66	5.49
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1009	211	82.77	0.88	M	Adult	23.00	3	1.72	2.07
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1010	259	160.78	0.93	F	Adult	12.00	6	6.42	6.08
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1011	214	86.52	0.88	F	Adult	12.00	4	3.42	2.01
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1012	245	126.51	0.86	F	Adult	12.00	5	5.99	4.63
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1013	216	99.54	0.99	M	Adult	23.00	8	1.73	2.82
08-08-21	BAFF21FHMLNAN0004	BAFF21UMLNFRSC1014	256	119.85	0.71	M	Adult	23.00	8	2.90	4.39
08-08-21	BAFF21FHMLNGN1007	BAFF21UMLNFRSC1015	344	351.86	0.86	F	Adult	12.00	9	14.71	16.30
09-08-21	BAFF21FHMLNGN1008	BAFF21UMLNFRSC1016	228	124.17	1.05	F	Adult	12.00	5	4.21	2.76
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1017	250	158.27	1.01	M	Adult	23.00	7	8.75	5.41
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1018	228	106.42	0.90	F	Adult	12.00	5	3.04	2.73
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1019	309	335.65	1.14	F	Adult	12.00	10	10.72	81.83
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1020	206	84.32	0.96	F	Adult	12.00	4	2.40	2.83
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1021	253	149.80	0.92	F	Adult	12.00	5	6.75	7.57
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1022	211	90.87	0.97	F	Adult	12.00	5	2.95	2.39
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1023	257	145.39	0.86	M	Adult	23.00	9	3.57	7.21
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1024	211	90.79	0.97	M	Adult	23.00	5	1.55	4.84
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1025	209	82.28	0.90	M	Adult	23.00	6	1.59	3.10
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1026	228	115.22	0.97	F	Adult	12.00	6	4.52	4.25
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1027	214	74.09	0.76	M	Adult	23.00	6	1.11	3.84
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1028	251	128.60	0.81	M	Adult	23.00	6	2.37	6.57
09-08-21	BAFF21FHMLNAN1005	BAFF21UMLNFRSC1029	233	115.48	0.91	F	Adult	12.00	6	4.44	4.70
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1030	230	113.62	0.93	M	Adult	23.00	6	1.69	3.25
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1031	312	249.52	0.82	F	Adult	12.00	10	9.00	15.78
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1032	280	196.87	0.90	M	Adult	23.00	9	5.88	7.40
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1033	215	82.22	0.83	M	Adult	23.00	5	1.75	3.46
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1034	325	320.90	0.93	F	Adult	12.00	10	23.91	21.57
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1035	216	94.84	0.94	M	Adult	23.00	4	2.18	2.68
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1036	249	143.05	0.93	M	Adult	23.00	7	2.29	6.85
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1037	248	147.91	0.97	M	Adult	23.00	6	3.27	8.77
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1038	225	108.99	0.96	M	Adult	23.00	6	1.98	4.69
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1039	239	115.70	0.85	F	Adult	12.00	6	4.83	4.11
10-08-21	BAFF21FHMLNAN1007	BAFF21UMLNFRSC1040	214	85.75	0.87	M	Adult	23.00	5	3.23	3.67

Notes:

(a) Refer to Table 7-1 in Report for descriptions of maturity codes.

d = day; m = month; y = year; F = female; M = male.

Table 7B-2: Internal and External Assessments of Fourhorn Sculpin Lethally Sampled from the Milne Port Area, 2021

Fish Identification Number	External Assessment										Internal Assessment						
	Body Deformity	Eyes	Skin	Thymus	Opercula	Gills	Pseudo-branchs	Fins	Vent	Parasites	Liver[a]	Spleen	Gall Bladder	Gonads	Mesenteric Fat (%)	Parasites[b]	Kidney
BAFF21UMLNFRSC1001	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1002	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1003	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1004	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1005	N	N	0	0	0	N	N	0	0	N	C	B	-	N	<50	0	N
BAFF21UMLNFRSC1006	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1007	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1008	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1009	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1010	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1011	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1012	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1013	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1014	N	N	0	0	0	N	N	0	0	N	C	B	-	N	<50	0	N
BAFF21UMLNFRSC1015	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1016	N	N	0	0	0	N	N	0	0	N	C	B	-	N	<50	0	N
BAFF21UMLNFRSC1017	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1018	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1019	N	N	0	0	0	N	N	0	0	N	A	B	0	-	<50	0	N
BAFF21UMLNFRSC1020	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1021	N	N	0	0	0	N	N	0	0	N	A	B	0	-	<50	0	N
BAFF21UMLNFRSC1022	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1023	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1024	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1025	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1026	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1027	N	N	0	0	0	N	N	0	0	N	C	B	0	-	<50	1	N
BAFF21UMLNFRSC1028	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1029	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1030	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1031	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	0	N
BAFF21UMLNFRSC1032	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1033	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1034	N	N	0	0	0	N	N	0	0	N	A	B	0	N	<50	1	N
BAFF21UMLNFRSC1035	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1036	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1037	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1038	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	1	N
BAFF21UMLNFRSC1039	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N
BAFF21UMLNFRSC1040	N	N	0	0	0	N	N	0	0	N	C	B	0	N	<50	0	N

Notes:

(a) A = Normal, solid red or light red colour; C = "Fatty" liver, "coffee with cream" colour.

(b) 0 = No observed parasites; 1 = Few observed parasites.

% = percent; N, 0, or B = normal; - = not collected; < = less than

Table 7B-3: Fish Health Data for Hiatella arctica Lethally Sampled from the Milne Port Area, 2021

Date (d-m-y)	Effort Number	Fish Identification Number	Composite	Field Measurements		Laboratory Measurements[a]							
				Total Length (mm)	Whole Animal Wet Weight (g)	Total Length (mm)	Whole Animal Wet Weight (g)	Shell Wet Weight (g)	Tissue Wet Weight (g)	Gonad Wet Weight (g)	Shell Dry Weight (g)	Tissue Dry Weight (g)[b]	Age (y)
09-08-21	BAFF21FHMLNSW51001	BAFF21UMLNHTAR1501	BAFF21UMLNHTARCOMP9	33.25	6.7180	35.03	5.8641	2.2213	2.8698	2.5575	0.0287	1.0590	16
09-08-21	BAFF21FHMLNSW51001	BAFF21UMLNHTAR1502	BAFF21UMLNHTARCOMP7	30.23	6.9270	31.26	6.2588	3.9720	2.2348	3.4560	0.0332	0.8246	25
09-08-21	BAFF21FHMLNSW51001	BAFF21UMLNHTAR1503	-	32.72	6.7680	34.43	5.1816	3.8153	1.5662	3.1908	0.0263	0.5779	28
09-08-21	BAFF21FHMLNSW51001	BAFF21UMLNHTAR1504	-	29.33	5.5600	31.07	4.8301	2.1991	2.6814	2.1667	0.0240	0.9894	16
09-08-21	BAFF21FHMLNSW51001	BAFF21UMLNHTAR1505	-	29.87	3.7820	31.15	3.2244	1.8862	1.3443	1.5481	0.0215	0.4960	15
10-08-21	BAFF21FHMLNSW31001	BAFF21UMLNHTAR1506	BAFF21UMLNHTARCOMP6	34.83	8.2910	34.45	7.1473	4.7795	2.3313	4.0434	0.0798	0.8602	32
10-08-21	BAFF21FHMLNSW31001	BAFF21UMLNHTAR1507	-	33.13	4.7320	32.86	4.4982	2.0614	2.4215	1.6290	0.0408	0.8935	17
10-08-21	BAFF21FHMLNSW31001	BAFF21UMLNHTAR1508	BAFF21UMLNHTARCOMP1	29.76	4.2180	30.54	3.9026	1.9483	1.9488	1.6618	0.0541	0.7191	24
10-08-21	BAFF21FHMLNSW31001	BAFF21UMLNHTAR1509	-	35.18	6.6890	35.07	5.9138	3.6123	2.4640	2.8669	0.0779	0.9092	26
10-08-21	BAFF21FHMLNSW31001	BAFF21UMLNHTAR1510	BAFF21UMLNHTARCOMP3	32.88	6.9510	33.18	5.5623	3.0104	2.5989	2.5999	0.0289	0.9590	29
14-08-21	BAFF21FHMLNSW21001	BAFF21UMLNHTAR1511	BAFF21UMLNHTARCOMP13	30.22	5.7670	30.79	5.2173	2.6218	2.4102	2.3206	0.0540	0.8894	28
14-08-21	BAFF21FHMLNSW21001	BAFF21UMLNHTAR1512	BAFF21UMLNHTARCOMP5	30.99	5.1530	30.70	4.9101	2.4252	2.4367	1.9997	0.0459	0.8991	29
14-08-21	BAFF21FHMLNSW21001	BAFF21UMLNHTAR1513	BAFF21UMLNHTARCOMP10	30.40	4.0200	30.24	3.3855	1.7313	1.6745	1.5225	0.0606	0.6179	15
14-08-21	BAFF21FHMLNSW21001	BAFF21UMLNHTAR1514	BAFF21UMLNHTARCOMP7	30.07	4.4200	30.45	3.9825	1.9972	1.9059	1.7991	0.0461	0.7033	16
14-08-21	BAFF21FHMLNSW21001	BAFF21UMLNHTAR1515	BAFF21UMLNHTARCOMP10	33.15	6.4390	32.47	5.4600	2.9823	2.5207	2.5210	0.0501	0.9301	24
14-08-21	BAFF21FHMLNSE11001	BAFF21UMLNHTAR1516	BAFF21UMLNHTARCOMP4	31.46	7.1290	32.07	6.0603	3.5941	2.4629	3.1784	0.0497	0.9088	23
14-08-21	BAFF21FHMLNSE11001	BAFF21UMLNHTAR1517	BAFF21UMLNHTARCOMP16	30.58	4.9040	29.87	4.3641	2.7957	1.8289	2.2823	0.0360	0.6749	25
14-08-21	BAFF21FHMLNSE11001	BAFF21UMLNHTAR1518	BAFF21UMLNHTARCOMP1	32.89	8.3070	33.08	8.1284	5.1394	2.8741	4.7250	0.0394	1.0605	39
14-08-21	BAFF21FHMLNSE11001	BAFF21UMLNHTAR1519	BAFF21UMLNHTARCOMP9	22.54	1.2860	22.14	1.1127	0.4978	0.6059	0.4163	0.0350	0.2236	8
14-08-21	BAFF21FHMLNSE11001	BAFF21UMLNHTAR1520	BAFF21UMLNHTARCOMP2	20.69	1.4670	20.68	1.3078	0.6033	0.6786	0.4872	0.0189	0.2504	6
16-08-21	BAFF21FHMLNSE61001	BAFF21UMLNHTAR1521	BAFF21UMLNHTARCOMP14	29.46	-	29.21	3.1109	1.7368	1.3578	1.5106	0.0450	0.5010	15
16-08-21	BAFF21FHMLNSE61001	BAFF21UMLNHTAR1522	BAFF21UMLNHTARCOMP8	26.23	-	27.04	3.7495	1.8192	1.9707	1.5705	0.0352	0.7272	19
16-08-21	BAFF21FHMLNSE61001	BAFF21UMLNHTAR1523	BAFF21UMLNHTARCOMP16	27.82	-	27.97	4.1702	2.4920	1.6154	2.1154	0.0450	0.5961	26
16-08-21	BAFF21FHMLNSE61001	BAFF21UMLNHTAR1524	BAFF21UMLNHTARCOMP8	30.99	-	31.15	3.5326	1.6087	1.9339	1.1794	0.0373	0.7136	14
16-08-21	BAFF21FHMLNSE61001	BAFF21UMLNHTAR1525	BAFF21UMLNHTARCOMP15	27.23	-	27.34	2.6501	1.1712	1.4850	1.2270	0.0487	0.5480	12
17-08-21	BAFF21FHMLNSNW11001	BAFF21UMLNHTAR1526	BAFF21UMLNHTARCOMP4	21.73	-	22.23	1.5293	0.7319	0.7970	0.6321	0.0214	0.2941	12
17-08-21	BAFF21FHMLNSNW11001	BAFF21UMLNHTAR1527	BAFF21UMLNHTARCOMP12	27.77	-	27.70	2.8062	1.3218	1.1615	1.1422	0.0122	0.4286	17
17-08-21	BAFF21FHMLNSNW11001	BAFF21UMLNHTAR1528	BAFF21UMLNHTARCOMP3	24.21	-	23.73	1.4782	0.7129	0.7611	0.6208	0.8200	0.2808	10
17-08-21	BAFF21FHMLNSNW11001	BAFF21UMLNHTAR1529	BAFF21UMLNHTARCOMP11	24.19	-	24.34	2.0688	1.0240	1.0513	0.8306	0.0121	0.3879	14
17-08-21	BAFF21FHMLNSNW11001	BAFF21UMLNHTAR1530	BAFF21UMLNHTARCOMP1	17.48	-	17.47	0.4805	0.2187	0.2351	0.1145	0.0023	0.0868	1
18-08-21	BAFF21FHMLNSNE11001	BAFF21UMLNHTAR1531	BAFF21UMLNHTARCOMP14	32.66	-	33.03	4.8160	2.4915	2.2798	2.0586	0.0530	0.8412	17
18-08-21	BAFF21FHMLNSNE11001	BAFF21UMLNHTAR1532	BAFF21UMLNHTARCOMP5	25.60	-	26.12	2.9710	1.5115	1.4719	1.1618	0.0249	0.5431	14
18-08-21	BAFF21FHMLNSNE11001	BAFF21UMLNHTAR1533	BAFF21UMLNHTARCOMP15	29.53	-	29.92	4.2666	2.4380	2.0326	1.8601	0.0198	0.7500	25
18-08-21	BAFF21FHMLNSNE11001	BAFF21UMLNHTAR1534	BAFF21UMLNHTARCOMP6	28.18	-	27.53	3.0586	1.6118	1.5239	1.2499	0.0164	0.5623	13
18-08-21	BAFF21FHMLNSNE11001	BAFF21UMLNHTAR1535	-	30.41	-	30.29	3.7359	2.7469	0.9481	2.4174	0.0462	0.3498	23

Notes:

(a) Measurements collected by Biological Environmental Services Ltd.

(b) Estimated using conversion factor from Brey et al. (2001).

d = day; m = month; y = year.

Table 7B-4: Relative Weight of Stomach Contents Observed in Fishes Sampled form the Milne Port Area, 2021

Phyllum	Subphyllum	Class	Subclass	Order	Family	Taxon	Fish Species	
							Arctic Char (*n* = 18)	Fourhorn Sculpin (*n* = 15)
Acanthocephala	-	-	-	-	-	Acanthocephala indet.	<1%	-
Annelida	-	Polychaeta	-	-	-	Polychaeta indet.	<1%	-
Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	10%	<1%
		Hexanauplii	Copepoda	Calanoida	Calanidae	*Calanus glacialis*	<1%	-
						Calanus sp.	<1%	<1%
					-	Calanoida indet.	<1%	-
				Harpacticoida	-	Harpacticoida indet.	-	<1%
		Malacostraca	Eumalacostraca	Amphipoda	Atylidae	*Atylus carinatus*	<1%	-
						Atylus sp.	<1%	-
					Gammaridae	*Gammarus* sp.	<1%	5%
						Gammaridae indet.	-	3%
					Hyperiidae	*Themisto libellula*	26%	-
						Themisto sp.	<1%	-
						Hyperiidea indet.	8%	-
					Oedicerotidae	Monoporeia affinis	-	<1%
					Uristidae	*Anonyx* sp.	-	2%
						Onisimus sp.	2%	<1%
					-	Amphipoda indet.	1%	16%
				Mysida	Mysidae	*Mysis* sp.	<1%	<1%
					-	Mysida indet.	<1%	<1%
		Thecostraca	Cirripedia	Balanomorpha	-	Balanomorpha indet.	-	<1%
				-	-	Cirripedia indet.	-	<1%
	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Hydrobaenus* sp.	<1%	-
					Simuliidae	Simuliidae indet.	<1%	-
					Tipulidae	Tipulidae indet.	<1%	34%
				Ephemeroptera	-	Ephemeroptera indet.	<1%	-
			-	-	-	Insecta indet.	<1%	-
Chordata	Tunicata	Ascidiacea	-	-	-	Ascidiacea indet.	-	<1%
	Vertebrata	Actinopteri	Teleostei	Perciformes	Cottidae	*Myoxocephalus* sp.	4%	-
						Cottidae indet.	9%	-
		-	-	-	-	Pisces indet.	34%	36%
Mollusca	-	Bivalvia	-	-	-	Bivalvia indet.	-	<1%
	-	Gastropoda	Heterobranchia	Pteropoda	Limacinidae	*Limacina* sp.	<1%	<1%
Nemertea	-	-	-	-	-	Nemertea indet.	<1%	-
Non-food						Unidentified tissue	5%	2%

n = sample size; sp. = species; indet. = indeterminate; - = not identified.

Table 7B-5: Stomach Contents of All Fish Captured from the Milne Port Area, 2021

Species	Fish Identification Number	Fullness (%)	Digested (%)	Full Stomach Weight (g)	Phyllum	Subphyllum	Class	Subclass	Order	Family	Taxon	Total Abundance	Total Wet Weight (g)	Wet Weight / Individual (g)
Fourhorn Sculpin	BAFF21UMLNFHSC1005	0	0	5.0580	-	-	-	-	-	-	Empty Stomach	-	-	-
	BAFF21UMLNFHSC1011	100	75	5.6676	-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	-	-
					Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	0.0661	0.0661
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Amphipoda indet.	-	0.1407	0.1407
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammaridae indet.	6	0.0408	0.0068
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Onisimus sp.	3	0.0858	0.0286
	BAFF21UMLNFHSC1015	5	0	16.0053	-	-	-	-	-	-	Sand	-	-	-
					Mollusca	-	Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina sp.	1	0.0080	0.0080
	BAFF21UMLNFHSC1016	25	75	5.4192	-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	-	-
					Mollusca	-	Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina sp.	-	0.0300	0.0300
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Amphipoda indet.	-	0.0165	0.0165
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammaridae indet.	1	0.0107	0.0107
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Oedicerotidae	Monoporeia affinis	1	0.0113	0.0113
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Anonyx sp.	1	0.0916	0.0916
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Onisimus sp.	5	0.0387	0.0077
					Arthropoda	Crustacea	Thecostraca	Cirripedia	Balanomorpha	-	Balanomorpha indet.	1	0.0000	0.0000
	BAFF21UMLNFHSC1018	75	100	5.3940	-	-	-	-	-	-	Plant material	-	-	-
					-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	-	-
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammaridae indet.	2	0.0159	0.0080
					Arthropoda	Crustacea	Thecostraca	Cirripedia	Balanomorpha	-	Balanomorpha indet.	15	0.0003	0.0000
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	-	1.1241	1.1241
	BAFF21UMLNFHSC1019	50	75	12.7315	-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	-	-
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammaridae indet.	4	0.0748	0.0187
	BAFF21UMLNFHSC1020	100	100	5.1767	-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	-	-
					Mollusca	-	Bivalvia	-	-	-	Bivalvia indet.	-	0.0233	0.0233
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Amphipoda indet.	-	2.5146	2.5146
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammaridae indet.	-	0.3049	0.3049
	BAFF21UMLNFHSC1026	75	100	6.1231	-	-	-	-	-	-	Plant material	-	-	-
					-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	-	-
					Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	0.0156	0.0156
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Amphipoda indet.	-	0.0242	0.0242
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	-	Mysida indet.	-	0.0198	0.0198
					Arthropoda	Crustacea	Thecostraca	Cirripedia	-	-	Cirripedia indet.	7	0.0007	0.0001
					Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Tipulidae	Tipulidae indet.	3	5.9843	1.9948
	BAFF21UMLNFHSC1027	10	75	3.4292	-	-	-	-	-	-	Unidentified tissue	-	-	-
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.0018	0.0018
	BAFF21UMLNFHSC1028	10	100	3.7038	-	-	-	-	-	-	Unidentified tissue	-	-	-
	BAFF21UMLNFHSC1029	100	50	7.5666	-	-	-	-	-	-	Plant material	-	-	-
					-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	-	-
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	Calanidae	Calanus sp.	105	0.1306	0.0012
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Amphipoda indet.	-	0.0031	0.0031
					Arthropoda	Crustacea	Thecostraca	Cirripedia	Balanomorpha	-	Balanomorpha indet.	11	0.0010	0.0001
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	2.7013	2.7013
	BAFF21UMLNFHSC1035	25	50	2.2578	-	-	-	-	-	-	Unidentified tissue	-	-	-
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.0083	0.0083
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Oedicerotidae	Monoporeia affinis	1	0.0113	0.0113
					Arthropoda	Crustacea	Thecostraca	Cirripedia	Balanomorpha	-	Balanomorpha indet.	11	0.0006	0.0001
	BAFF21UMLNFHSC1036	100	75	6.6209	-	-	-	-	-	-	Sand	-	-	-
					-	-	-	-	-	-	Unidentified tissue	-	0.2307	0.2307
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Amphipoda indet.	-	0.0277	0.0277
					Arthropoda	Crustacea	Thecostraca	Cirripedia	Balanomorpha	-	Balanomorpha indet.	7	0.0003	0.0000
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	2.4316	2.4316
	BAFF21UMLNFHSC1038	50	25	3.1214	-	-	-	-	-	-	Unidentified tissue	-	0.1599	0.1599
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.7934	0.7934
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Oedicerotidae	Monoporeia affinis	1	0.0046	0.0046
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Anonyx sp.	1	0.2541	0.2541
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	2	0.0509	0.0255
					Chordata	Tunicata	Ascidiacea	-	-	-	Ascidiacea indet.	1	0.0970	0.0970
	BAFF21UMLNFHSC1040	5	75	1.8706	-	-	-	-	-	-	Unidentified tissue	-	0.0226	0.0226
					Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	0.0006	0.0006
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Harpacticoida	-	Harpacticoida indet.	1	0.0000	0.0000
					Arthropoda	Crustacea	Thecostraca	Cirripedia	Balanomorpha	-	Balanomorpha indet.	5	0.0002	0.0000

Table 7B-5: Stomach Contents of All Fish Captured from the Milne Port Area, 2021

Species	Fish Identification Number	Fullness (%)	Digested (%)	Full Stomach Weight (g)	Phyllum	Subphyllum	Class	Subclass	Order	Family	Taxon	Total Abundance	Total Wet Weight (g)	Wet Weight / Individual (g)
Arctic Char	BAFF21UMLNGN03ARCH03	25	100	26.2445	-	-	-	-	-	-	Unidentified tissue	-	1.5732	1.5732
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	-	1.5804	1.5804
	BAFF21UMLNGN03ARCH04	75	75	13.1581	Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	Calanidae	Calanus sp.	2	0.0074	0.0037
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	1	0.0306	0.0306
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	1.3989	1.3989
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	3	3.1729	1.0576
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	-	4.7610	4.7610
	BAFF21UMLNGN04ARCH46	75	25	11.5345	-	-	-	-	-	-	Unidentified tissue	-	1.0825	1.0825
					Mollusca	-	Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina sp.	1	0.0019	0.0019
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	Calanidae	Calanus sp.	8	0.0356	0.0045
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Hyperiidea indet.	1	0.0274	0.0274
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	7	0.2638	0.0377
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Onisimus sp.	48	1.4461	0.0301
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	0.4437	0.4437
	BAFF21UMLNGN05ARCH03	25	25	18.4049	-	-	-	-	-	-	Unidentified tissue	-	0.0334	0.0334
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	-	Calanoida indet.	2	0.0021	0.0011
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Hyperiidea indet.	1	0.0285	0.0285
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Atylidae	Atylus carinatus	1	0.0937	0.0937
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Atylidae	Atylus carinatus	1	0.0088	0.0088
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	5	0.0737	0.0147
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	1	0.0306	0.0306
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	0.6523	0.6523
	BAFF21UMLNGN05ARCH04	25	100	7.1648	-	-	-	-	-	-	Unidentified tissue	-	0.0855	0.0855
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	-	Calanoida indet.	2	0.0140	0.0070
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	-	0.6483	0.6483
	BAFF21UMLNGN05ARCH05	75	50	13.6432	Acanthocephala	-	-	-	-	-	Acanthocephala indet.	4	0.0087	0.0022
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.0010	0.0010
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	2	0.0454	0.0227
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	1	0.1051	0.1051
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	2	1.7665	0.8832
					Chordata	Vertebrata	Actinopteri	Teleostei	Perciformes	Cottidae	Cottidae indet.	1	2.1222	2.1222
	BAFF21UMLNGN06ARCH09[a]	75	100	0.2796	-	-	-	-	-	-	Unidentified tissue	-	0.0223	0.0223
					Arthropoda	Hexapoda	Insecta	-	-	-	Insecta indet.	-	0.0164	0.0164
					Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	Hydrobaenus sp.	25	0.0052	0.0002
					Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Simuliidae	Simuliidae indet.	1	0.0012	0.0012
					Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Tipulidae	Tipulidae indet.	1	0.0107	0.0107
					Arthropoda	Hexapoda	Insecta	Pterygota	Ephemeroptera	-	Ephemeroptera indet.	4	0.0001	0.0000
	BAFF21UMLNGN08ARCH03	5	100	2.9449	-	-	-	-	-	-	Unidentified tissue	-	0.0758	0.0758
					Mollusca	-	Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina sp.	-	0.0223	0.0223
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	8.7152	8.7152
	BAFF21UMLNGN10ARCH10	50	75	7.2455	Nemertea	-	-	-	-	-	Nemertea indet.	1	0.0354	0.0354
					Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	0.7356	0.7356
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	Calanidae	Calanus sp.	1	0.0011	0.0011
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	4	0.2652	0.0663
	BAFF21UMLNGN20ARCH02	75	50	10.2863	-	-	-	-	-	-	Unidentified tissue	-	0.0101	0.0101
					Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	0.4548	0.4548
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	Calanidae	Calanus sp.	2	0.0106	0.0053
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Hyperiidea indet.	-	0.0241	0.0241
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	19	1.9035	0.1002
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	-	Mysida indet.	2	0.0127	0.0063
	BAFF21UMLNGN21ARCH04	25	75	4.6684	-	-	-	-	-	-	Unidentified tissue	-	0.0043	0.0043
					Annelida	-	Polychaeta	-	-	-	Polychaeta indet.	-	0.0029	0.0029
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	-	Calanoida indet.	10	0.0001	0.0000
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Atylidae	Atylus sp.	1	0.0019	0.0019
					Chordata	Vertebrata	Actinopteri	Teleostei	Perciformes	Cottidae	Cottidae indet.	3	0.1998	0.0666
	BAFF21UMLNGN23ARCH01	100	50	39.0314	-	-	-	-	-	-	Unidentified tissue	-	0.3748	0.3748
					Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	5.8112	5.8112
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	148	8.4544	0.0571
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Onisimus sp.	4	0.0997	0.0249
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	-	0.2637	0.2637
	BAFF21UMLNGN25ARCH03	75	50	6.4741	Arthropoda	Crustacea	-	-	-	-	Crustacea indet.	-	1.3261	1.3261
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	46	1.9817	0.0431
	BAFF21UMLNGN25ARCH04	75	50	5.3719	-	-	-	-	-	-	Unidentified tissue	-	0.0356	0.0356
					Arthropoda	Crustacea	Hexanauplii	Copepoda	Calanoida	Calanidae	Calanus glacialis	3	0.0348	0.0116
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	-	Mysida indet.	2	0.0125	0.0062
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	-	1.2360	1.2360
					Chordata	Vertebrata	Actinopteri	Teleostei	Perciformes	Cottidae	Cottidae indet.	1	1.1486	1.1486
					Chordata	Vertebrata	Actinopteri	Teleostei	Perciformes	Cottidae	Cottidae indet.	9	1.1331	0.1259
	BAFF21UMLNGN25ARCH05	100	75	11.8608	Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	0.0922	0.0922
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	-	1.7193	1.7193
					Chordata	Vertebrata	Actinopteri	Teleostei	Perciformes	Cottidae	Cottidae indet.	19	2.5301	0.1332
					Chordata	Vertebrata	Actinopteri	Teleostei	Perciformes	Cottidae	Myoxocephalus sp.	3	3.1375	1.0458
	BAFF21UMLNGN25ARCH06	100	50	30.3276	-	-	-	-	-	-	Unidentified tissue	-	0.0296	0.0296
					Acanthocephala	-	-	-	-	-	Acanthocephala indet.	1	0.0025	0.0025
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Hyperiidea indet.	-	6.1572	6.1572
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	150	6.9122	0.0461
	BAFF21UMLNGN25ARCH13	75	50	13.0553	-	-	-	-	-	-	Unidentified tissue	-	0.8804	0.8804
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	-	Amphipoda indet.	-	0.8284	0.8284
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	1	0.0500	0.0500
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	29	1.0941	0.0377
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Onisimus sp.	1	0.0027	0.0027
					Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Onisimus sp.	2	0.0448	0.0224
					Chordata	Vertebrata	-	-	-	-	Pisces indet.	1	0.9961	0.9961

(a) Potentially feeding in freshwater prior to capture.

indet. = indeterminable; sp. = species; - = not available.

Table 7B-6: Outliers Omitted from Statistical Comparisons of Fourhorn Sculpin Health Endpoints, 2020 – 2021

Sex	Parameter	Year	FIN	Total Length (mm)	Total Weight (g)	SR
Female	Relative Liver Weight	2021	BAFF21UMLNFRSC1034	325	320	10.34
	Relative Gonad Weight	2021	BAFF21UMLNFRSC1019	309	335	35.89
Male	Relative Liver Weight	2021	BAFF21UMLNFRSC1017	250	158	7.08

Table 7B-7: Statistical Comparisons Between 2020 and 2021 for Fish Health Endpoints for Hiatella arctica, Milne Port

Species	Effect Indicator	Endpoint	Dependent Variable	Covariate	Statistical Test	Data Subset?	*n* Outliers	*n*		LSM		MSE	Interaction *P*-value	Levene's Test	Shapiro-Wilk	*P*-value	RPD (%)	Power Analysis	
								2020	2021	2020	2021							Minimum Detectable Difference	Sensitivity
Hiatella arctica	Condition	Condition	Total Weight	Total Length	$ANCOVA_{log10}$	Yes > 25 mm	0	50	29	0.645	0.605	0.006	0.220	0.862	0.701	**0.047**	9%	1.16	29%
						No	0	50	35	0.622	0.551	0.006	**0.001**	0.555	0.210	**0.001**	nc[(a)]	nc	nc

n = samples size; LSM = least-squares means; RPD = relative percent difference; log_{10} = log_{10}-transformed data; nc = not calculated.

(a) Not calculated due to significant interaction term.

APPENDIX 7C

Fish Tissue Data

Table 7C-1: Sample Counts for Fish Tissue Chemistry Analyses from the Milne Port Area, 2010 to 2021

Species	Year	Number of Samples	
		Metals	Polycyclic Aromatic Hydrocarbons
Arctic Char	2010	22[(a)]	0
	2013	17	14
	2015	5	0
	2016	13	0
	2017	2	0
	2018	26	0
	2019	47	0
	2020	8	8
	2021	8	8
Arctic Staghorn Sculpin	2013	1	0
Fourhorn Sculpin	2013	2	1
	2019	30	0
	2020	8	8
	2021	8	8
Hiatella arctica	2018	24	0
	2019	80	0
	2020	8	8
	2021	8	8
Unknown Sculpin	2019	30	0
Unknown Fish	2015	10	0
Total	**-**	**357**	**63**

(a) Includes 11 muscle samples and 11 liver samples.

Table 7C-2 Concentrations of Metals in Arctic Char Muscle Tissue Collected from the Milne Port Area, 2021

Parameter	DL	Fish Identification Number								
		BAFF21UMLNGN03ARCH03	BAFF21UMLNGN05ARCH03	BAFF21UMLNGN06ARCH09	BAFF21UMLNGN09ARCH03	BAFF21UMLNGN10ARCH10	BAFF21UMLNGN20ARCH02	BAFF21UMLNGN25ARCH03	BAFF21UMLNGN25ARCH05	Duplicate[a]
Moisture (%)	0.30	73.00	74.00	75.00	69.00	75.00	74.00	74.00	73.00	-
Total Metals (mg/kg ww)										
Aluminum	0.20 - 0.50	0.25	0.29	6.43	<0.20	<0.20	<0.20	<0.20	<0.20	9.78
Antimony	0.0010 - 0.0020	0.0012	0.0012	0.0038	<0.0010	<0.0010	0.0013	<0.0010	<0.0010	0.0052
Arsenic	0.0040 - 0.0050	5.5400	2.8800	0.0974	4.2500	2.6500	3.8400	0.4960	0.6870	0.1050
Barium	0.010	<0.010	<0.010	0.112	<0.010	<0.010	<0.010	<0.010	<0.010	0.134
Beryllium	0.0010 - 0.0020	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Bismuth	0.001 - 0.0013	<0.0010	<0.0010	<0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0013
Boron	0.20	<0.20	<0.20	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	0.32
Cadmium	0.0010 - 0.0013	0.0017	0.0012	<0.0013	<0.0010	0.0018	0.0019	0.0020	<0.0010	<0.0013
Calcium	2.0 - 4.0	60.1	73.0	439.0	425.0	136.0	154.0	227.0	122.0	323.0
Chromium	0.010 - 0.025	<0.010	0.013	0.115	<0.010	<0.010	<0.010	0.012	<0.010	0.106
Cobalt	0.0013	0.0041	0.0031	0.0135	0.0036	0.0031	0.0030	0.0084	0.0047	0.0206
Copper	0.010 - 0.013	0.487	0.607	0.475	0.358	0.386	0.299	0.370	0.484	0.342
Iron	0.25	4.68	6.23	89.90	3.11	3.49	3.41	3.79	4.15	84.40
Lead	0.0010 - 0.0013	0.0016	0.0088	0.0379	<0.0010	<0.0010	0.0041	0.0061	0.0017	0.0868
Magnesium	0.40	307.00	289.00	378.00	270.00	324.00	332.00	311.00	304.00	376.00
Manganese	0.010	0.060	0.084	0.576	0.133	0.083	0.079	0.075	0.092	0.582
Mercury	0.0020 - 0.0130	0.0478	0.0394	0.0630	0.0421	0.0334	0.0304	0.0604	0.0245	0.0540
Molybdenum	0.0040 - 0.0080	<0.0040	<0.0040	0.0122	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0121
Nickel	0.010	<0.010	0.022	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	0.055
Phosphorous	2.0	3050.0	2980.0	3120.0	2980.0	3240.0	3270.0	3370.0	3230.0	2900.0
Potassium	2.0 - 2.5	4520.0	4550.0	4810.0	4030.0	5010.0	4740.0	4370.0	4500.0	4560.0
Selenium	0.010	0.438	0.404	0.186	0.403	0.447	0.468	0.480	0.343	0.179
Silver	0.0010 - 0.0013	<0.0010	<0.0010	<0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0013
Sodium	2.0 - 2.5	274.0	292.0	428.0	289.0	235.0	268.0	334.0	250.0	416.0
Strontium	0.010 - 0.013	0.103	0.127	0.181	1.120	0.397	0.287	0.340	0.231	0.171
Thallium	0.00040	0.00199	0.00270	0.00854	0.00236	0.00228	0.00149	0.00396	0.00239	0.00882
Tin	0.020	<0.020	<0.020	0.045	<0.020	<0.020	<0.020	<0.020	<0.020	0.093
Titanium	0.020 - 0.130	0.431	0.424	0.550	0.423	0.434	0.450	0.473	0.449	1.550
Uranium	0.00040	<0.00040	<0.00040	0.00817	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00730
Vanadium	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc	0.040 - 0.200	4.570	4.440	9.340	5.090	4.480	4.390	5.580	6.090	10.300

% = percent; mg/kg ww = milligram per killigram wet weight; DL = Detection Limit; < = less than.

(a) Duplicate sample FIN: BAFF21UMLNGN06ARCH09

Table 7C-3 Concentrations of Metals in Fourhorn Sculpin Muscle Tissue Collected from the Milne Port Area, 2021

Parameter	DL	Fish Identification Number							
		BAFF21UMLNFRSC1003	BAFF21UMLNFRSC1006	BAFF21UMLNFRSC1019	BAFF21UMLNFRSC1029	BAFF21UMLNFRSC1030	BAFF21UMLNFRSC1031	BAFF21UMLNFRSC1033	BAFF21UMLNFRSC1036
Moisture (%)	0.30	77	78	78	78	79	78	76	80
Total Metals (mg/kg ww)									
Aluminum	0.20 - 0.50	0.31	0.49	0.56	0.61	0.62	0.28	1.25	0.34
Antimony	0.0010 - 0.0020	0.0012	0.0013	0.0013	<0.0010	0.0028	0.0021	0.0010	0.0012
Arsenic	0.0040 - 0.0050	4.2600	3.3900	4.8900	2.3300	3.8800	3.9700	2.0700	2.4100
Barium	0.010	0.015	0.034	0.060	0.028	<0.010	0.011	0.034	0.060
Beryllium	0.0010 - 0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010
Bismuth	0.0010 - 0.0013	0.0021	0.0014	0.0019	<0.0010	0.0026	0.0031	0.0018	0.0015
Boron	0.20	<0.20	<0.20	0.32	0.54	<0.20	<0.20	<0.20	<0.20
Cadmium	0.0010 - 0.0013	0.0051	0.0042	0.0095	0.0057	0.0041	0.0053	0.0056	0.0070
Calcium	2.0 - 4.0	200.0	515.0	1190.0	628.0	199.0	188.0	455.0	945.0
Chromium	0.010 - 0.025	0.020	0.018	0.019	0.030	0.028	<0.010	0.038	0.010
Cobalt	0.0013	0.0070	0.0076	0.0069	0.0065	0.0102	0.0119	0.0079	0.0087
Copper	0.010 - 0.013	0.516	0.445	0.470	0.453	0.708	0.554	0.458	0.464
Iron	0.25	6.39	6.25	6.92	5.38	9.16	8.14	7.86	5.37
Lead	0.0010 - 0.0013	0.0037	0.0037	0.0061	0.0055	0.0052	0.0134	0.0076	0.0053
Magnesium	0.40	245.00	304.00	261.00	297.00	272.00	236.00	308.00	295.00
Manganese	0.010	0.215	0.270	0.246	0.255	0.315	0.182	0.347	0.292
Mercury	0.0020 - 0.013	0.3240	0.1990	0.4210	0.1070	0.1980	0.3070	0.1020	0.1580
Molybdenum	0.0040 - 0.008	<0.0040	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040
Nickel	0.010	0.015	0.025	0.020	0.027	0.079	0.019	0.026	0.016
Phosphorous	2.0	2270.0	2500.0	2620.0	2440.0	2030.0	2250.0	2460.0	2690.0
Potassium	2.0 - 2.5	3700.0	3870.0	3520.0	3420.0	3440.0	3770.0	3730.0	3660.0
Selenium	0.010	0.572	0.508	0.534	0.498	0.409	0.547	0.426	0.437
Silver	0.0010 - 0.0013	<0.0010	<0.0010	<0.0010	0.0015	<0.0013	<0.0010	<0.0010	<0.0010
Sodium	2.0 - 2.5	622.0	649.0	775.0	1010.0	941.0	727.0	546.0	769.0
Strontium	0.010 - 0.013	0.905	2.350	7.340	2.570	1.040	1.240	2.450	5.150
Thallium	0.00040	0.00078	0.00076	0.00074	0.00050	0.00104	0.00076	0.00081	0.00063
Tin	0.020	0.025	0.024	<0.020	0.042	0.025	0.190	<0.020	<0.020
Titanium	0.020 - 0.130	0.343	0.370	0.377	0.367	0.300	0.317	0.516	0.380
Uranium	0.00040	<0.00040	0.00101	0.00141	0.00075	0.00079	<0.00040	<0.00040	0.00078
Vanadium	0.020	<0.020	<0.020	0.056	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc	0.040 - 0.200	22.400	12.500	19.000	9.590	17.400	26.100	10.100	18.200

% = percent; mg/kg ww = milligram per killigram wet weight; DL = Detection Limit; < = less than.

Table 7C-4 Concentrations of Metals in Hiatella arctica Tissue Collected from the Milne Port Area, 2021

Parameter	DL	Fish Identification Number							
		BAFF21UMLNHTARCOMP1	BAFF21UMLNHTARCOMP2	BAFF21UMLNHTARCOMP3	BAFF21UMLNHTARCOMP4	BAFF21UMLNHTARCOMP5	BAFF21UMLNHTARCOMP6	BAFF21UMLNHTARCOMP7	BAFF21UMLNHTARCOMP8
Moisture (%)	0.30	66	77	78	70	75	76	68	76
Total Metals (mg/kg ww)									
Aluminum	0.50	1380	923	439	1500	390	784	867	551
Antimony	0.0020	0.0244	0.0161	0.0121	0.0237	0.0105	0.0169	0.0323	0.0111
Arsenic	0.0050	5.61	2.98	3.19	2.91	2.19	3.41	6.24	2.43
Barium	0.010	13.9	6.72	8.79	9.38	12.3	9.06	13.4	5.20
Beryllium	0.0020	0.0718	0.0466	0.0250	0.0808	0.0209	0.0400	0.0465	0.0279
Bismuth	0.0013	0.0133	0.0119	0.0059	0.0167	0.0055	0.0085	0.0105	0.0065
Boron	0.20	11.8	8.04	5.17	11.6	4.75	6.90	8.73	4.95
Cadmium	0.0013	0.524	0.937	0.540	0.918	1.00	0.608	0.877	0.932
Calcium	4.0	12200	6790	4790	12300	4330	6390	9880	4050
Chromium	0.025	4.50	2.72	1.20	4.04	1.15	1.98	2.55	1.47
Cobalt	0.0013	1.62	1.54	0.708	1.69	0.679	0.786	3.25	0.567
Copper	0.013	2.49	3.16	1.66	3.91	2.16	2.21	2.98	1.61
Iron	0.25	5170	2050	1570	3560	1290	2010	3380	969
Lead	0.0013	1.51	1.83	0.668	2.06	0.557	0.967	1.41	0.682
Magnesium	0.40	5660	3760	2010	5720	2010	3000	3940	2490
Manganese	0.010	194	192	84.3	201	77.5	134	611	54.9
Mercury	0.013	0.033	0.031	0.033	0.023	0.029	0.030	0.036	0.029
Molybdenum	0.0080	0.402	0.356	0.222	0.466	0.264	0.216	0.681	0.253
Nickel	0.010	2.93	2.21	1.15	2.93	1.36	1.56	2.93	1.21
Phosphorous	2.0	1350	1510	1100	1340	1430	1700	1700	1490
Potassium	2.5	1780	1740	1250	2090	1440	1560	1600	1560
Selenium	0.010	1.44	1.36	1.38	1.20	1.54	1.32	1.68	1.25
Silver	0.0013	0.0078	0.0107	0.0039	0.0413	0.0062	0.0071	0.0094	0.0042
Sodium	2.5	3540	3860	2950	3420	2950	3840	2790	3270
Strontium	0.013	44.7	19.8	25.4	28.0	17.3	24.0	41.2	11.0
Thallium	0.00040	0.0358	0.0242	0.0109	0.0332	0.0102	0.0153	0.0547	0.0112
Tin	0.020	0.123	0.083	0.054	0.105	0.055	0.092	0.064	0.053
Titanium	0.13	67.8	32.9	16.7	53.8	13.7	27.6	33.1	19.5
Uranium	0.00040	0.279	0.164	0.138	0.281	0.126	0.141	0.204	0.107
Vanadium	0.020	5.38	3.79	2.09	5.42	1.76	2.90	4.96	2.09
Zinc	0.20	13.6	15.1	11.9	14.3	17.3	11.6	14.1	12.6

% = percent; mg/kg ww = milligram per killigram wet weight; DL = Detection Limit; < = less than.

Table 7C-5 Concentrations of Polycyclic Aromatic Hydrocarbons in Arctic Char Muscle Tissue Collected from the Milne Port Area, 2021

Parameter	DL	Fish Identification Number							
		BAFF21UMLNGN03ARCH03	BAFF21UMLNGN05ARCH03	BAFF21UMLNGN06ARCH09	BAFF21UMLNGN09ARCH03	BAFF21UMLNGN10ARCH10	BAFF21UMLNGN20ARCH02	BAFF21UMLNGN25ARCH03	BAFF21UMLNGN25ARCH05
Polycyclic Aromatic Hydrocarbons (mg/kg ww)									
1-Methylnaphthalene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(j)fluoranthene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Perylene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Naphthalene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoranthene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Pyrene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)anthracene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Chrysene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(b)fluoranthene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	0.050 - 0.070	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050
Surrogate Recovery (%)									
D10-Anthracene	-	83	89	94	96	93	81	90	88
D8-Acenaphthylene	-	88	91	94	98	96	82	93	89
Terphenyl-D14	-	83	87	91	95	93	76	87	86

% = percent; mg/kg ww = milligram per killigram wet weight; DL = Detection Limit; < = less than.

Table 7C-6 Concentrations of Polycyclic Aromatic Hydrocarbons in Fourhorn Sculpin Muscle Tissue Collected from the Milne Port Area, 2021

Parameter	DL	Fish Identification Number							
		BAFF21UMLNFRSC1003	BAFF21UMLNFRSC1006	BAFF21UMLNFRSC1019	BAFF21UMLNFRSC1029	BAFF21UMLNFRSC1030	BAFF21UMLNFRSC1031	BAFF21UMLNFRSC1033	BAFF21UMLNFRSC1036
Polycyclic Aromatic Hydrocarbons (mg/kg ww)									
1-Methylnaphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(j)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Perylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Naphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chrysene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(b)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Surrogate Recovery (%)									
D10-Anthracene	-	90	91	85	88	80	92	94	101
D8-Acenaphthylene	-	90	94	86	90	79	97	96	102
Terphenyl-D14	-	89	90	83	86	78	92	93	99

% = percent; mg/kg ww = milligram per killigram wet weight; DL = Detection Limit; < = less than.

Table 7C-7 Concentrations of Polycyclic Aromatic Hydrocarbons in Hiatella arctica Tissues Collected from the Milne Port Area, 2021

Parameter	DL	Fish Identification Number							
		BAFF21UMLNHTARCOMP10	BAFF21UMLNHTARCOMP11	BAFF21UMLNHTARCOMP12	BAFF21UMLNHTARCOMP13	BAFF21UMLNHTARCOMP14	BAFF21UMLNHTARCOMP15	BAFF21UMLNHTARCOMP16	BAFF21UMLNHTARCOMP9
Polycyclic Aromatic Hydrocarbons (mg/kg ww)									
1-Methylnaphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(j)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Perylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Naphthalene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chrysene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(b)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Surrogate Recovery (%)									
D10-Anthracene	-	101	104	102	107	98	101	102	100
D8-Acenaphthylene	-	98	99	97	104	95	99	98	99
Terphenyl-D14	-	98	103	99	105	96	99	99	99

% = percent; mg/kg ww = milligram per killigram wet weight; DL = Detection Limit; < = less than.

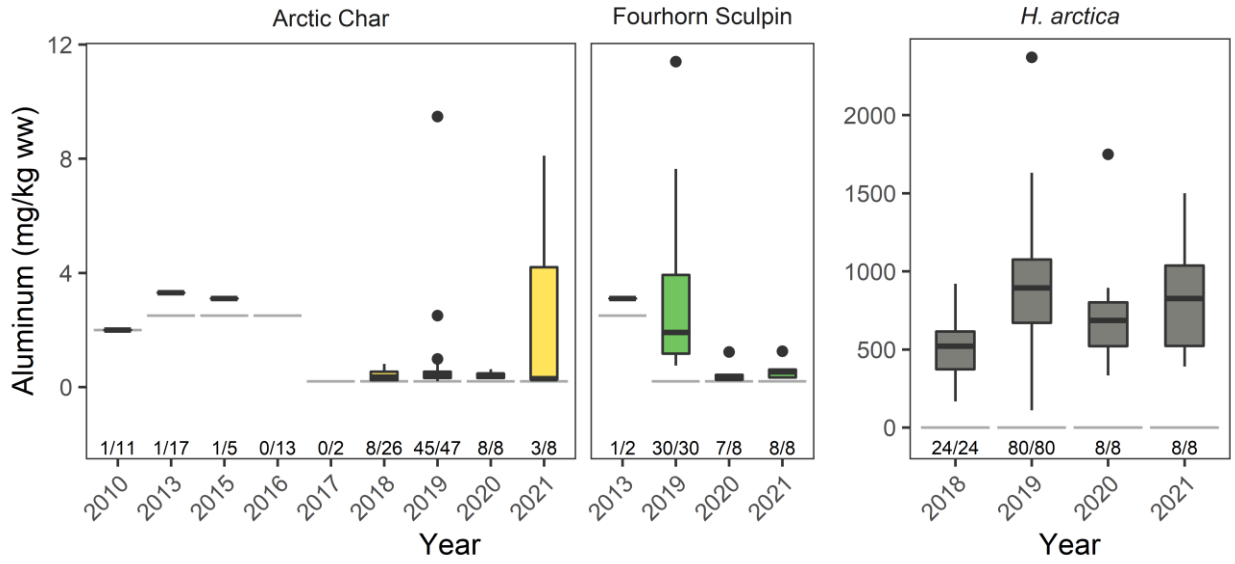
Table 7C-8: Statistical Comparisons including High Leverage Points Between 2020 and 2021 for Arctic Char Tissue Chemistry, Milne Port

Species	Parameter	Test	Sample Size				*n* Outliers	High Leverage Point Included?	*P*-value	Error (MSE)	LS Mean				Post-hoc *P*-value						RPD (%)						Power Analysis	
			2018	2019	2020	2021					2018	2019	2020	2021	2018* 2019	2018* 2020	2018* 2021	2019* 2020	2019* 2021	2020* 2021	2018* 2019	2018* 2020	2018* 2021	2019* 2020	2019* 2021	2020* 2021	Min Detectable Difference	Sensitivity
Arctic Char	Selenium	$ANCOVA_{rank}$	26	45	8	7	1	No	**<0.001**	758.095	0.334	0.403	0.327	0.426	**<0.001**	0.938	**<0.001**	**0.001**	0.556	**0.001**	-19%	nc	24%	nc	nc	26%	0.116	31%
			26	45	8	7	0	Yes	**<0.001**	784.268	0.336	0.401	0.324	0.393	**<0.001**	0.937	**0.002**	**0.004**	0.753	**0.005**	-18%	nc	16%	nc	nc	19%	0.131	37%

n = samples size; LSM = least-squares means; RPD = relative percent difference; rank = rank-transformed data.

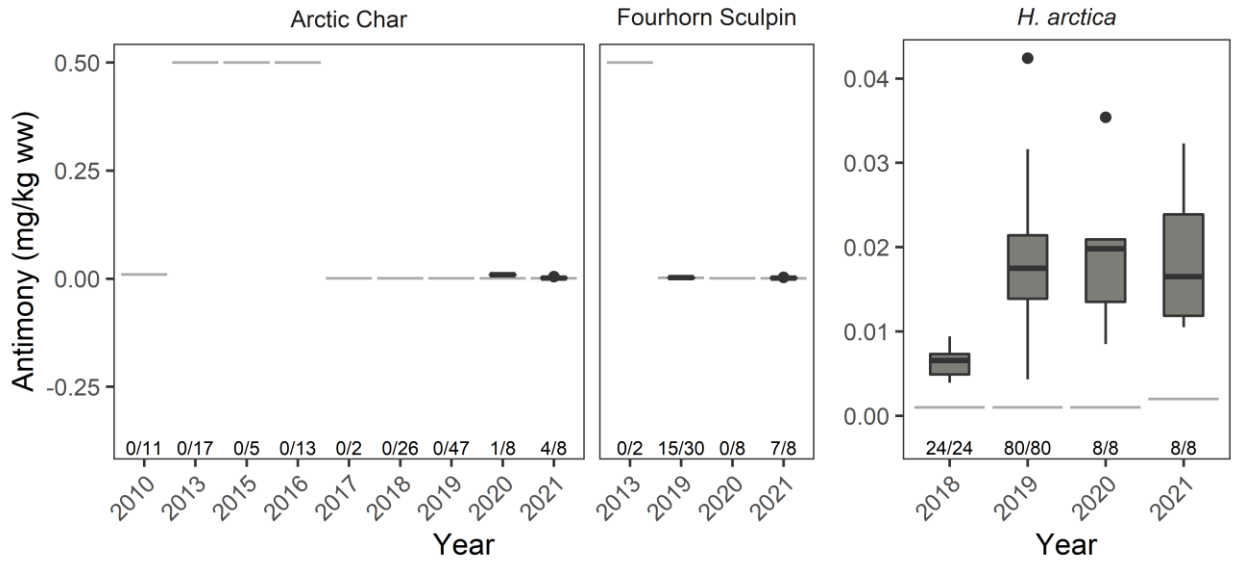
APPENDIX 7D

Fish Tissue Boxplots



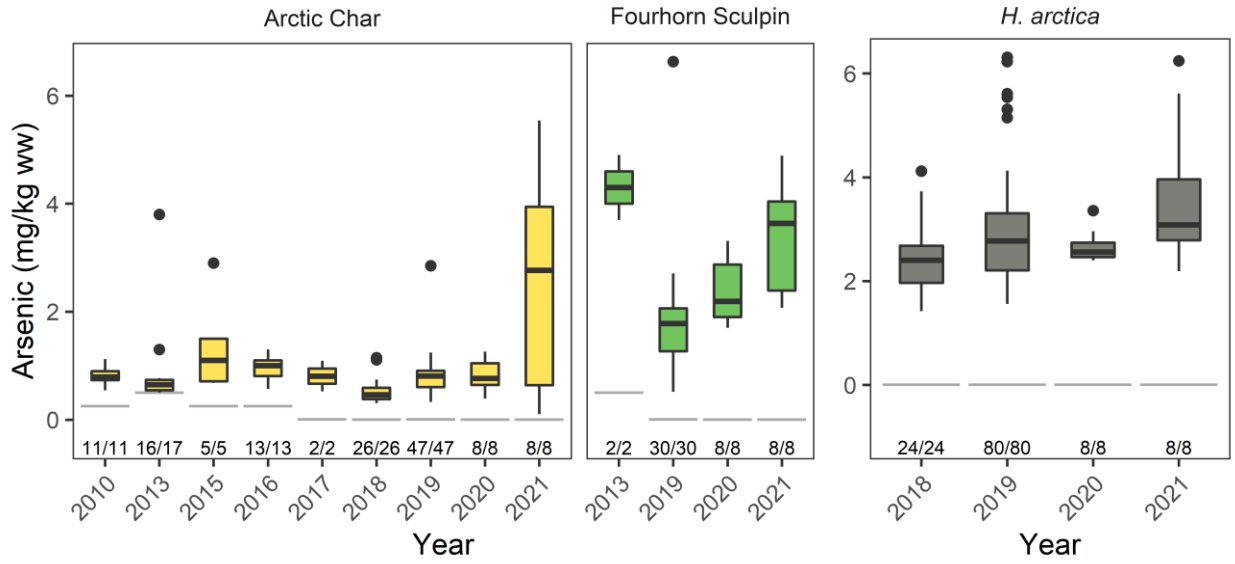
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-1: Concentrations of Aluminum for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



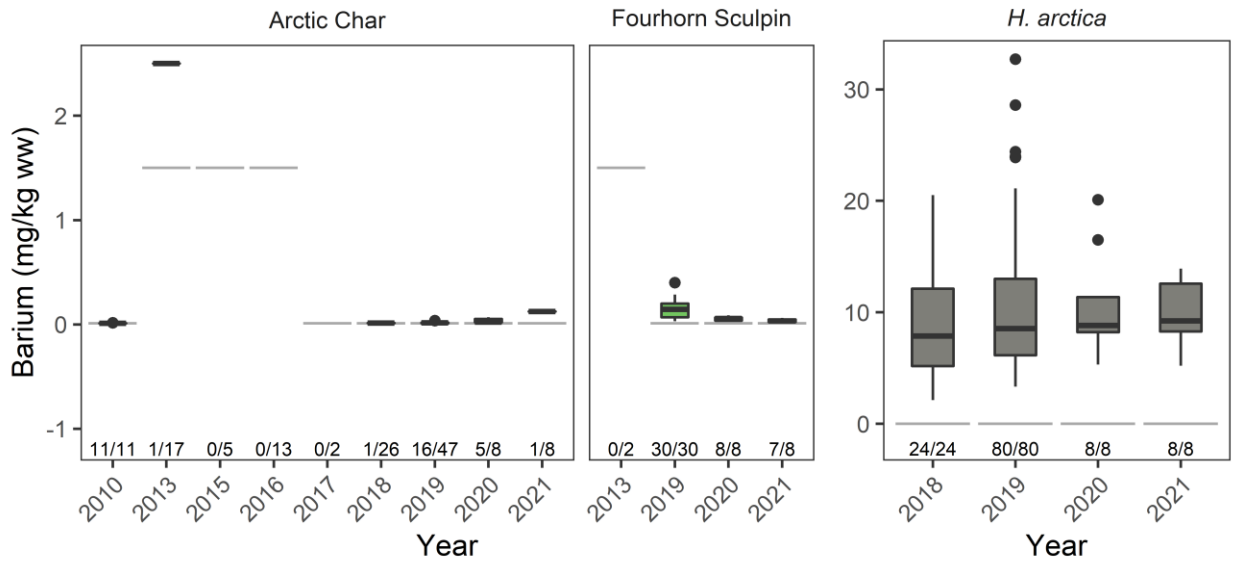
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-2: Concentrations of Antimony for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



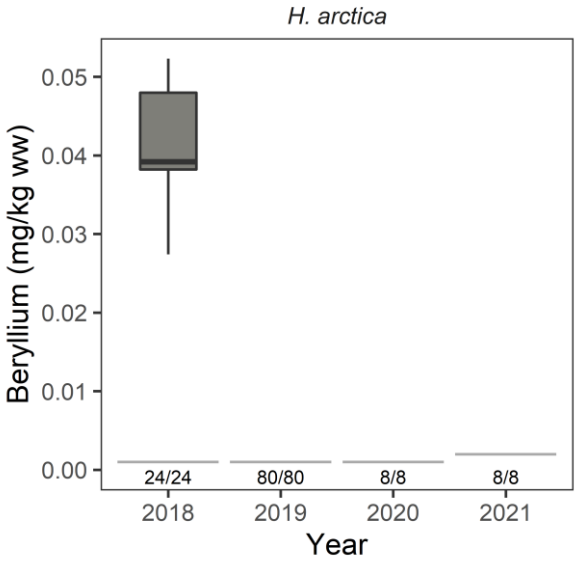
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits. One Arctic Char sample removed from 2020 (BAFF20UMLNGN18ARCH003, 33.2 mg/kg ww) to improve plotting.

Figure 7D-3: Concentrations of Arsenic for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



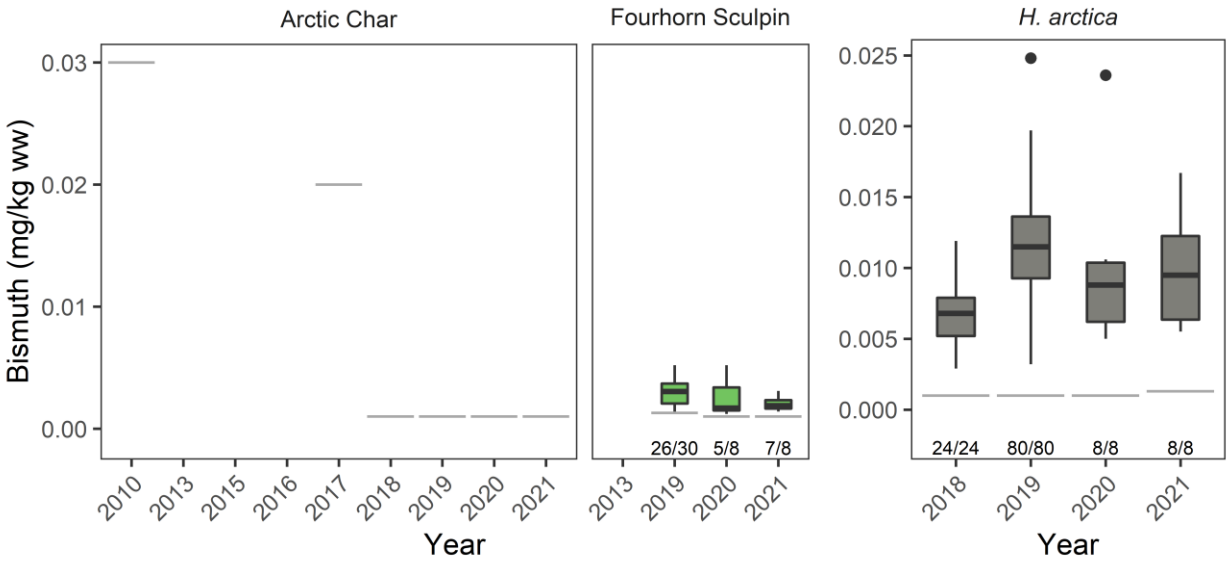
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-4: Concentrations of Barium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



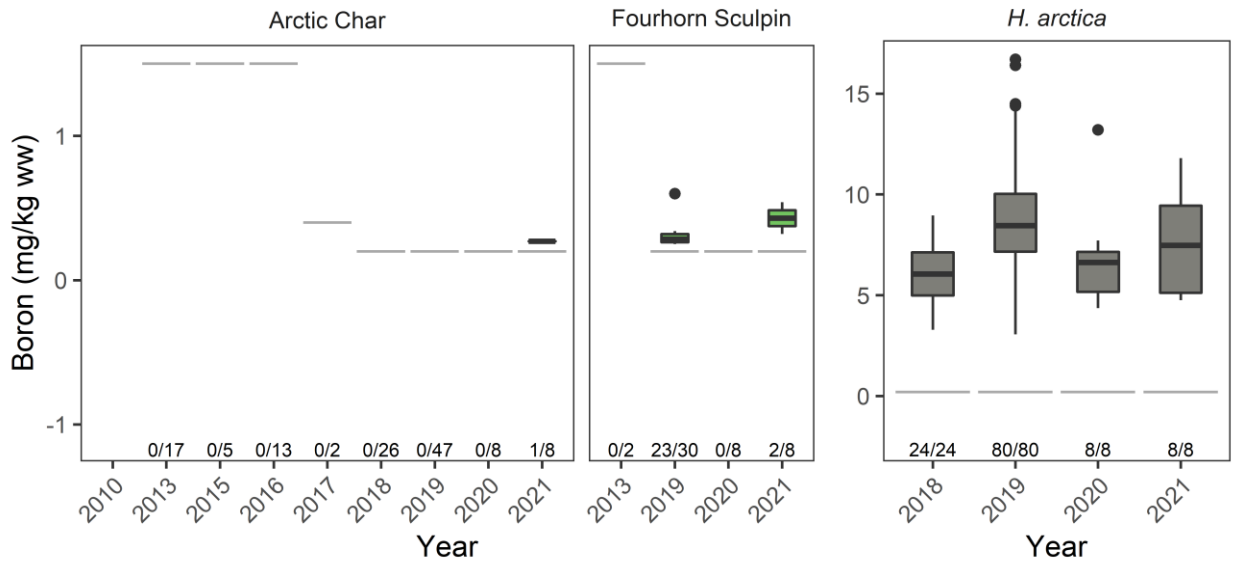
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-5: Concentrations of Beryllium for *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



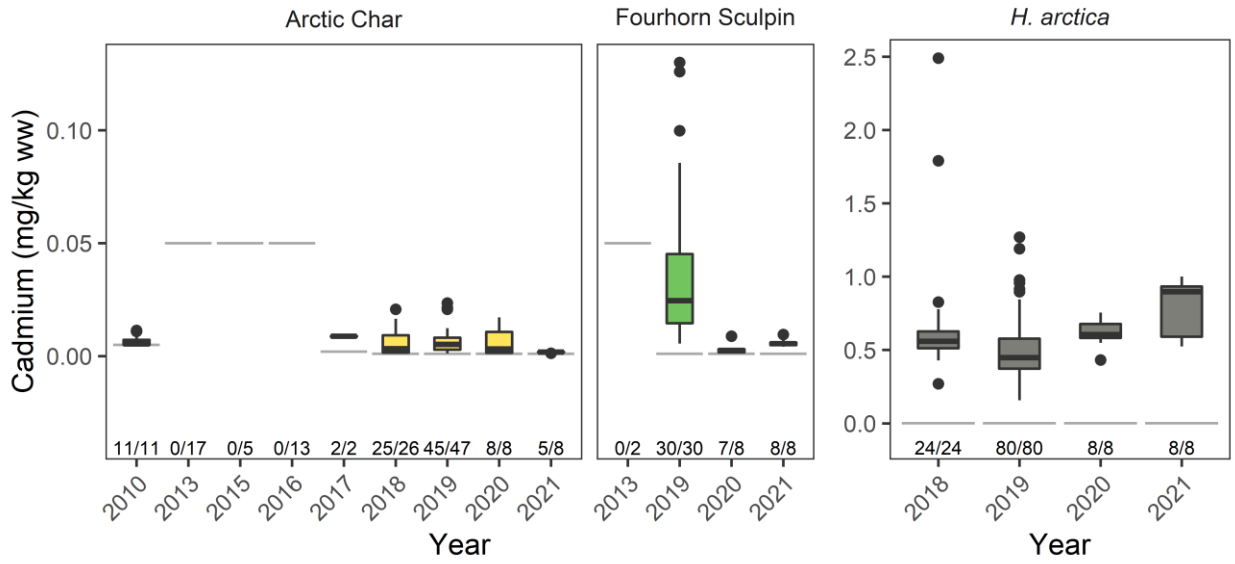
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-6: Concentrations of Bismuth for Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



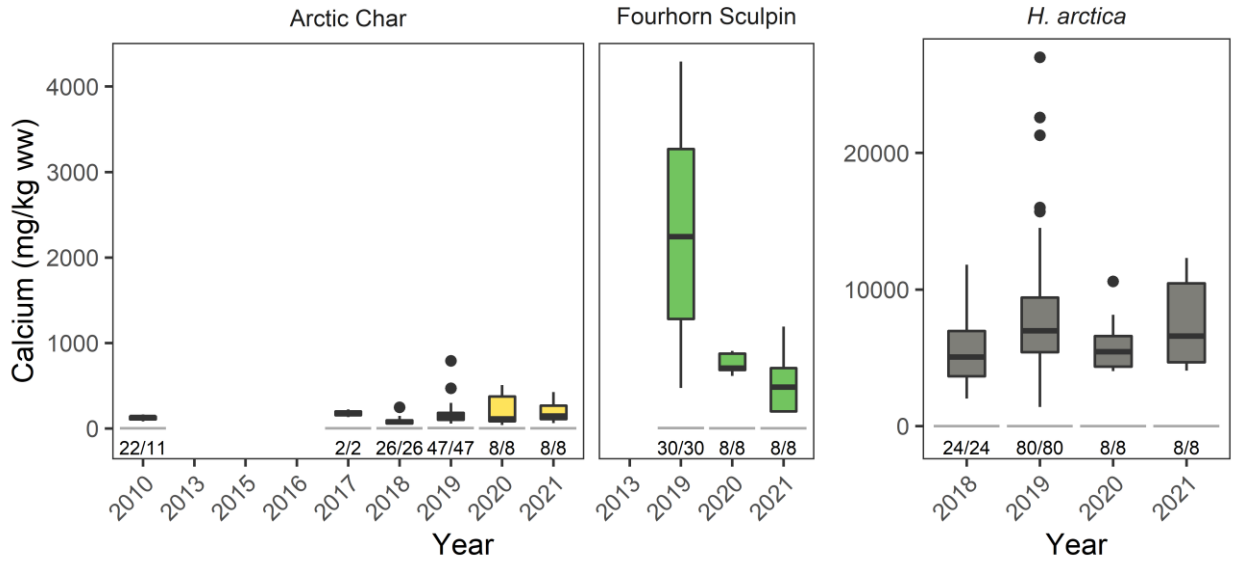
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-7: Concentrations of Boron for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



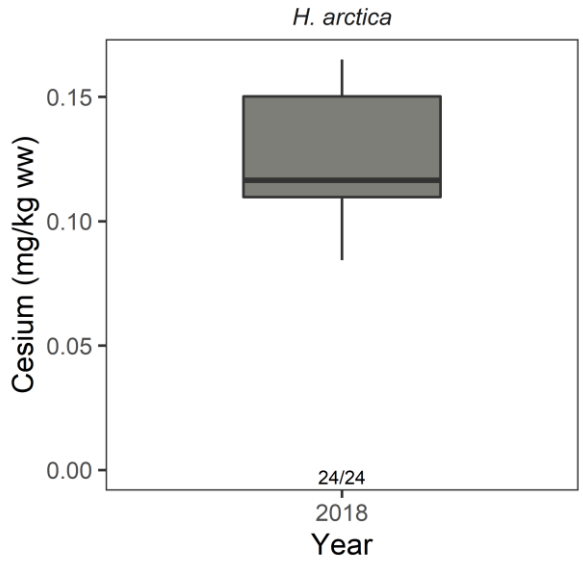
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-8: Concentrations of Cadmium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



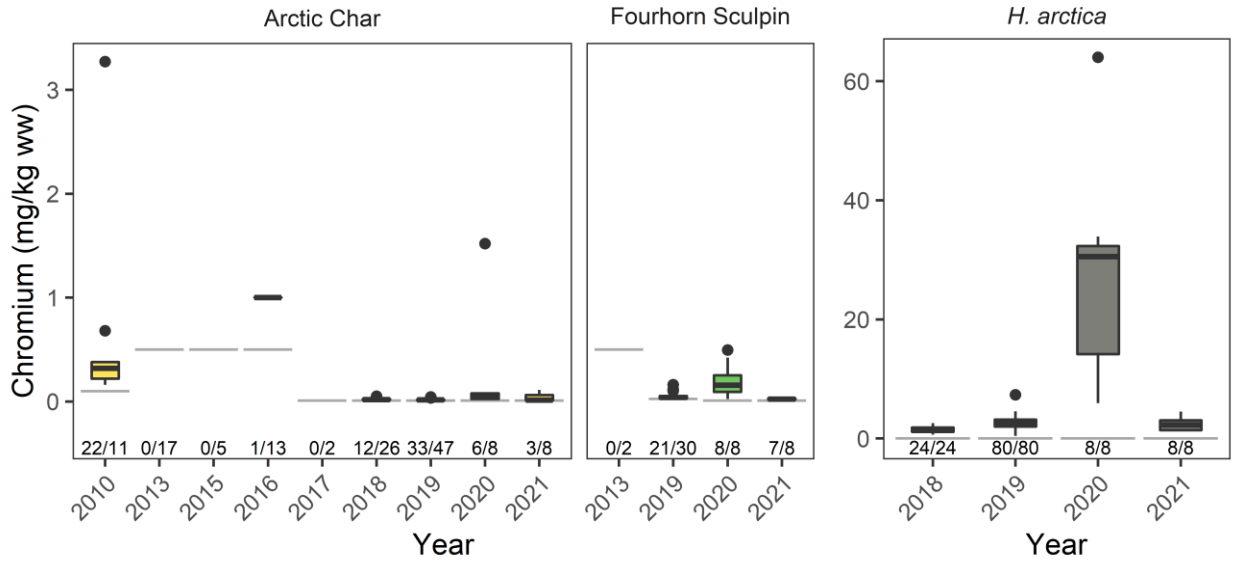
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-9: Concentrations of Calcium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



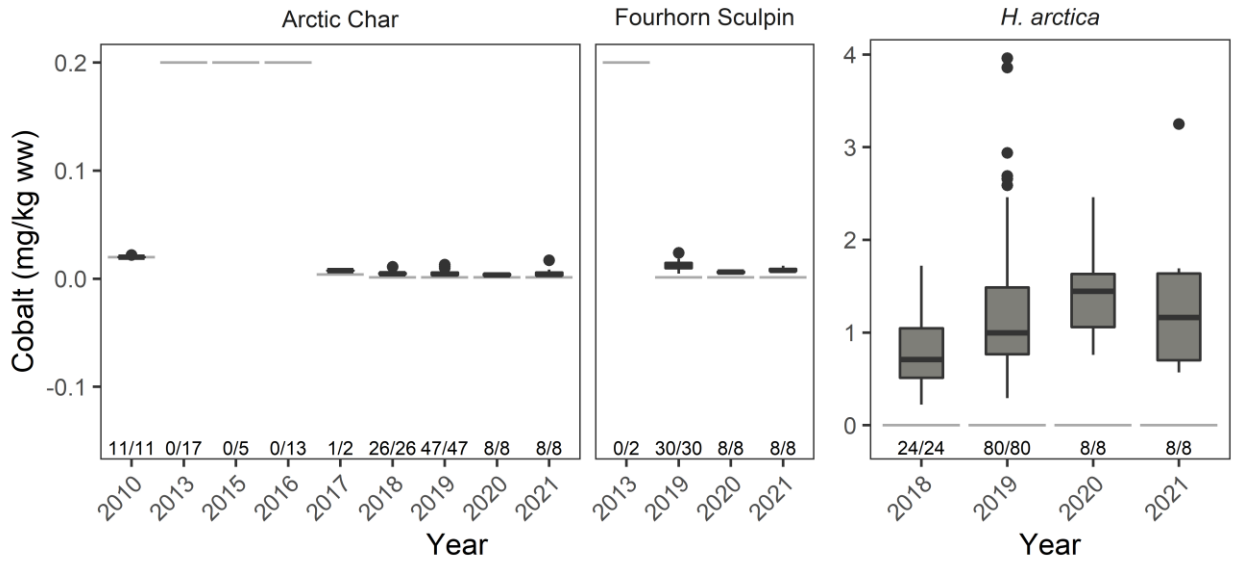
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-10: Concentrations of Cesium for *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



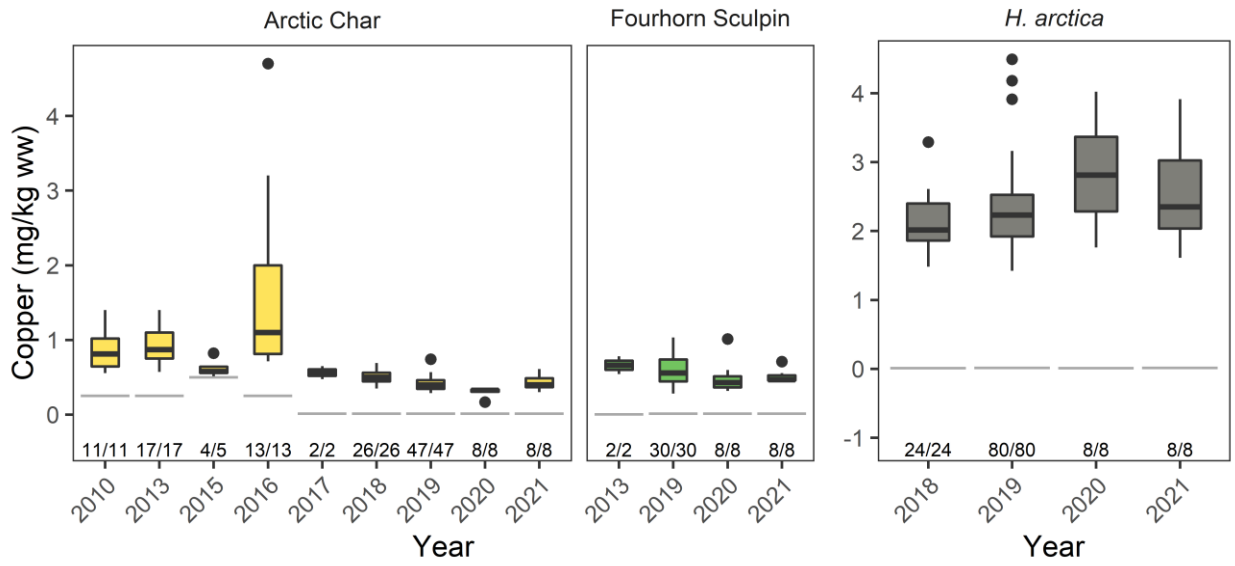
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-11: Concentrations of Chromium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



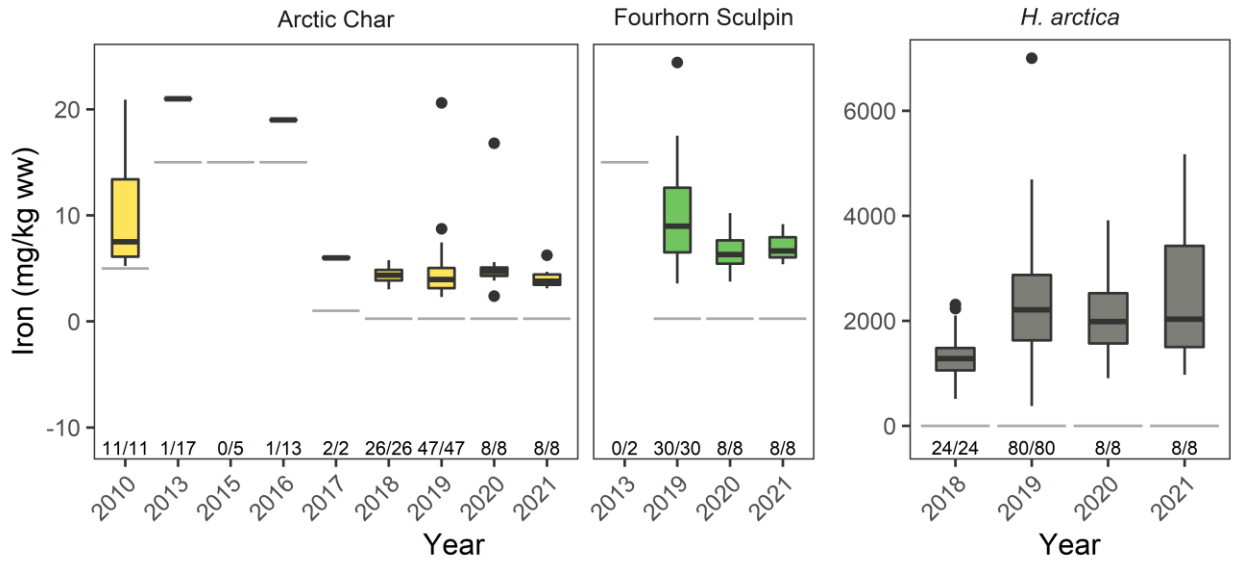
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-12: Concentrations of Cobalt for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



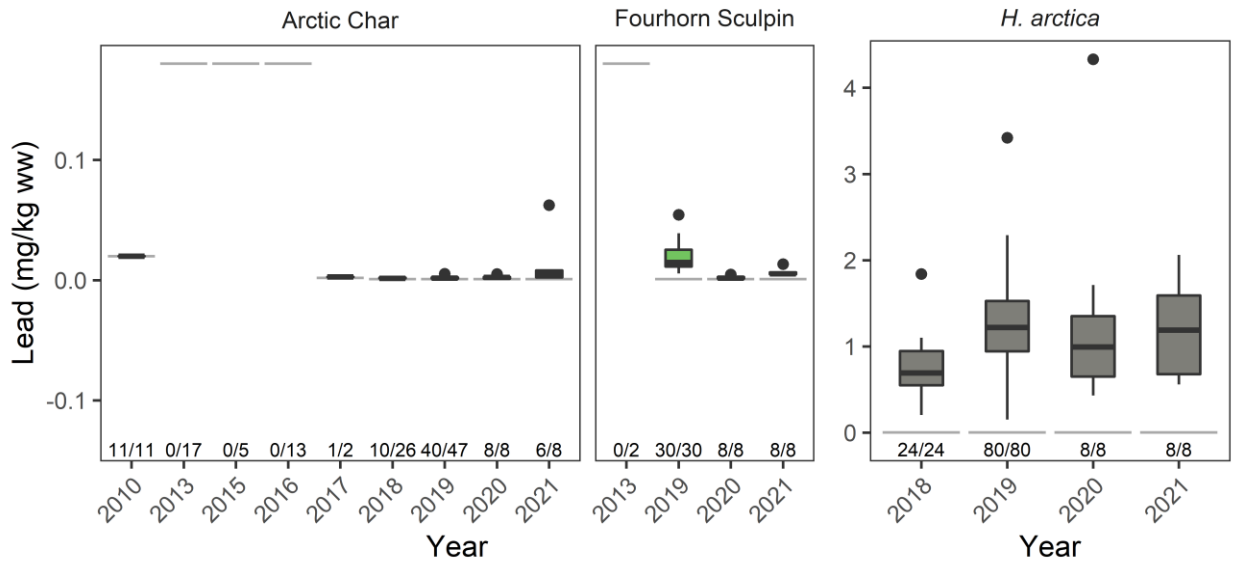
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-13: Concentrations of Copper for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



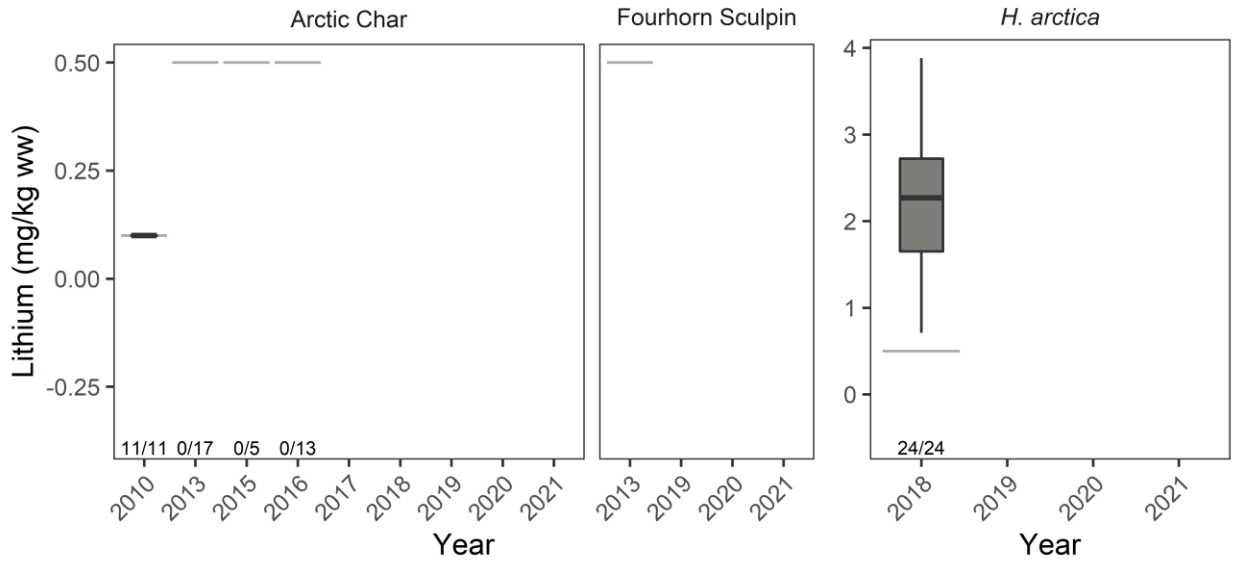
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits. One Arctic Char sample removed from 2021 (BAFF21UMLNGN06ARCH09, 87.15 mg/kg ww) to improve plotting.

Figure 7D-14: Concentrations of Iron for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



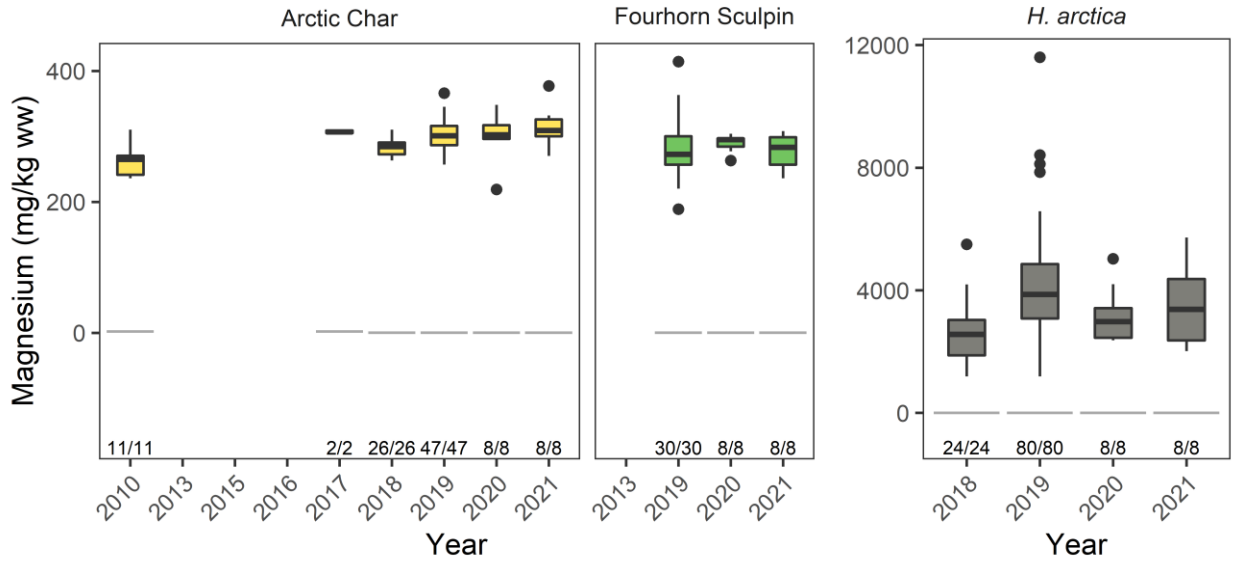
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-15: Concentrations of Lead for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



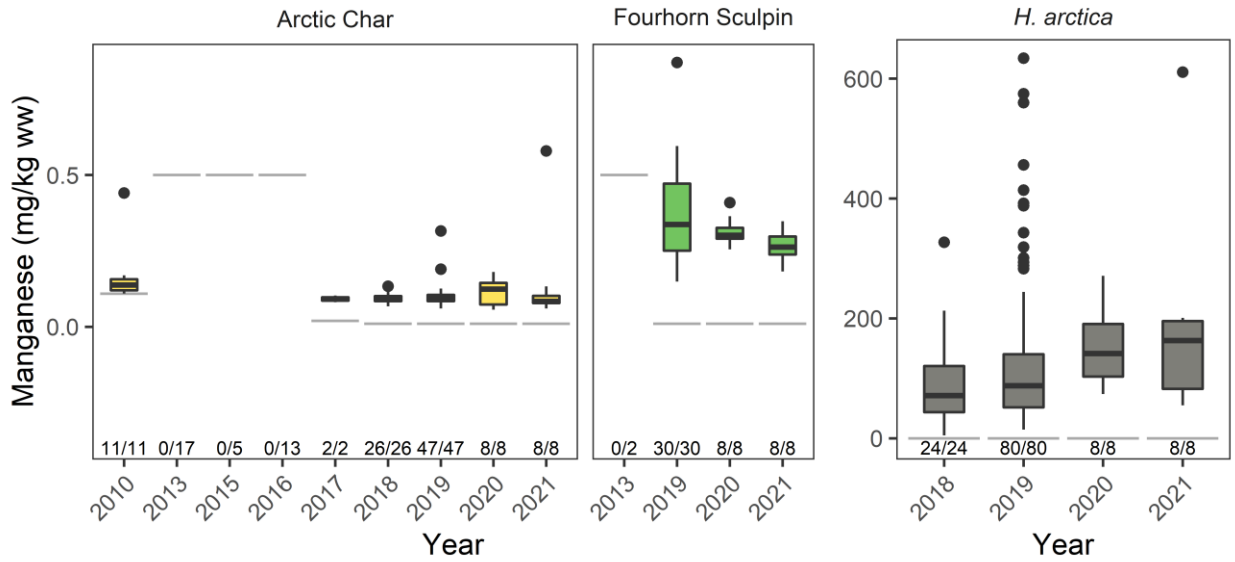
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-16: Concentrations of Lithium for *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



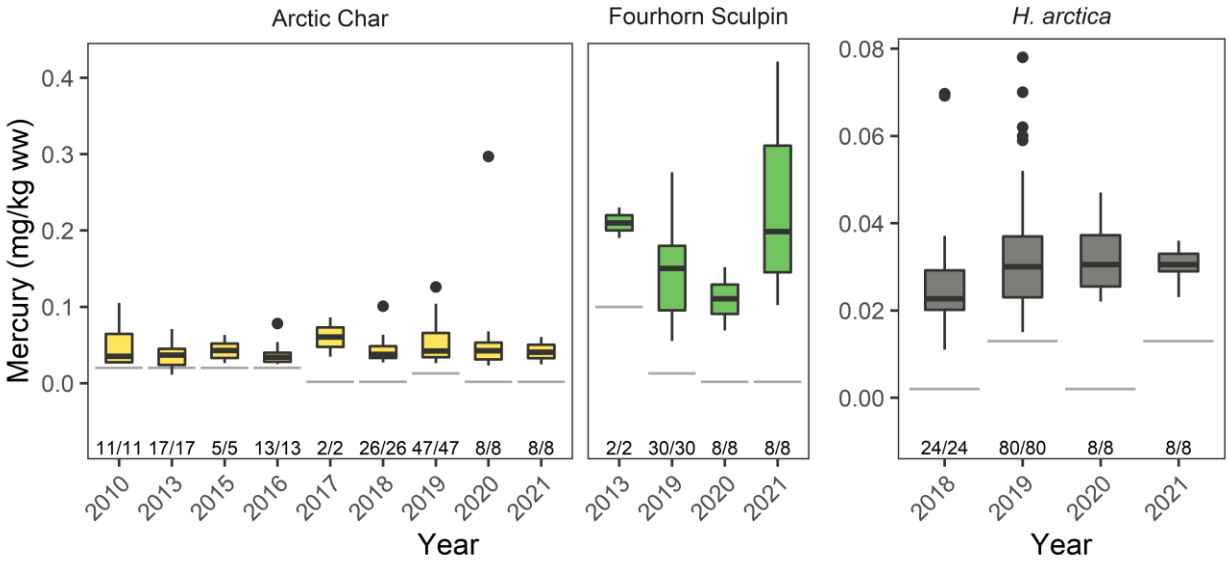
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-17: Concentrations of Magnesium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



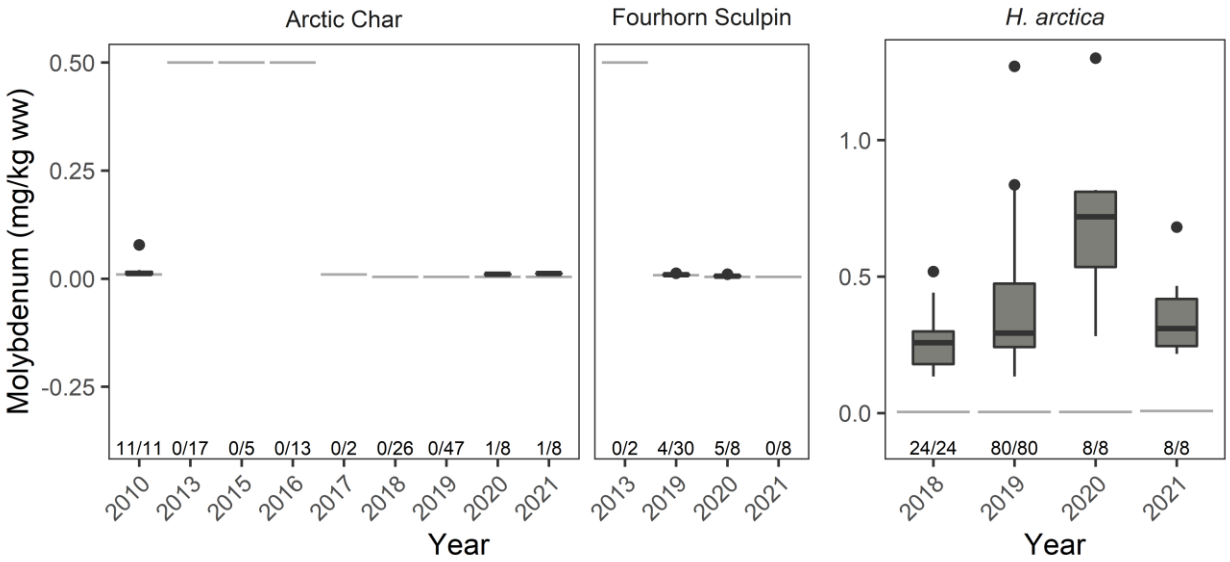
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-18: Concentrations of Manganese for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



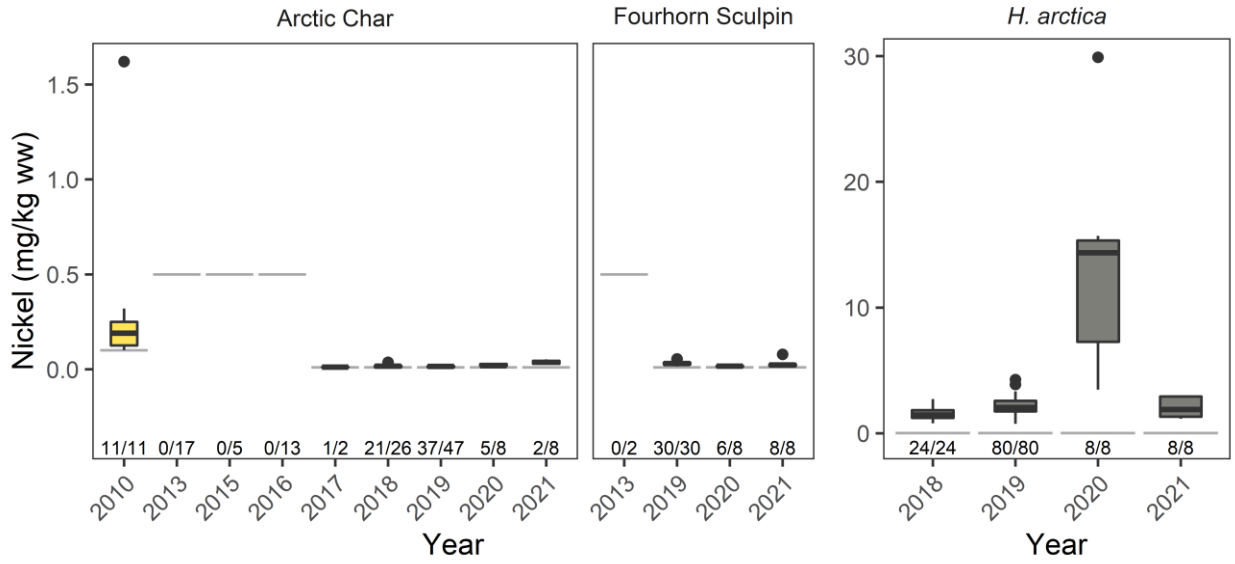
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-19: Concentrations of Mercury for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



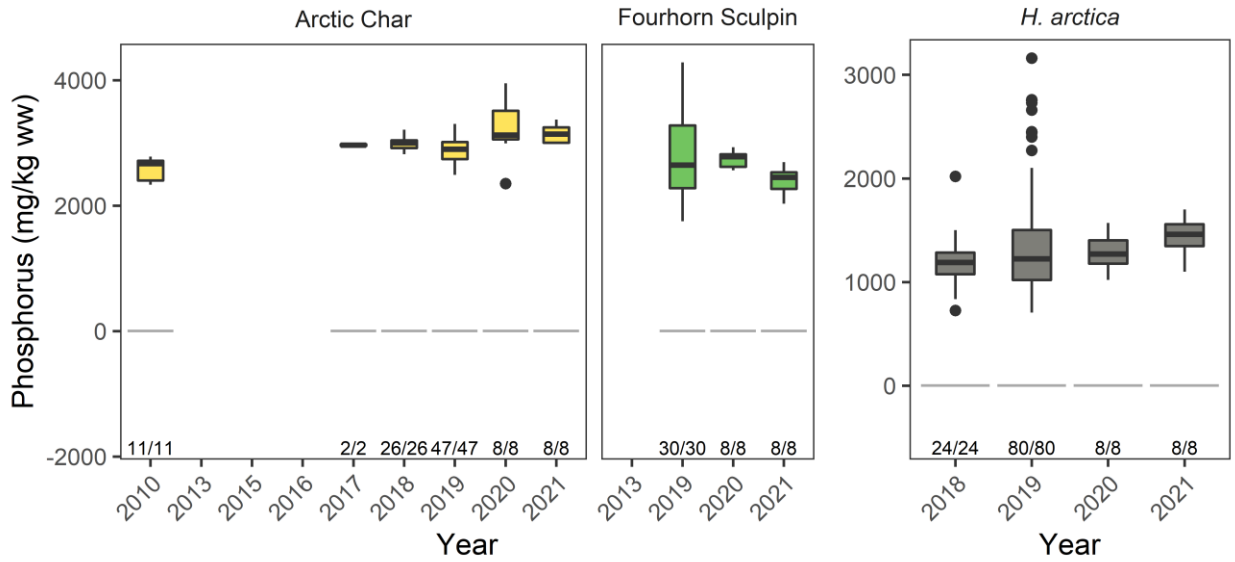
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-20: Concentrations of Molybdenum for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



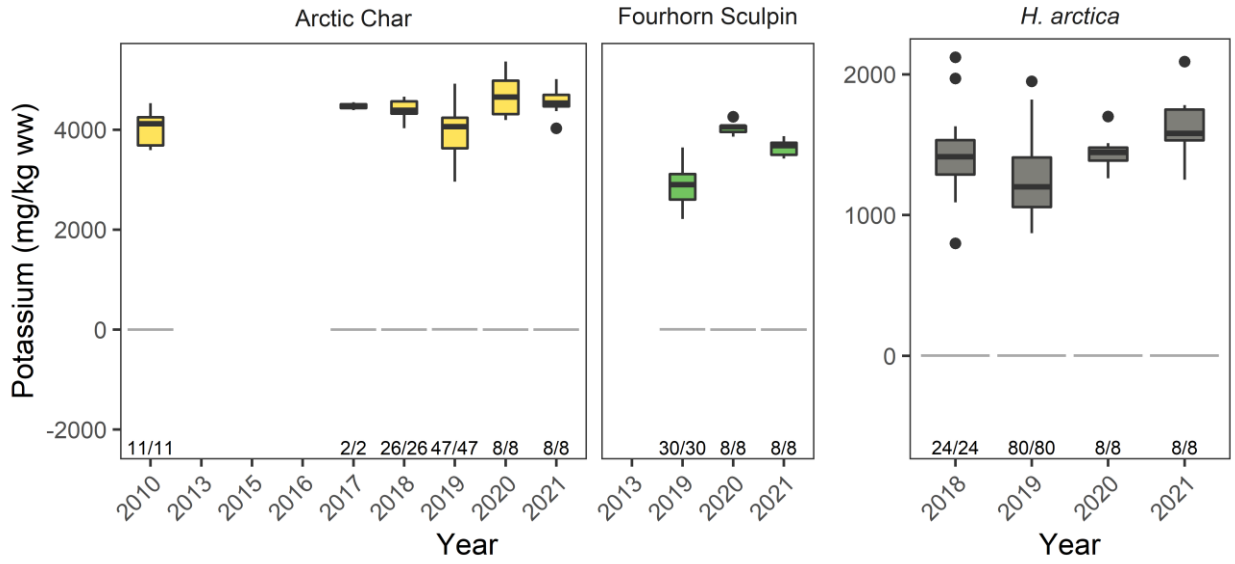
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-21: Concentrations of Nickel for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



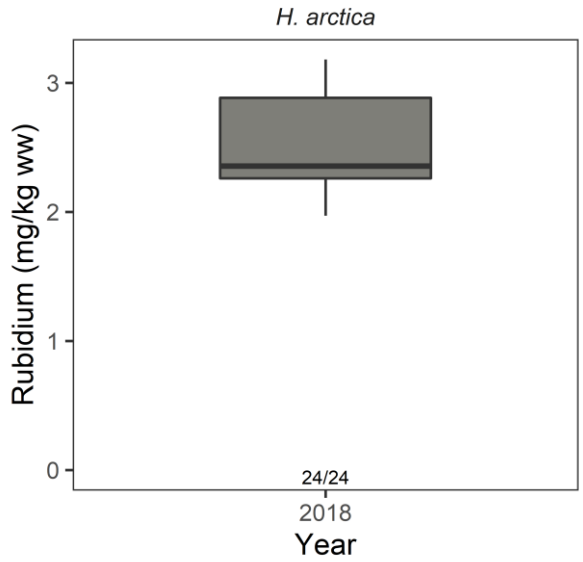
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-22: Concentrations of Phosphorus for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



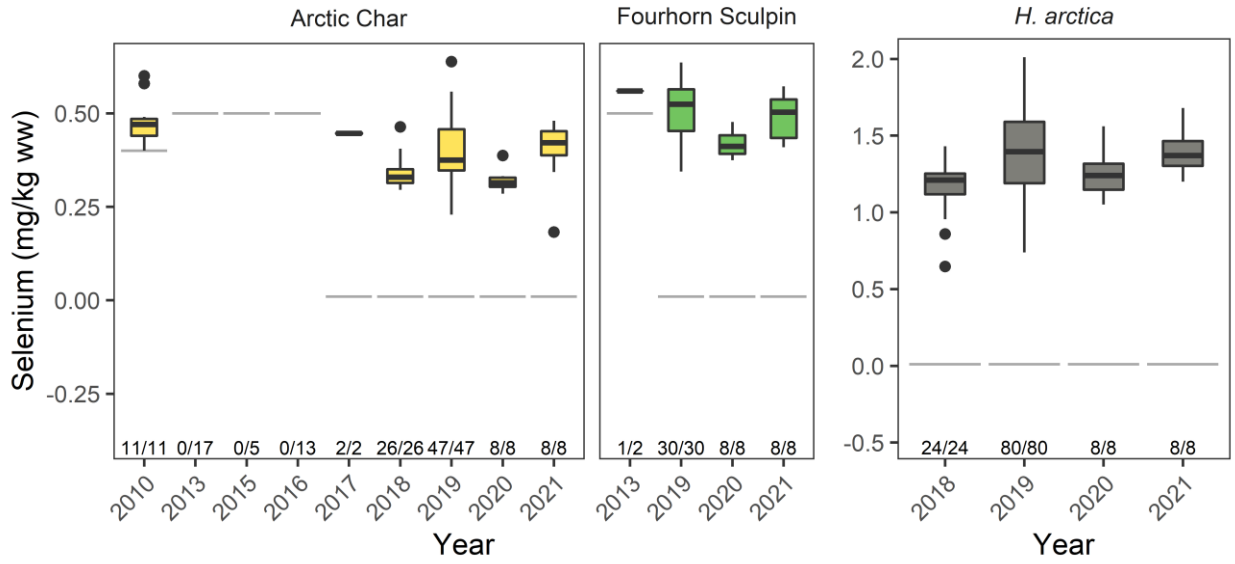
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-23: Concentrations of Potassium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



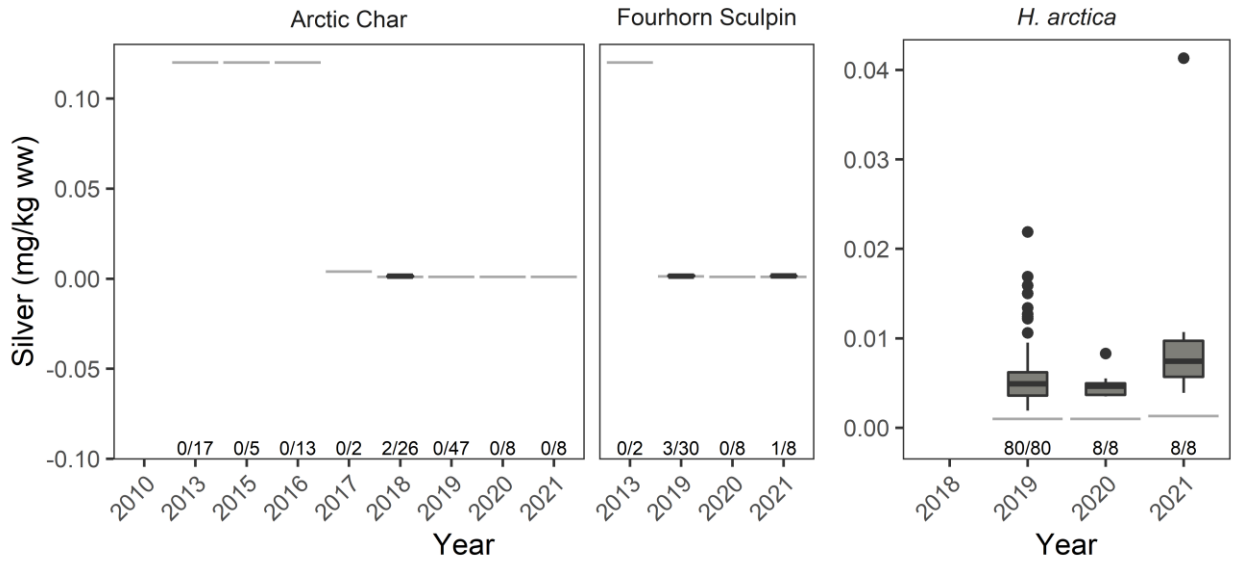
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-24: Concentrations of Rubidium for *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



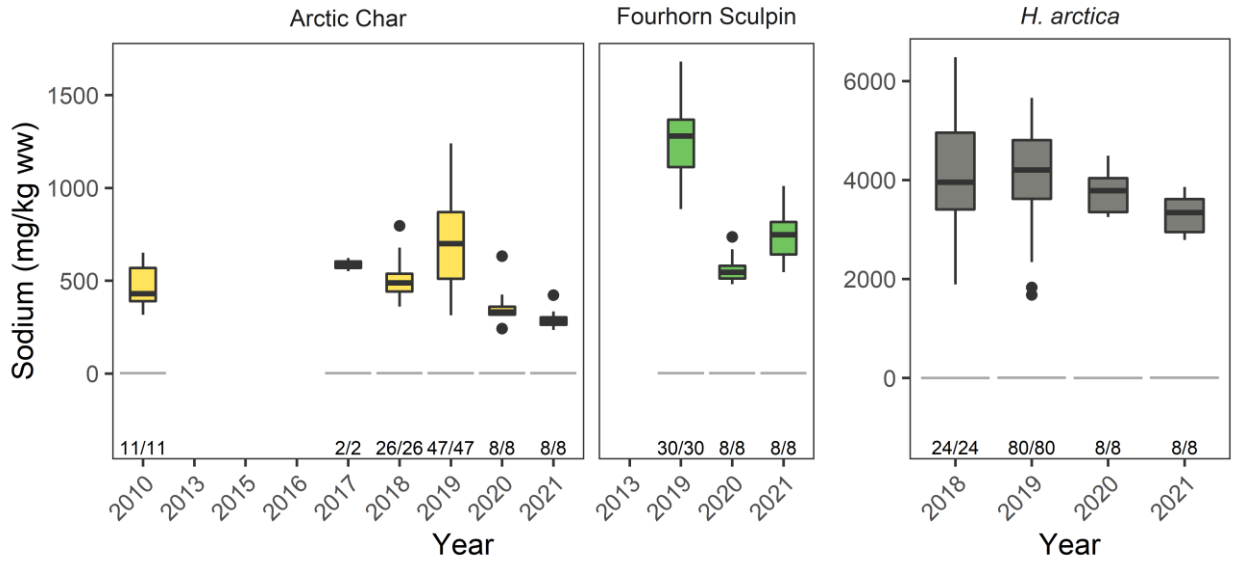
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-25: Concentrations of Selenium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



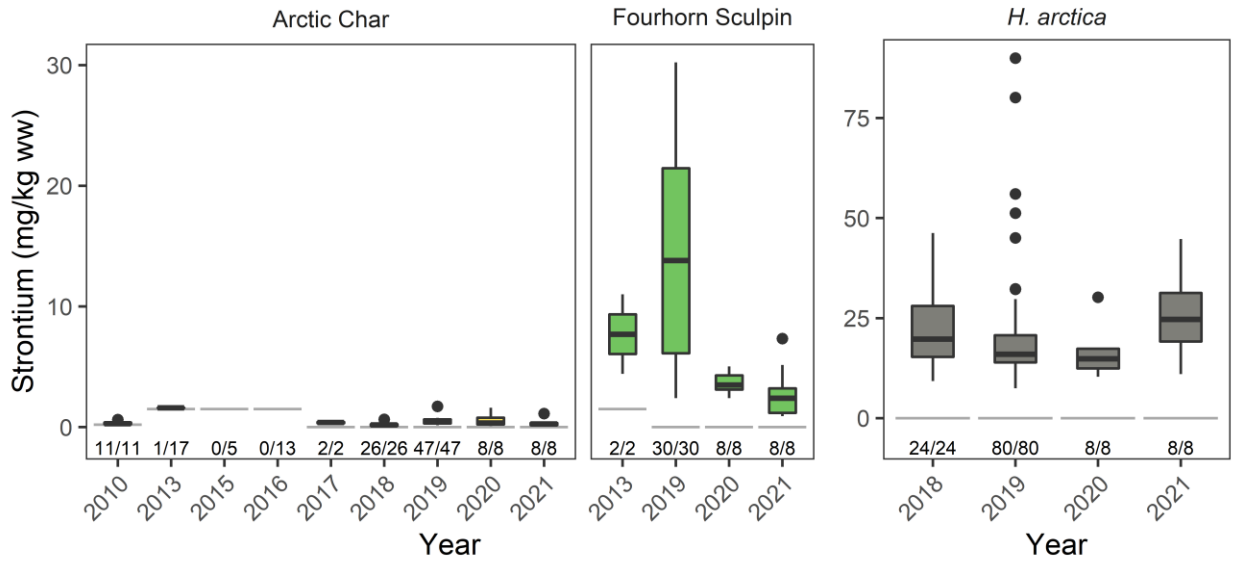
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-26: Concentrations of Silver for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



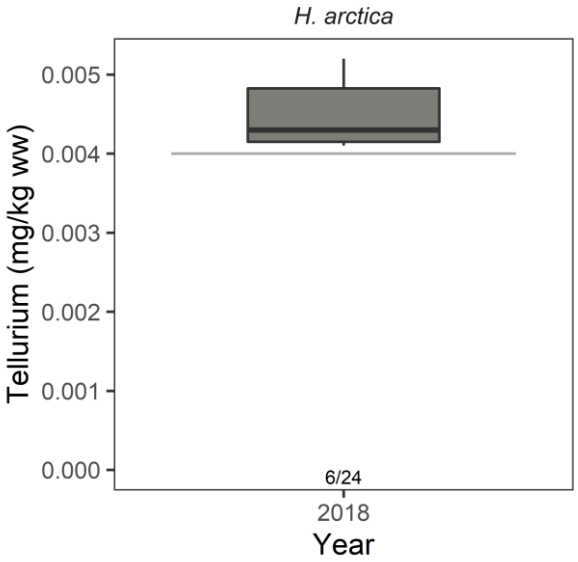
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-27: Concentrations of Sodium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



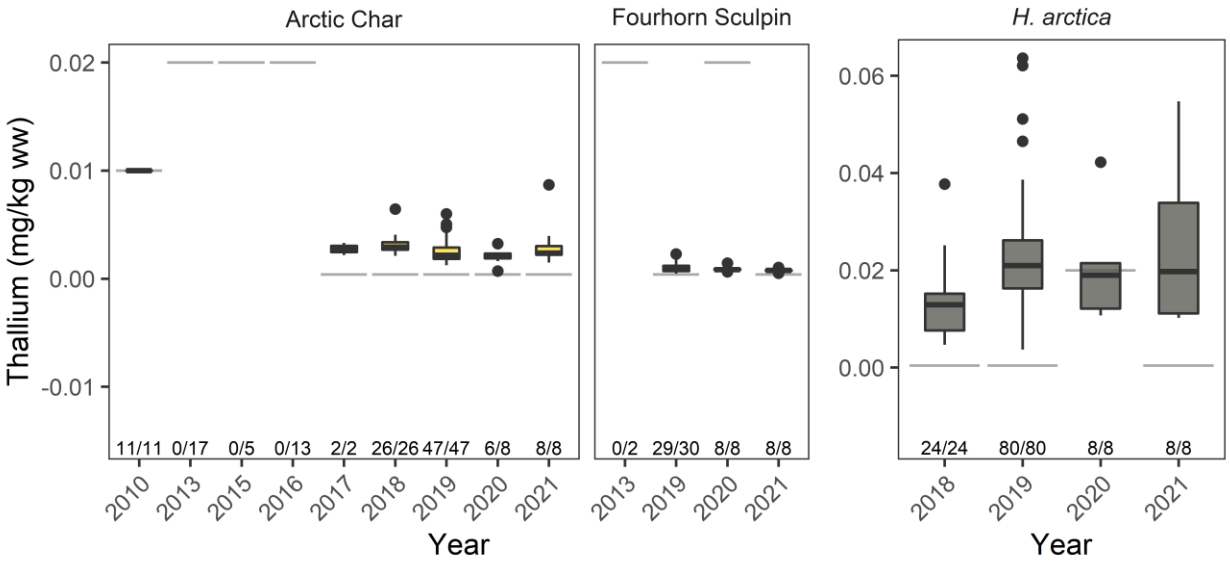
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-28: Concentrations of Strontium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



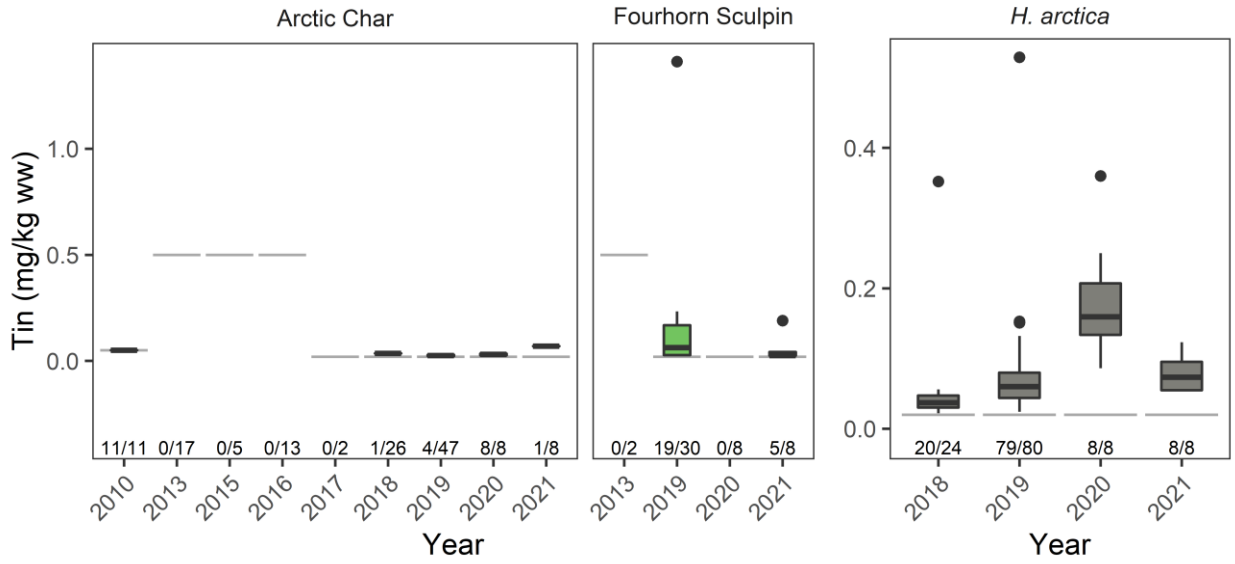
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-29: Concentrations of Tellurium for *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



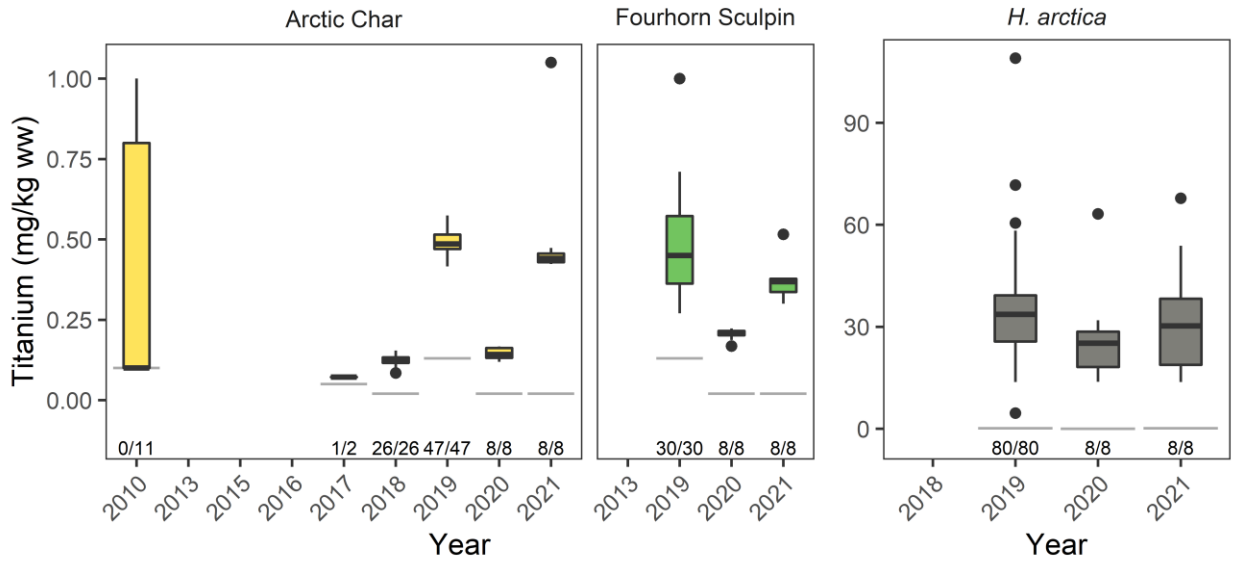
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-30: Concentrations of Thallium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



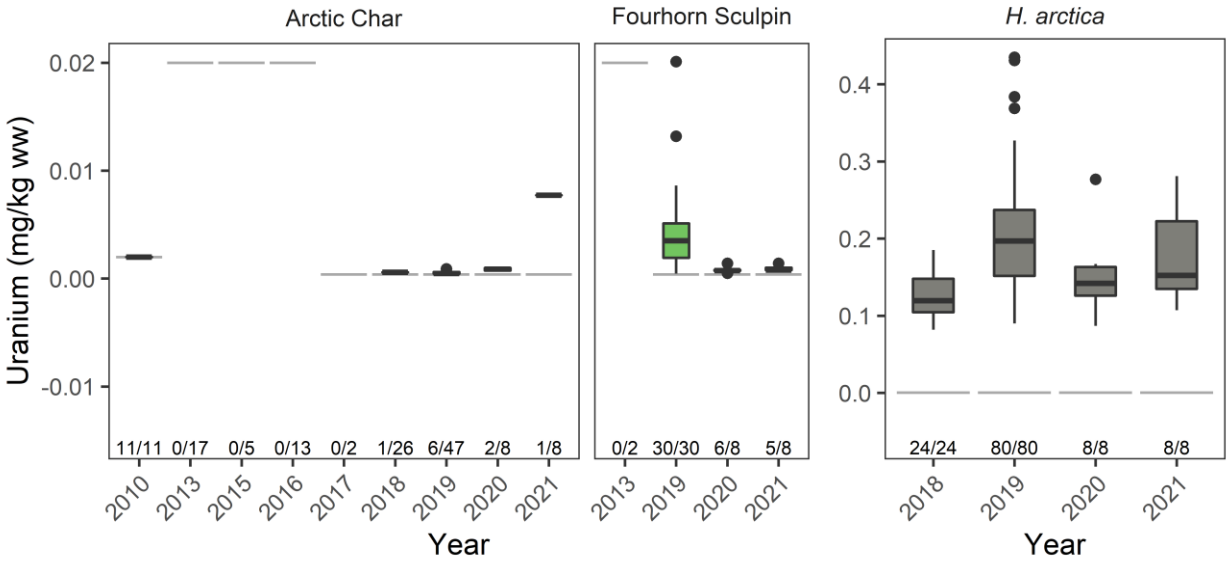
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-31: Concentrations of Tin for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



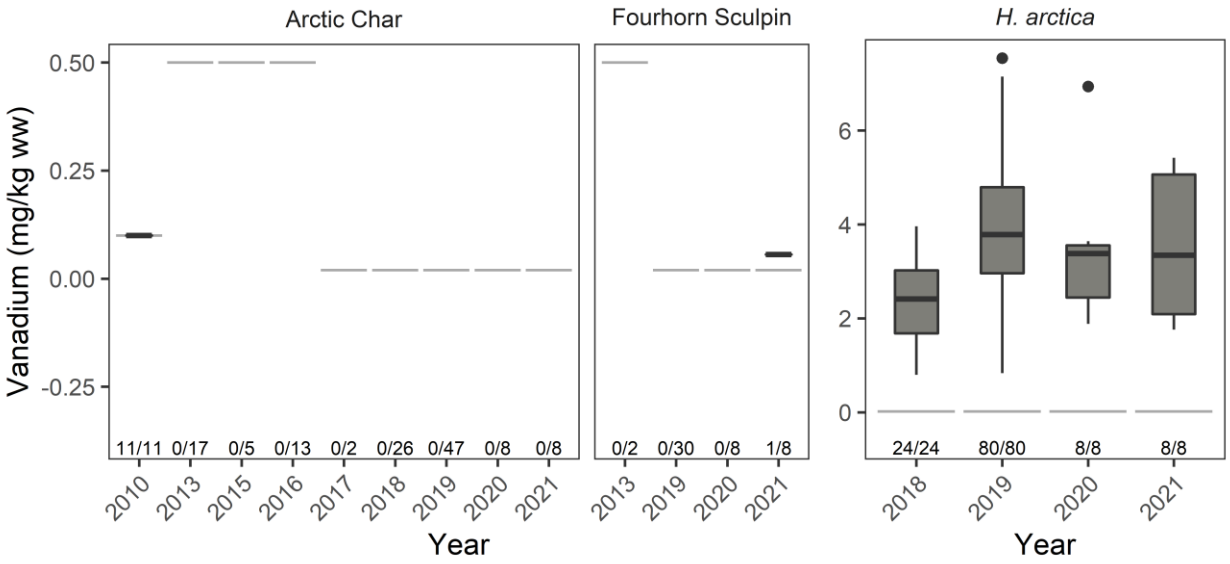
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-32: Concentrations of Titanium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



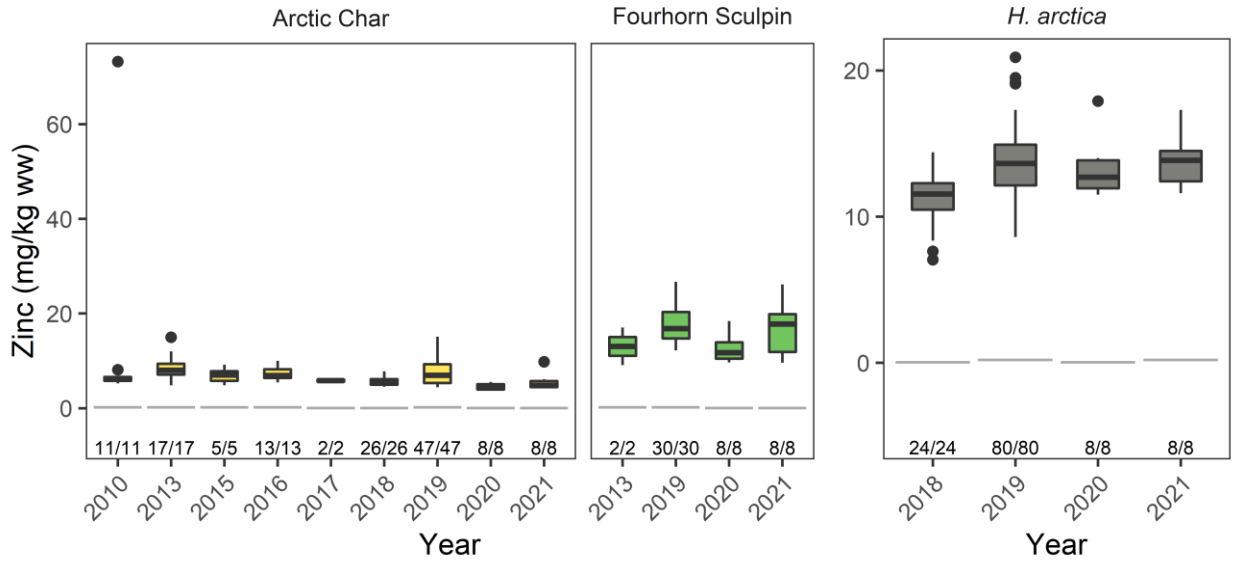
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-33: Concentrations of Uranium for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



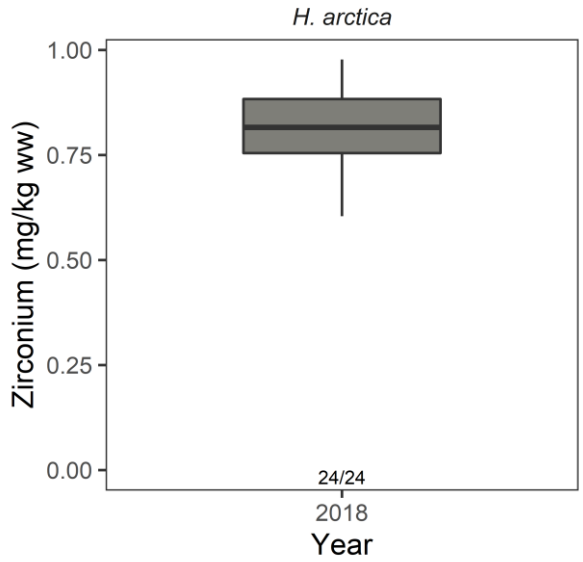
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as “n>DL/n”. Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-34: Concentrations of Vanadium for *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



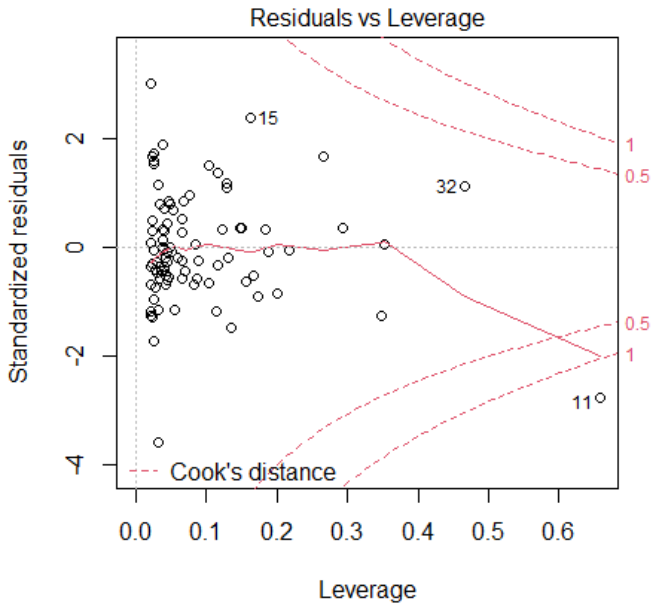
Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-35: Concentrations of Zinc for Arctic Char, Fourhorn Sculpin and *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



Total sample size (n) and number of samples above detection limits (n>DL) are shown below each bar as "n>DL/n". Values below DL are not shown. Grey lines indicate detection limits.

Figure 7D-36: Concentrations of Zirconium for *Hiatella arctica* Tissue Sampled from the Milne Port Area, 2010 to 2021



Point 11 = FIN BAFF21UMLNGN06ARCH09.

Figure 7D-37: Leverage Plot for Arctic Char Selenium ANCOVA, Indicating Point 11 as Having Excessive Leverage.

APPENDIX 7E

Certificate of Analysis

Your Project #: 1663724
Site#: MINE PORT REFERENCE SITE
Site Location: 44000/03 BAFFINLAND IRON MINE
Your C.O.C. #: 08497711

Attention: Collin Arens

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2022/01/05
Report #: R3118203
Version: 4 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C171211
Received: 2021/09/23, 08:00

Sample Matrix: Tissue
Samples Received: 16

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS - Tissue Plug Wet Wt	2	2021/10/15	2021/10/16	BBY WI-00033	Auto Calc
Elements by CRC ICPMS - Tissue Wet Wt	14	2021/10/13	2021/10/21	BBY7SOP-00021 / BBY7SOP-00002	EPA 6020b R2 m
Moisture in Tissue - Freeze Drying	2	2021/10/15	2021/10/16	BBY7SOP-00021	BCMOE BCLM Aug 2014
Moisture in Tissue	14	2021/10/10	2021/10/13	BBY8SOP-00017	BCMOE BCLM Dec2000 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 1663724
Site#: MINE PORT REFERENCE SITE
Site Location: 44000/03 BAFFINLAND IRON MINE
Your C.O.C. #: 08497711

Attention: Collin Arens

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2022/01/05
Report #: R3118203
Version: 4 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C171211
Received: 2021/09/23, 08:00

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Cynny Hagen, Key Account Specialist
Email: Cynny.HAGEN@bureauveritas.com
Phone# (403)735-2273
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		AGP039	AGP040	AGU164		
Sampling Date		2021/08/08 13:40	2021/08/08 14:33	2021/08/09 11:22		
COC Number		08497711	08497711	08497711		
	UNITS	BAFF21UMLNFRSC1003	BAFF21UMLNFRSC1006	BAFF21UMLNFRSC1019	RDL	QC Batch
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.31	0.49	0.56	0.20	A385672
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0012	0.0013	0.0013	0.0010	A385672
Total (Wet Wt) Arsenic (As)	mg/kg	4.26	3.39	4.89	0.0040	A385672
Total (Wet Wt) Barium (Ba)	mg/kg	0.015	0.034	0.060	0.010	A385672
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0021	0.0014	0.0019	0.0010	A385672
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	0.32	0.20	A385672
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0051	0.0042	0.0095	0.0010	A385672
Total (Wet Wt) Calcium (Ca)	mg/kg	200	515	1190	2.0	A385672
Total (Wet Wt) Chromium (Cr)	mg/kg	0.020	0.018	0.019	0.010	A385672
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0070	0.0076	0.0069	0.0013	A385672
Total (Wet Wt) Copper (Cu)	mg/kg	0.516	0.445	0.470	0.010	A385672
Total (Wet Wt) Iron (Fe)	mg/kg	6.39	6.25	6.92	0.25	A385672
Total (Wet Wt) Lead (Pb)	mg/kg	0.0037	0.0037	0.0061	0.0010	A385672
Total (Wet Wt) Magnesium (Mg)	mg/kg	245	304	261	0.40	A385672
Total (Wet Wt) Manganese (Mn)	mg/kg	0.215	0.270	0.246	0.010	A385672
Total (Wet Wt) Mercury (Hg)	mg/kg	0.324	0.199	0.421	0.0020	A385672
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	A385672
Total (Wet Wt) Nickel (Ni)	mg/kg	0.015	0.025	0.020	0.010	A385672
Total (Wet Wt) Phosphorus (P)	mg/kg	2270	2500	2620	2.0	A385672
Total (Wet Wt) Potassium (K)	mg/kg	3700	3870	3520	2.0	A385672
Total (Wet Wt) Selenium (Se)	mg/kg	0.572	0.508	0.534	0.010	A385672
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Sodium (Na)	mg/kg	622	649	775	2.0	A385672
Total (Wet Wt) Strontium (Sr)	mg/kg	0.905	2.35	7.34	0.010	A385672
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00078	0.00076	0.00074	0.00040	A385672
Total (Wet Wt) Tin (Sn)	mg/kg	0.025	0.024	<0.020	0.020	A385672
Total (Wet Wt) Titanium (Ti)	mg/kg	0.343	0.370	0.377	0.020	A385672
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	0.00101	0.00141	0.00040	A385672
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	0.056	0.020	A385672
Total (Wet Wt) Zinc (Zn)	mg/kg	22.4	12.5	19.0	0.040	A385672

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		AGU165			AGU166		
Sampling Date		2021/08/09 14:53			2021/08/10 12:32		
COC Number		08497711			08497711		
	UNITS	BAFF21UMLNFRSC1029	RDL	QC Batch	BAFF21UMLNFRSC1030	RDL	QC Batch
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.61	0.20	A385672	0.62	0.50	A372381
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	0.0010	A385672	0.0028	0.0020	A372381
Total (Wet Wt) Arsenic (As)	mg/kg	2.33	0.0040	A385672	3.88	0.0050	A372381
Total (Wet Wt) Barium (Ba)	mg/kg	0.028	0.010	A385672	<0.010	0.010	A372381
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	0.0010	A385672	<0.0020	0.0020	A372381
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	0.0010	A385672	0.0026	0.0013	A372381
Total (Wet Wt) Boron (B)	mg/kg	0.54	0.20	A385672	<0.20	0.20	A372381
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0057	0.0010	A385672	0.0041	0.0013	A372381
Total (Wet Wt) Calcium (Ca)	mg/kg	628	2.0	A385672	199	4.0	A372381
Total (Wet Wt) Chromium (Cr)	mg/kg	0.030	0.010	A385672	0.028	0.025	A372381
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0065	0.0013	A385672	0.0102	0.0013	A372381
Total (Wet Wt) Copper (Cu)	mg/kg	0.453	0.010	A385672	0.708	0.013	A372381
Total (Wet Wt) Iron (Fe)	mg/kg	5.38	0.25	A385672	9.16	0.25	A372381
Total (Wet Wt) Lead (Pb)	mg/kg	0.0055	0.0010	A385672	0.0052	0.0013	A372381
Total (Wet Wt) Magnesium (Mg)	mg/kg	297	0.40	A385672	272	0.40	A372381
Total (Wet Wt) Manganese (Mn)	mg/kg	0.255	0.010	A385672	0.315	0.010	A372381
Total (Wet Wt) Mercury (Hg)	mg/kg	0.107	0.0020	A385672	0.198	0.013	A372381
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	0.0040	A385672	<0.0080	0.0080	A372381
Total (Wet Wt) Nickel (Ni)	mg/kg	0.027	0.010	A385672	0.079	0.010	A372381
Total (Wet Wt) Phosphorus (P)	mg/kg	2440	2.0	A385672	2030	2.0	A372381
Total (Wet Wt) Potassium (K)	mg/kg	3420	2.0	A385672	3440	2.5	A372381
Total (Wet Wt) Selenium (Se)	mg/kg	0.498	0.010	A385672	0.409	0.010	A372381
Total (Wet Wt) Silver (Ag)	mg/kg	0.0015	0.0010	A385672	<0.0013	0.0013	A372381
Total (Wet Wt) Sodium (Na)	mg/kg	1010	2.0	A385672	941	2.5	A372381
Total (Wet Wt) Strontium (Sr)	mg/kg	2.57	0.010	A385672	1.04	0.013	A372381
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00050	0.00040	A385672	0.00104	0.00040	A372381
Total (Wet Wt) Tin (Sn)	mg/kg	0.042	0.020	A385672	0.025	0.020	A372381
Total (Wet Wt) Titanium (Ti)	mg/kg	0.367	0.020	A385672	0.30	0.13	A372381
Total (Wet Wt) Uranium (U)	mg/kg	0.00075	0.00040	A385672	0.00079	0.00040	A372381
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	0.020	A385672	<0.020	0.020	A372381
Total (Wet Wt) Zinc (Zn)	mg/kg	9.59	0.040	A385672	17.4	0.20	A372381

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		AGU167	AGU168	AGU169		
Sampling Date		2021/08/10 12:50	2021/08/10 13:22	2021/08/10 14:24		
COC Number		08497711	08497711	08497711		
	UNITS	BAFF21UMLNFRSC1031	BAFF21UMLNFRSC1033	BAFF21UMLNFRSC1036	RDL	QC Batch
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.28	1.25	0.34	0.20	A385672
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0021	0.0010	0.0012	0.0010	A385672
Total (Wet Wt) Arsenic (As)	mg/kg	3.97	2.07	2.41	0.0040	A385672
Total (Wet Wt) Barium (Ba)	mg/kg	0.011	0.034	0.060	0.010	A385672
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0031	0.0018	0.0015	0.0010	A385672
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	A385672
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0053	0.0056	0.0070	0.0010	A385672
Total (Wet Wt) Calcium (Ca)	mg/kg	188	455	945	2.0	A385672
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	0.038	0.010	0.010	A385672
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0119	0.0079	0.0087	0.0013	A385672
Total (Wet Wt) Copper (Cu)	mg/kg	0.554	0.458	0.464	0.010	A385672
Total (Wet Wt) Iron (Fe)	mg/kg	8.14	7.86	5.37	0.25	A385672
Total (Wet Wt) Lead (Pb)	mg/kg	0.0134	0.0076	0.0053	0.0010	A385672
Total (Wet Wt) Magnesium (Mg)	mg/kg	236	308	295	0.40	A385672
Total (Wet Wt) Manganese (Mn)	mg/kg	0.182	0.347	0.292	0.010	A385672
Total (Wet Wt) Mercury (Hg)	mg/kg	0.307	0.102	0.158	0.0020	A385672
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	A385672
Total (Wet Wt) Nickel (Ni)	mg/kg	0.019	0.026	0.016	0.010	A385672
Total (Wet Wt) Phosphorus (P)	mg/kg	2250	2460	2690	2.0	A385672
Total (Wet Wt) Potassium (K)	mg/kg	3770	3730	3660	2.0	A385672
Total (Wet Wt) Selenium (Se)	mg/kg	0.547	0.426	0.437	0.010	A385672
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Sodium (Na)	mg/kg	727	546	769	2.0	A385672
Total (Wet Wt) Strontium (Sr)	mg/kg	1.24	2.45	5.15	0.010	A385672
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00076	0.00081	0.00063	0.00040	A385672
Total (Wet Wt) Tin (Sn)	mg/kg	0.190	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Titanium (Ti)	mg/kg	0.317	0.516	0.380	0.020	A385672
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	0.00078	0.00040	A385672
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Zinc (Zn)	mg/kg	26.1	10.1	18.2	0.040	A385672

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		AGU170	AGU171		
Sampling Date		2021/08/06 13:28	2021/08/06 14:58		
COC Number		08497711	08497711		
	UNITS	BAFF21UMLNGN03ARCH03	BAFF21UMLNGN05ARCH03	RDL	QC Batch
Total Metals by ICPMS					
Total (Wet Wt) Aluminum (Al)	mg/kg	0.25	0.29	0.20	A385672
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0012	0.0012	0.0010	A385672
Total (Wet Wt) Arsenic (As)	mg/kg	5.54	2.88	0.0040	A385672
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	0.010	A385672
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	0.20	A385672
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0017	0.0012	0.0010	A385672
Total (Wet Wt) Calcium (Ca)	mg/kg	60.1	73.0	2.0	A385672
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	0.013	0.010	A385672
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0041	0.0031	0.0013	A385672
Total (Wet Wt) Copper (Cu)	mg/kg	0.487	0.607	0.010	A385672
Total (Wet Wt) Iron (Fe)	mg/kg	4.68	6.23	0.25	A385672
Total (Wet Wt) Lead (Pb)	mg/kg	0.0016	0.0088	0.0010	A385672
Total (Wet Wt) Magnesium (Mg)	mg/kg	307	289	0.40	A385672
Total (Wet Wt) Manganese (Mn)	mg/kg	0.060	0.084	0.010	A385672
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0478	0.0394	0.0020	A385672
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	0.0040	A385672
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	0.022	0.010	A385672
Total (Wet Wt) Phosphorus (P)	mg/kg	3050	2980	2.0	A385672
Total (Wet Wt) Potassium (K)	mg/kg	4520	4550	2.0	A385672
Total (Wet Wt) Selenium (Se)	mg/kg	0.438	0.404	0.010	A385672
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Sodium (Na)	mg/kg	274	292	2.0	A385672
Total (Wet Wt) Strontium (Sr)	mg/kg	0.103	0.127	0.010	A385672
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00199	0.00270	0.00040	A385672
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Titanium (Ti)	mg/kg	0.431	0.424	0.020	A385672
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	0.00040	A385672
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Zinc (Zn)	mg/kg	4.57	4.44	0.040	A385672

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		AGU172		AGU172		
Sampling Date		2021/08/07 15:12		2021/08/07 15:12		
COC Number		08497711		08497711		
	UNITS	BAFF21UMLNGN06ARCH09	QC Batch	BAFF21UMLNGN06ARCH09 REPEAT	RDL	QC Batch
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	6.43	A372381	9.78	0.50	A415877
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0038	A372381	0.0052	0.0020	A415877
Total (Wet Wt) Arsenic (As)	mg/kg	0.0974	A372381	0.105	0.0050	A415877
Total (Wet Wt) Barium (Ba)	mg/kg	0.112	A372381	0.134	0.010	A415877
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	A372381	<0.0020	0.0020	A415877
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0013	A372381	<0.0013	0.0013	A415877
Total (Wet Wt) Boron (B)	mg/kg	0.22	A372381	0.32	0.20	A415877
Total (Wet Wt) Cadmium (Cd)	mg/kg	<0.0013	A372381	<0.0013	0.0013	A415877
Total (Wet Wt) Calcium (Ca)	mg/kg	439	A372381	323	4.0	A415877
Total (Wet Wt) Chromium (Cr)	mg/kg	0.115	A372381	0.106	0.025	A415877
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0135	A372381	0.0206	0.0013	A415877
Total (Wet Wt) Copper (Cu)	mg/kg	0.475	A372381	0.342	0.013	A415877
Total (Wet Wt) Iron (Fe)	mg/kg	89.9	A372381	84.4	0.25	A415877
Total (Wet Wt) Lead (Pb)	mg/kg	0.0379	A372381	0.0868	0.0013	A415877
Total (Wet Wt) Magnesium (Mg)	mg/kg	378	A372381	376	0.40	A415877
Total (Wet Wt) Manganese (Mn)	mg/kg	0.576	A372381	0.582	0.010	A415877
Total (Wet Wt) Mercury (Hg)	mg/kg	0.063	A372381	0.054	0.013	A415877
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0122	A372381	0.0121	0.0080	A415877
Total (Wet Wt) Nickel (Ni)	mg/kg	0.049	A372381	0.055	0.010	A415877
Total (Wet Wt) Phosphorus (P)	mg/kg	3120	A372381	2900	2.0	A415877
Total (Wet Wt) Potassium (K)	mg/kg	4810	A372381	4560	2.5	A415877
Total (Wet Wt) Selenium (Se)	mg/kg	0.186	A372381	0.179	0.010	A415877
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	A372381	<0.0013	0.0013	A415877
Total (Wet Wt) Sodium (Na)	mg/kg	428	A372381	416	2.5	A415877
Total (Wet Wt) Strontium (Sr)	mg/kg	0.181	A372381	0.171	0.013	A415877
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00854	A372381	0.00882	0.00040	A415877
Total (Wet Wt) Tin (Sn)	mg/kg	0.045	A372381	0.093	0.020	A415877
Total (Wet Wt) Titanium (Ti)	mg/kg	0.55	A372381	1.55	0.13	A415877
Total (Wet Wt) Uranium (U)	mg/kg	0.00817	A372381	0.00730	0.00040	A415877
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	A372381	<0.020	0.020	A415877
Total (Wet Wt) Zinc (Zn)	mg/kg	9.34	A372381	10.3	0.20	A415877

RDL = Reportable Detection Limit

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		AGU173	AGU174	AGU175		
Sampling Date		2021/08/10 09:00	2021/08/11 16:09	2021/08/17 12:50		
COC Number		08497711	08497711	08497711		
	UNITS	BAFF21UMLNGN09ARCH03	BAFF21UMLNGN10ARCH10	BAFF21UMLNGN20ARCH02	RDL	QC Batch
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	<0.20	<0.20	<0.20	0.20	A385672
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	0.0013	0.0010	A385672
Total (Wet Wt) Arsenic (As)	mg/kg	4.25	2.65	3.84	0.0040	A385672
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	<0.010	0.010	A385672
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	A385672
Total (Wet Wt) Cadmium (Cd)	mg/kg	<0.0010	0.0018	0.0019	0.0010	A385672
Total (Wet Wt) Calcium (Ca)	mg/kg	425	136	154	2.0	A385672
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	0.010	A385672
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0036	0.0031	0.0030	0.0013	A385672
Total (Wet Wt) Copper (Cu)	mg/kg	0.358	0.386	0.299	0.010	A385672
Total (Wet Wt) Iron (Fe)	mg/kg	3.11	3.49	3.41	0.25	A385672
Total (Wet Wt) Lead (Pb)	mg/kg	<0.0010	<0.0010	0.0041	0.0010	A385672
Total (Wet Wt) Magnesium (Mg)	mg/kg	270	324	332	0.40	A385672
Total (Wet Wt) Manganese (Mn)	mg/kg	0.133	0.083	0.079	0.010	A385672
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0421	0.0334	0.0304	0.0020	A385672
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	A385672
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	<0.010	0.010	A385672
Total (Wet Wt) Phosphorus (P)	mg/kg	2980	3240	3270	2.0	A385672
Total (Wet Wt) Potassium (K)	mg/kg	4030	5010	4740	2.0	A385672
Total (Wet Wt) Selenium (Se)	mg/kg	0.403	0.447	0.468	0.010	A385672
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Sodium (Na)	mg/kg	289	235	268	2.0	A385672
Total (Wet Wt) Strontium (Sr)	mg/kg	1.12	0.397	0.287	0.010	A385672
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00236	0.00228	0.00149	0.00040	A385672
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Titanium (Ti)	mg/kg	0.423	0.434	0.450	0.020	A385672
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00040	A385672
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Zinc (Zn)	mg/kg	5.09	4.48	4.39	0.040	A385672

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		AGU176	AGU177		
Sampling Date		2021/08/18 16:15	2021/08/18 16:15		
COC Number		08497711	08497711		
	UNITS	BAFF21UMLNGN25ARCH03	BAFF21UMLNGN25ARCH05	RDL	QC Batch
Total Metals by ICPMS					
Total (Wet Wt) Aluminum (Al)	mg/kg	<0.20	<0.20	0.20	A385672
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Arsenic (As)	mg/kg	0.496	0.687	0.0040	A385672
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	0.010	A385672
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	0.20	A385672
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0020	<0.0010	0.0010	A385672
Total (Wet Wt) Calcium (Ca)	mg/kg	227	122	2.0	A385672
Total (Wet Wt) Chromium (Cr)	mg/kg	0.012	<0.010	0.010	A385672
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0084	0.0047	0.0013	A385672
Total (Wet Wt) Copper (Cu)	mg/kg	0.370	0.484	0.010	A385672
Total (Wet Wt) Iron (Fe)	mg/kg	3.79	4.15	0.25	A385672
Total (Wet Wt) Lead (Pb)	mg/kg	0.0061	0.0017	0.0010	A385672
Total (Wet Wt) Magnesium (Mg)	mg/kg	311	304	0.40	A385672
Total (Wet Wt) Manganese (Mn)	mg/kg	0.075	0.092	0.010	A385672
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0604	0.0245	0.0020	A385672
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	0.0040	A385672
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	0.010	A385672
Total (Wet Wt) Phosphorus (P)	mg/kg	3370	3230	2.0	A385672
Total (Wet Wt) Potassium (K)	mg/kg	4370	4500	2.0	A385672
Total (Wet Wt) Selenium (Se)	mg/kg	0.480	0.343	0.010	A385672
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	0.0010	A385672
Total (Wet Wt) Sodium (Na)	mg/kg	334	250	2.0	A385672
Total (Wet Wt) Strontium (Sr)	mg/kg	0.340	0.231	0.010	A385672
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00396	0.00239	0.00040	A385672
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Titanium (Ti)	mg/kg	0.473	0.449	0.020	A385672
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	0.00040	A385672
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	0.020	A385672
Total (Wet Wt) Zinc (Zn)	mg/kg	5.58	6.09	0.040	A385672

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

PHYSICAL TESTING (TISSUE)

Bureau Veritas ID		AGP039	AGP040	AGU164		
Sampling Date		2021/08/08 13:40	2021/08/08 14:33	2021/08/09 11:22		
COC Number		08497711	08497711	08497711		
	UNITS	BAFF21UMLNFRSC1003	BAFF21UMLNFRSC1006	BAFF21UMLNFRSC1019	RDL	QC Batch
Physical Properties						
Moisture	%	77	78	78	0.30	A382831
RDL = Reportable Detection Limit						

Bureau Veritas ID		AGU165		AGU166		AGU167		
Sampling Date		2021/08/09 14:53		2021/08/10 12:32		2021/08/10 12:50		
COC Number		08497711		08497711		08497711		
	UNITS	BAFF21UMLNFRSC1029	QC Batch	BAFF21UMLNFRSC1030	QC Batch	BAFF21UMLNFRSC1031	RDL	QC Batch
Physical Properties								
Moisture	%	78	A382831	79	A371604	78	0.30	A382831
RDL = Reportable Detection Limit								

Bureau Veritas ID		AGU168	AGU169	AGU170	AGU171		
Sampling Date		2021/08/10 13:22	2021/08/10 14:24	2021/08/06 13:28	2021/08/06 14:58		
COC Number		08497711	08497711	08497711	08497711		
	UNITS	BAFF21UMLNFRSC1033	BAFF21UMLNFRSC1036	BAFF21UMLNGN03ARCH03	BAFF21UMLNGN05ARCH03	RDL	QC Batch
Physical Properties							
Moisture	%	76	80	73	74	0.30	A382831
RDL = Reportable Detection Limit							

Bureau Veritas ID		AGU172		AGU173	AGU174		
Sampling Date		2021/08/07 15:12		2021/08/10 09:00	2021/08/11 16:09		
COC Number		08497711		08497711	08497711		
	UNITS	BAFF21UMLNGN06ARCH09	QC Batch	BAFF21UMLNGN09ARCH03	BAFF21UMLNGN10ARCH10	RDL	QC Batch
Physical Properties							
Moisture	%	75	A371604	69	75	0.30	A382831
RDL = Reportable Detection Limit							

Bureau Veritas ID		AGU175	AGU176	AGU177		
Sampling Date		2021/08/17 12:50	2021/08/18 16:15	2021/08/18 16:15		
COC Number		08497711	08497711	08497711		
	UNITS	BAFF21UMLNGN20ARCH02	BAFF21UMLNGN25ARCH03	BAFF21UMLNGN25ARCH05	RDL	QC Batch
Physical Properties						
Moisture	%	74	74	73	0.30	A382831
RDL = Reportable Detection Limit						

GENERAL COMMENTS

Sample AGP039 [BAFF21UMLNFRSC1003] : Version #4: Report reissued to include additional results for metals on sample AGU172 (BAFF21UMLNGN06ARCH09) due to request for re-analysis by client. Both sets of data are reported.

Results relate only to the items tested.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A371604	CG5	RPD	Moisture	2021/10/09	0.13		%	20
A372381	SOM	QC Standard	Total (Wet Wt) Aluminum (Al)	2021/10/12		102	%	N/A
			Total (Wet Wt) Arsenic (As)	2021/10/12		93	%	N/A
			Total (Wet Wt) Cadmium (Cd)	2021/10/12		91	%	N/A
			Total (Wet Wt) Chromium (Cr)	2021/10/12		84	%	N/A
			Total (Wet Wt) Cobalt (Co)	2021/10/12		92	%	N/A
			Total (Wet Wt) Copper (Cu)	2021/10/12		90	%	N/A
			Total (Wet Wt) Iron (Fe)	2021/10/12		94	%	N/A
			Total (Wet Wt) Lead (Pb)	2021/10/12		56 (1)	%	N/A
			Total (Wet Wt) Mercury (Hg)	2021/10/12		90	%	N/A
			Total (Wet Wt) Molybdenum (Mo)	2021/10/12		93	%	N/A
			Total (Wet Wt) Nickel (Ni)	2021/10/12		83	%	N/A
			Total (Wet Wt) Phosphorus (P)	2021/10/12		91	%	N/A
			Total (Wet Wt) Selenium (Se)	2021/10/12		97	%	N/A
			Total (Wet Wt) Sodium (Na)	2021/10/12		98	%	N/A
			Total (Wet Wt) Uranium (U)	2021/10/12		105	%	N/A
			Total (Wet Wt) Zinc (Zn)	2021/10/12		90	%	N/A
A372381	SOM	Spiked Blank	Total (Wet Wt) Aluminum (Al)	2021/10/16		101	%	80 - 120
			Total (Wet Wt) Antimony (Sb)	2021/10/16		102	%	80 - 120
			Total (Wet Wt) Arsenic (As)	2021/10/16		100	%	80 - 120
			Total (Wet Wt) Barium (Ba)	2021/10/16		100	%	80 - 120
			Total (Wet Wt) Beryllium (Be)	2021/10/16		96	%	80 - 120
			Total (Wet Wt) Bismuth (Bi)	2021/10/16		101	%	80 - 120
			Total (Wet Wt) Boron (B)	2021/10/16		99	%	80 - 120
			Total (Wet Wt) Cadmium (Cd)	2021/10/16		98	%	80 - 120
			Total (Wet Wt) Calcium (Ca)	2021/10/16		102	%	80 - 120
			Total (Wet Wt) Chromium (Cr)	2021/10/16		99	%	80 - 120
			Total (Wet Wt) Cobalt (Co)	2021/10/16		102	%	80 - 120
			Total (Wet Wt) Copper (Cu)	2021/10/16		102	%	80 - 120
			Total (Wet Wt) Iron (Fe)	2021/10/16		108	%	80 - 120
			Total (Wet Wt) Lead (Pb)	2021/10/16		101	%	80 - 120
			Total (Wet Wt) Magnesium (Mg)	2021/10/16		106	%	80 - 120
			Total (Wet Wt) Manganese (Mn)	2021/10/16		99	%	80 - 120
			Total (Wet Wt) Mercury (Hg)	2021/10/16		107	%	80 - 120
			Total (Wet Wt) Molybdenum (Mo)	2021/10/16		103	%	80 - 120
			Total (Wet Wt) Nickel (Ni)	2021/10/16		100	%	80 - 120
			Total (Wet Wt) Phosphorus (P)	2021/10/16		99	%	80 - 120
			Total (Wet Wt) Potassium (K)	2021/10/16		106	%	80 - 120
			Total (Wet Wt) Selenium (Se)	2021/10/16		101	%	80 - 120
			Total (Wet Wt) Silver (Ag)	2021/10/16		100	%	80 - 120
			Total (Wet Wt) Sodium (Na)	2021/10/16		106	%	80 - 120
			Total (Wet Wt) Strontium (Sr)	2021/10/16		101	%	80 - 120
			Total (Wet Wt) Thallium (Tl)	2021/10/16		103	%	80 - 120
			Total (Wet Wt) Tin (Sn)	2021/10/16		102	%	80 - 120
			Total (Wet Wt) Titanium (Ti)	2021/10/16		101	%	80 - 120
			Total (Wet Wt) Uranium (U)	2021/10/16		106	%	80 - 120
			Total (Wet Wt) Vanadium (V)	2021/10/16		97	%	80 - 120
			Total (Wet Wt) Zinc (Zn)	2021/10/16		95	%	80 - 120
A372381	SOM	Method Blank	Total (Wet Wt) Aluminum (Al)	2021/10/16	<0.50		mg/kg	
			Total (Wet Wt) Antimony (Sb)	2021/10/16	<0.0020		mg/kg	
			Total (Wet Wt) Arsenic (As)	2021/10/16	<0.0050		mg/kg	
			Total (Wet Wt) Barium (Ba)	2021/10/16	<0.010		mg/kg	
			Total (Wet Wt) Beryllium (Be)	2021/10/16	<0.0020		mg/kg	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total (Wet Wt) Bismuth (Bi)	2021/10/16	<0.0013		mg/kg	
			Total (Wet Wt) Boron (B)	2021/10/16	<0.20		mg/kg	
			Total (Wet Wt) Cadmium (Cd)	2021/10/16	<0.0013		mg/kg	
			Total (Wet Wt) Calcium (Ca)	2021/10/16	<4.0		mg/kg	
			Total (Wet Wt) Chromium (Cr)	2021/10/16	<0.025		mg/kg	
			Total (Wet Wt) Cobalt (Co)	2021/10/16	<0.0013		mg/kg	
			Total (Wet Wt) Copper (Cu)	2021/10/16	<0.013		mg/kg	
			Total (Wet Wt) Iron (Fe)	2021/10/16	<0.25		mg/kg	
			Total (Wet Wt) Lead (Pb)	2021/10/16	<0.0013		mg/kg	
			Total (Wet Wt) Magnesium (Mg)	2021/10/16	<0.40		mg/kg	
			Total (Wet Wt) Manganese (Mn)	2021/10/16	<0.010		mg/kg	
			Total (Wet Wt) Mercury (Hg)	2021/10/16	<0.013		mg/kg	
			Total (Wet Wt) Molybdenum (Mo)	2021/10/16	<0.0080		mg/kg	
			Total (Wet Wt) Nickel (Ni)	2021/10/16	<0.010		mg/kg	
			Total (Wet Wt) Phosphorus (P)	2021/10/16	<2.0		mg/kg	
			Total (Wet Wt) Potassium (K)	2021/10/16	<2.5		mg/kg	
			Total (Wet Wt) Selenium (Se)	2021/10/16	<0.010		mg/kg	
			Total (Wet Wt) Silver (Ag)	2021/10/16	<0.0013		mg/kg	
			Total (Wet Wt) Sodium (Na)	2021/10/16	<2.5		mg/kg	
			Total (Wet Wt) Strontium (Sr)	2021/10/16	<0.013		mg/kg	
			Total (Wet Wt) Thallium (Tl)	2021/10/16	<0.00040		mg/kg	
			Total (Wet Wt) Tin (Sn)	2021/10/16	<0.020		mg/kg	
			Total (Wet Wt) Titanium (Ti)	2021/10/16	<0.13		mg/kg	
			Total (Wet Wt) Uranium (U)	2021/10/16	<0.00040		mg/kg	
			Total (Wet Wt) Vanadium (V)	2021/10/16	<0.020		mg/kg	
			Total (Wet Wt) Zinc (Zn)	2021/10/16	<0.20		mg/kg	
A372381	SOM	RPD	Total (Wet Wt) Aluminum (Al)	2021/10/16	14		%	40
			Total (Wet Wt) Antimony (Sb)	2021/10/16	5.8		%	40
			Total (Wet Wt) Arsenic (As)	2021/10/16	6.1		%	40
			Total (Wet Wt) Barium (Ba)	2021/10/16	4.7		%	40
			Total (Wet Wt) Beryllium (Be)	2021/10/16	12		%	40
			Total (Wet Wt) Bismuth (Bi)	2021/10/16	32		%	40
			Total (Wet Wt) Boron (B)	2021/10/16	NC		%	40
			Total (Wet Wt) Cadmium (Cd)	2021/10/16	4.8		%	40
			Total (Wet Wt) Calcium (Ca)	2021/10/16	29		%	60
			Total (Wet Wt) Chromium (Cr)	2021/10/16	40		%	40
			Total (Wet Wt) Cobalt (Co)	2021/10/16	5.6		%	40
			Total (Wet Wt) Copper (Cu)	2021/10/16	3.0		%	40
			Total (Wet Wt) Iron (Fe)	2021/10/16	1.6		%	40
			Total (Wet Wt) Lead (Pb)	2021/10/16	24		%	40
			Total (Wet Wt) Magnesium (Mg)	2021/10/16	13		%	40
			Total (Wet Wt) Manganese (Mn)	2021/10/16	4.5		%	40
			Total (Wet Wt) Mercury (Hg)	2021/10/16	NC		%	40
			Total (Wet Wt) Molybdenum (Mo)	2021/10/16	4.5		%	40
			Total (Wet Wt) Nickel (Ni)	2021/10/16	18		%	40
			Total (Wet Wt) Phosphorus (P)	2021/10/16	1.1		%	40
			Total (Wet Wt) Potassium (K)	2021/10/16	1.1		%	40
			Total (Wet Wt) Selenium (Se)	2021/10/16	0.066		%	40
			Total (Wet Wt) Silver (Ag)	2021/10/16	5.9		%	40
			Total (Wet Wt) Sodium (Na)	2021/10/16	1.2		%	40
			Total (Wet Wt) Strontium (Sr)	2021/10/16	23		%	60
			Total (Wet Wt) Thallium (Tl)	2021/10/16	4.3		%	40
			Total (Wet Wt) Tin (Sn)	2021/10/16	6.0		%	40

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total (Wet Wt) Titanium (Ti)	2021/10/16	3.4		%	40
			Total (Wet Wt) Uranium (U)	2021/10/16	3.5		%	40
			Total (Wet Wt) Vanadium (V)	2021/10/16	1.5		%	40
			Total (Wet Wt) Zinc (Zn)	2021/10/16	11		%	40
A382831	CG5	RPD	Moisture	2021/10/13	1.8		%	20
A385672	JLP	Matrix Spike [AGU170-01]	Total (Wet Wt) Aluminum (Al)	2021/10/21		97	%	75 - 125
			Total (Wet Wt) Antimony (Sb)	2021/10/21		96	%	75 - 125
			Total (Wet Wt) Arsenic (As)	2021/10/21		119	%	75 - 125
			Total (Wet Wt) Barium (Ba)	2021/10/21		94	%	75 - 125
			Total (Wet Wt) Beryllium (Be)	2021/10/21		93	%	75 - 125
			Total (Wet Wt) Bismuth (Bi)	2021/10/21		92	%	75 - 125
			Total (Wet Wt) Boron (B)	2021/10/21		96	%	75 - 125
			Total (Wet Wt) Cadmium (Cd)	2021/10/21		95	%	75 - 125
			Total (Wet Wt) Calcium (Ca)	2021/10/21		83	%	75 - 125
			Total (Wet Wt) Chromium (Cr)	2021/10/21		90	%	75 - 125
			Total (Wet Wt) Cobalt (Co)	2021/10/21		88	%	75 - 125
			Total (Wet Wt) Copper (Cu)	2021/10/21		94	%	75 - 125
			Total (Wet Wt) Iron (Fe)	2021/10/21		104	%	75 - 125
			Total (Wet Wt) Lead (Pb)	2021/10/21		93	%	75 - 125
			Total (Wet Wt) Magnesium (Mg)	2021/10/21		110	%	75 - 125
			Total (Wet Wt) Manganese (Mn)	2021/10/21		92	%	75 - 125
			Total (Wet Wt) Mercury (Hg)	2021/10/21		113	%	75 - 125
			Total (Wet Wt) Molybdenum (Mo)	2021/10/21		102	%	75 - 125
			Total (Wet Wt) Nickel (Ni)	2021/10/21		87	%	75 - 125
			Total (Wet Wt) Phosphorus (P)	2021/10/21		109	%	75 - 125
			Total (Wet Wt) Potassium (K)	2021/10/21		NC	%	75 - 125
			Total (Wet Wt) Selenium (Se)	2021/10/21		107	%	75 - 125
			Total (Wet Wt) Silver (Ag)	2021/10/21		91	%	75 - 125
			Total (Wet Wt) Sodium (Na)	2021/10/21		97	%	75 - 125
			Total (Wet Wt) Strontium (Sr)	2021/10/21		97	%	75 - 125
			Total (Wet Wt) Thallium (Tl)	2021/10/21		94	%	75 - 125
			Total (Wet Wt) Tin (Sn)	2021/10/21		101	%	75 - 125
			Total (Wet Wt) Titanium (Ti)	2021/10/21		89	%	75 - 125
			Total (Wet Wt) Uranium (U)	2021/10/21		100	%	75 - 125
			Total (Wet Wt) Vanadium (V)	2021/10/21		91	%	75 - 125
			Total (Wet Wt) Zinc (Zn)	2021/10/21		111	%	75 - 125
A385672	JLP	QC Standard	Total (Wet Wt) Aluminum (Al)	2021/10/21		107	%	75 - 125
			Total (Wet Wt) Arsenic (As)	2021/10/21		104	%	75 - 125
			Total (Wet Wt) Cadmium (Cd)	2021/10/21		101	%	75 - 125
			Total (Wet Wt) Chromium (Cr)	2021/10/21		81	%	75 - 125
			Total (Wet Wt) Cobalt (Co)	2021/10/21		96	%	75 - 125
			Total (Wet Wt) Copper (Cu)	2021/10/21		92	%	75 - 125
			Total (Wet Wt) Iron (Fe)	2021/10/21		102	%	75 - 125
			Total (Wet Wt) Lead (Pb)	2021/10/21		66 (2)	%	75 - 125
			Total (Wet Wt) Mercury (Hg)	2021/10/21		96	%	75 - 125
			Total (Wet Wt) Molybdenum (Mo)	2021/10/21		103	%	75 - 125
			Total (Wet Wt) Nickel (Ni)	2021/10/21		90	%	75 - 125
			Total (Wet Wt) Phosphorus (P)	2021/10/21		98	%	75 - 125
			Total (Wet Wt) Selenium (Se)	2021/10/21		102	%	75 - 125
			Total (Wet Wt) Sodium (Na)	2021/10/21		102	%	75 - 125
			Total (Wet Wt) Uranium (U)	2021/10/21		104	%	75 - 125
			Total (Wet Wt) Zinc (Zn)	2021/10/21		94	%	75 - 125

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A385672	JLP	Spiked Blank	Total (Wet Wt) Aluminum (Al)	2021/10/21		106	%	75 - 125
			Total (Wet Wt) Antimony (Sb)	2021/10/21		101	%	75 - 125
			Total (Wet Wt) Arsenic (As)	2021/10/21		100	%	75 - 125
			Total (Wet Wt) Barium (Ba)	2021/10/21		98	%	75 - 125
			Total (Wet Wt) Beryllium (Be)	2021/10/21		100	%	75 - 125
			Total (Wet Wt) Bismuth (Bi)	2021/10/21		99	%	75 - 125
			Total (Wet Wt) Boron (B)	2021/10/21		101	%	75 - 125
			Total (Wet Wt) Cadmium (Cd)	2021/10/21		97	%	75 - 125
			Total (Wet Wt) Calcium (Ca)	2021/10/21		103	%	75 - 125
			Total (Wet Wt) Chromium (Cr)	2021/10/21		99	%	75 - 125
			Total (Wet Wt) Cobalt (Co)	2021/10/21		98	%	75 - 125
			Total (Wet Wt) Copper (Cu)	2021/10/21		97	%	75 - 125
			Total (Wet Wt) Iron (Fe)	2021/10/21		106	%	75 - 125
			Total (Wet Wt) Lead (Pb)	2021/10/21		101	%	75 - 125
			Total (Wet Wt) Magnesium (Mg)	2021/10/21		108	%	75 - 125
			Total (Wet Wt) Manganese (Mn)	2021/10/21		100	%	75 - 125
			Total (Wet Wt) Mercury (Hg)	2021/10/21		96	%	75 - 125
			Total (Wet Wt) Molybdenum (Mo)	2021/10/21		106	%	75 - 125
			Total (Wet Wt) Nickel (Ni)	2021/10/21		99	%	75 - 125
			Total (Wet Wt) Phosphorus (P)	2021/10/21		101	%	75 - 125
			Total (Wet Wt) Potassium (K)	2021/10/21		103	%	75 - 125
			Total (Wet Wt) Selenium (Se)	2021/10/21		99	%	75 - 125
			Total (Wet Wt) Silver (Ag)	2021/10/21		96	%	75 - 125
			Total (Wet Wt) Sodium (Na)	2021/10/21		105	%	75 - 125
			Total (Wet Wt) Strontium (Sr)	2021/10/21		100	%	75 - 125
			Total (Wet Wt) Thallium (Tl)	2021/10/21		98	%	75 - 125
			Total (Wet Wt) Tin (Sn)	2021/10/21		102	%	75 - 125
			Total (Wet Wt) Titanium (Ti)	2021/10/21		102	%	75 - 125
			Total (Wet Wt) Uranium (U)	2021/10/21		106	%	75 - 125
			Total (Wet Wt) Vanadium (V)	2021/10/21		99	%	75 - 125
			Total (Wet Wt) Zinc (Zn)	2021/10/21		99	%	75 - 125
A385672	JLP	Method Blank	Total (Wet Wt) Aluminum (Al)	2021/10/21	<0.20		mg/kg	
			Total (Wet Wt) Antimony (Sb)	2021/10/21	<0.0010		mg/kg	
			Total (Wet Wt) Arsenic (As)	2021/10/21	<0.0040		mg/kg	
			Total (Wet Wt) Barium (Ba)	2021/10/21	<0.010		mg/kg	
			Total (Wet Wt) Beryllium (Be)	2021/10/21	<0.0010		mg/kg	
			Total (Wet Wt) Bismuth (Bi)	2021/10/21	<0.0010		mg/kg	
			Total (Wet Wt) Boron (B)	2021/10/21	<0.20		mg/kg	
			Total (Wet Wt) Cadmium (Cd)	2021/10/21	<0.0010		mg/kg	
			Total (Wet Wt) Calcium (Ca)	2021/10/21	<2.0		mg/kg	
			Total (Wet Wt) Chromium (Cr)	2021/10/21	<0.010		mg/kg	
			Total (Wet Wt) Cobalt (Co)	2021/10/21	<0.0013		mg/kg	
			Total (Wet Wt) Copper (Cu)	2021/10/21	<0.010		mg/kg	
			Total (Wet Wt) Iron (Fe)	2021/10/21	<0.25		mg/kg	
			Total (Wet Wt) Lead (Pb)	2021/10/21	<0.0010		mg/kg	
			Total (Wet Wt) Magnesium (Mg)	2021/10/21	<0.40		mg/kg	
			Total (Wet Wt) Manganese (Mn)	2021/10/21	<0.010		mg/kg	
			Total (Wet Wt) Mercury (Hg)	2021/10/21	<0.0020		mg/kg	
			Total (Wet Wt) Molybdenum (Mo)	2021/10/21	<0.0040		mg/kg	
			Total (Wet Wt) Nickel (Ni)	2021/10/21	<0.010		mg/kg	
			Total (Wet Wt) Phosphorus (P)	2021/10/21	<2.0		mg/kg	
			Total (Wet Wt) Potassium (K)	2021/10/21	<2.0		mg/kg	
			Total (Wet Wt) Selenium (Se)	2021/10/21	<0.010		mg/kg	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total (Wet Wt) Silver (Ag)	2021/10/21	<0.0010		mg/kg	
			Total (Wet Wt) Sodium (Na)	2021/10/21	<2.0		mg/kg	
			Total (Wet Wt) Strontium (Sr)	2021/10/21	<0.010		mg/kg	
			Total (Wet Wt) Thallium (Tl)	2021/10/21	<0.00040		mg/kg	
			Total (Wet Wt) Tin (Sn)	2021/10/21	<0.020		mg/kg	
			Total (Wet Wt) Titanium (Ti)	2021/10/21	<0.020		mg/kg	
			Total (Wet Wt) Uranium (U)	2021/10/21	<0.00040		mg/kg	
			Total (Wet Wt) Vanadium (V)	2021/10/21	<0.020		mg/kg	
			Total (Wet Wt) Zinc (Zn)	2021/10/21	<0.040		mg/kg	
A385672	JLP	RPD [AGU170-01]	Total (Wet Wt) Aluminum (Al)	2021/10/21	1.7		%	40
			Total (Wet Wt) Antimony (Sb)	2021/10/21	21		%	40
			Total (Wet Wt) Arsenic (As)	2021/10/21	2.7		%	40
			Total (Wet Wt) Barium (Ba)	2021/10/21	NC		%	40
			Total (Wet Wt) Beryllium (Be)	2021/10/21	NC		%	40
			Total (Wet Wt) Bismuth (Bi)	2021/10/21	NC		%	40
			Total (Wet Wt) Boron (B)	2021/10/21	NC		%	40
			Total (Wet Wt) Cadmium (Cd)	2021/10/21	4.2		%	40
			Total (Wet Wt) Calcium (Ca)	2021/10/21	16		%	60
			Total (Wet Wt) Cesium (Cs)	2021/10/21	0.48		%	40
			Total (Wet Wt) Chromium (Cr)	2021/10/21	NC		%	40
			Total (Wet Wt) Cobalt (Co)	2021/10/21	11		%	40
			Total (Wet Wt) Copper (Cu)	2021/10/21	16		%	40
			Total (Wet Wt) Iron (Fe)	2021/10/21	16		%	40
			Total (Wet Wt) Lanthanum (La)	2021/10/21	NC		%	40
			Total (Wet Wt) Lead (Pb)	2021/10/21	32		%	40
			Total (Wet Wt) Lithium (Li)	2021/10/21	NC		%	40
			Total (Wet Wt) Magnesium (Mg)	2021/10/21	3.2		%	40
			Total (Wet Wt) Manganese (Mn)	2021/10/21	4.7		%	40
			Total (Wet Wt) Mercury (Hg)	2021/10/21	1.2		%	40
			Total (Wet Wt) Molybdenum (Mo)	2021/10/21	NC		%	40
			Total (Wet Wt) Nickel (Ni)	2021/10/21	NC		%	40
			Total (Wet Wt) Phosphorus (P)	2021/10/21	4.1		%	40
			Total (Wet Wt) Potassium (K)	2021/10/21	4.0		%	40
			Total (Wet Wt) Rubidium (Rb)	2021/10/21	0.93		%	40
			Total (Wet Wt) Selenium (Se)	2021/10/21	3.3		%	40
			Total (Wet Wt) Silicon (Si)	2021/10/21	NC		%	40
			Total (Wet Wt) Silver (Ag)	2021/10/21	NC		%	40
			Total (Wet Wt) Sodium (Na)	2021/10/21	2.6		%	40
			Total (Wet Wt) Strontium (Sr)	2021/10/21	20		%	60
			Total (Wet Wt) Sulphur (S)	2021/10/21	2.9		%	40
			Total (Wet Wt) Tellurium (Te)	2021/10/21	NC		%	40
			Total (Wet Wt) Thallium (Tl)	2021/10/21	3.5		%	40
			Total (Wet Wt) Thorium (Th)	2021/10/21	NC		%	40
			Total (Wet Wt) Tin (Sn)	2021/10/21	NC		%	40
			Total (Wet Wt) Titanium (Ti)	2021/10/21	7.0		%	40
			Total (Wet Wt) Tungsten (W)	2021/10/21	NC		%	40
			Total (Wet Wt) Uranium (U)	2021/10/21	NC		%	40
			Total (Wet Wt) Vanadium (V)	2021/10/21	NC		%	40
			Total (Wet Wt) Zinc (Zn)	2021/10/21	2.1		%	40
			Total (Wet Wt) Zirconium (Zr)	2021/10/21	NC		%	40
A415877	JLP	QC Standard	Total (Wet Wt) Aluminum (Al)	2021/11/17		108	%	N/A
			Total (Wet Wt) Arsenic (As)	2021/11/17		92	%	N/A
			Total (Wet Wt) Cadmium (Cd)	2021/11/17		96	%	N/A

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total (Wet Wt) Chromium (Cr)	2021/11/17		82	%	N/A
			Total (Wet Wt) Cobalt (Co)	2021/11/17		96	%	N/A
			Total (Wet Wt) Copper (Cu)	2021/11/17		89	%	N/A
			Total (Wet Wt) Iron (Fe)	2021/11/17		91	%	N/A
			Total (Wet Wt) Lead (Pb)	2021/11/17		61 (2)	%	N/A
			Total (Wet Wt) Mercury (Hg)	2021/11/17		85	%	N/A
			Total (Wet Wt) Molybdenum (Mo)	2021/11/17		98	%	N/A
			Total (Wet Wt) Nickel (Ni)	2021/11/17		85	%	N/A
			Total (Wet Wt) Phosphorus (P)	2021/11/17		87	%	N/A
			Total (Wet Wt) Selenium (Se)	2021/11/17		97	%	N/A
			Total (Wet Wt) Sodium (Na)	2021/11/17		97	%	N/A
			Total (Wet Wt) Uranium (U)	2021/11/17		125	%	N/A
			Total (Wet Wt) Zinc (Zn)	2021/11/17		89	%	N/A
A415877	JLP	Spiked Blank	Total (Wet Wt) Aluminum (Al)	2021/11/17		101	%	80 - 120
			Total (Wet Wt) Antimony (Sb)	2021/11/17		96	%	80 - 120
			Total (Wet Wt) Arsenic (As)	2021/11/17		97	%	80 - 120
			Total (Wet Wt) Barium (Ba)	2021/11/17		97	%	80 - 120
			Total (Wet Wt) Beryllium (Be)	2021/11/17		95	%	80 - 120
			Total (Wet Wt) Bismuth (Bi)	2021/11/17		96	%	80 - 120
			Total (Wet Wt) Boron (B)	2021/11/17		103	%	80 - 120
			Total (Wet Wt) Cadmium (Cd)	2021/11/17		94	%	80 - 120
			Total (Wet Wt) Calcium (Ca)	2021/11/17		100	%	80 - 120
			Total (Wet Wt) Chromium (Cr)	2021/11/17		98	%	80 - 120
			Total (Wet Wt) Cobalt (Co)	2021/11/17		100	%	80 - 120
			Total (Wet Wt) Copper (Cu)	2021/11/17		98	%	80 - 120
			Total (Wet Wt) Iron (Fe)	2021/11/17		101	%	80 - 120
			Total (Wet Wt) Lead (Pb)	2021/11/17		96	%	80 - 120
			Total (Wet Wt) Magnesium (Mg)	2021/11/17		106	%	80 - 120
			Total (Wet Wt) Manganese (Mn)	2021/11/17		100	%	80 - 120
			Total (Wet Wt) Mercury (Hg)	2021/11/17		99	%	80 - 120
			Total (Wet Wt) Molybdenum (Mo)	2021/11/17		103	%	80 - 120
			Total (Wet Wt) Nickel (Ni)	2021/11/17		101	%	80 - 120
			Total (Wet Wt) Phosphorus (P)	2021/11/17		94	%	80 - 120
			Total (Wet Wt) Potassium (K)	2021/11/17		99	%	80 - 120
			Total (Wet Wt) Selenium (Se)	2021/11/17		99	%	80 - 120
			Total (Wet Wt) Silver (Ag)	2021/11/17		95	%	80 - 120
			Total (Wet Wt) Sodium (Na)	2021/11/17		102	%	80 - 120
			Total (Wet Wt) Strontium (Sr)	2021/11/17		97	%	80 - 120
			Total (Wet Wt) Thallium (Tl)	2021/11/17		98	%	80 - 120
			Total (Wet Wt) Tin (Sn)	2021/11/17		102	%	80 - 120
			Total (Wet Wt) Titanium (Ti)	2021/11/17		103	%	80 - 120
			Total (Wet Wt) Uranium (U)	2021/11/17		98	%	80 - 120
			Total (Wet Wt) Vanadium (V)	2021/11/17		96	%	80 - 120
			Total (Wet Wt) Zinc (Zn)	2021/11/17		111	%	80 - 120
A415877	JLP	Method Blank	Total (Wet Wt) Aluminum (Al)	2021/11/17	<0.50		mg/kg	
			Total (Wet Wt) Antimony (Sb)	2021/11/17	<0.0020		mg/kg	
			Total (Wet Wt) Arsenic (As)	2021/11/17	<0.0050		mg/kg	
			Total (Wet Wt) Barium (Ba)	2021/11/17	<0.010		mg/kg	
			Total (Wet Wt) Beryllium (Be)	2021/11/17	<0.0020		mg/kg	
			Total (Wet Wt) Bismuth (Bi)	2021/11/17	<0.0013		mg/kg	
			Total (Wet Wt) Boron (B)	2021/11/17	<0.20		mg/kg	
			Total (Wet Wt) Cadmium (Cd)	2021/11/17	<0.0013		mg/kg	
			Total (Wet Wt) Calcium (Ca)	2021/11/17	<4.0		mg/kg	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total (Wet Wt) Chromium (Cr)	2021/11/17	<0.025		mg/kg	
			Total (Wet Wt) Cobalt (Co)	2021/11/17	<0.0013		mg/kg	
			Total (Wet Wt) Copper (Cu)	2021/11/17	<0.013		mg/kg	
			Total (Wet Wt) Iron (Fe)	2021/11/17	<0.25		mg/kg	
			Total (Wet Wt) Lead (Pb)	2021/11/17	<0.0013		mg/kg	
			Total (Wet Wt) Magnesium (Mg)	2021/11/17	<0.40		mg/kg	
			Total (Wet Wt) Manganese (Mn)	2021/11/17	<0.010		mg/kg	
			Total (Wet Wt) Mercury (Hg)	2021/11/17	<0.013		mg/kg	
			Total (Wet Wt) Molybdenum (Mo)	2021/11/17	<0.0080		mg/kg	
			Total (Wet Wt) Nickel (Ni)	2021/11/17	<0.010		mg/kg	
			Total (Wet Wt) Phosphorus (P)	2021/11/17	<2.0		mg/kg	
			Total (Wet Wt) Potassium (K)	2021/11/17	<2.5		mg/kg	
			Total (Wet Wt) Selenium (Se)	2021/11/17	<0.010		mg/kg	
			Total (Wet Wt) Silver (Ag)	2021/11/17	<0.0013		mg/kg	
			Total (Wet Wt) Sodium (Na)	2021/11/17	<2.5		mg/kg	
			Total (Wet Wt) Strontium (Sr)	2021/11/17	<0.013		mg/kg	
			Total (Wet Wt) Thallium (Tl)	2021/11/17	<0.00040		mg/kg	
			Total (Wet Wt) Tin (Sn)	2021/11/17	<0.020		mg/kg	
			Total (Wet Wt) Titanium (Ti)	2021/11/17	<0.13		mg/kg	
			Total (Wet Wt) Uranium (U)	2021/11/17	<0.00040		mg/kg	
			Total (Wet Wt) Vanadium (V)	2021/11/17	<0.020		mg/kg	
			Total (Wet Wt) Zinc (Zn)	2021/11/17	<0.20		mg/kg	

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Reference outside acceptance criteria due to digestion limitations. Re-analysis yields similar results.

(2) Reference material outside acceptance criteria due to digestion limitations.

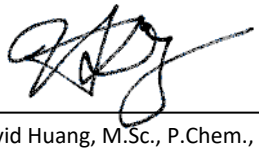
Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C171211
Report Date: 2022/01/05

GOLDER ASSOCIATES LTD
Client Project #: 1663724
Site Location: 44000/03 BAFFINLAND IRON MINE
Sampler Initials: BC

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



David Huang, M.Sc., P.Chem., QP, Scientific Services Manager

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company :	Golder Associates Ltd.	Company:		Quotation	C00599	☑ 5 - 7 Days Regular (Most analyses)
Contact Name:	Collin Arens	Contact Name:		P.O. #/AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	16820 107 Ave.	Address:				Rush TAT (Surcharges will be applied)
	Edmonton, AB PC: T5P 4C3		PC:	Project #:	1663724/44000/03	☐ Same Day ☐ 2 Days
Phone/Fax:	(780) 237-9638	Phone/Fax:		Site Location:	Baffinland Iron Mine	☐ 1 Day ☐ 3-4 Days
Email:	carens@golder.com	Email:		Site #:	Milne Port/Reference Site	Date Required:
Copies:	rsharpe@golder.com	Copies:		Sampled By:	Bradley Cox, Daniel Vicente	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

Depot Reception

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	☐ BTEXS / VPH	☐ VOC / BTEXS / VPH	☐ MTBE	☐ BTEX F1	☐ VOC / BTEX / F1	☐ PAH	☐ LEPH / HEPH / PAH	☐ EPH	☐ TEH	☐ F2 - F4	☐ Dissolved Metals	☐ Filtered?	☐ Preserved?	☐ Dissolved Mercury	☐ Filtered?	☐ Preserved?	☐ Total Metals	☐ Field Preserved?	☐ Total Mercury	☐ Field Preserved?	☐ Chloride	☐ Fluoride	☐ Sulphate	☐ TSS	☐ TDS	☐ COD	☐ BOD	☐ pH	☐ Conductivity	☐ Alkalinity	☐ Nitrite	☐ Nitrate	☐ Ammonia	☐ Alkylated PAHs	☐						HOLD - DO NOT ANALYZE
1	BAFF21UMLNFRSC1003	2021-08-08	13:40	Tissue	1																	X																									
2	BAFF21UMLNFRSC1006	2021-08-08	14:33	Tissue	1																	X																									
3	BAFF21UMLNFRSC1019	2021-08-09	11:22	Tissue	1																	X																									
4	BAFF21UMLNFRSC1029	2021-08-09	14:53	Tissue	1																	X																									
5	BAFF21UMLNFRSC1030	2021-08-10	12:32	Tissue	1																	X																									
6	BAFF21UMLNFRSC1031	2021-08-10	12:50	Tissue	1																	X																									
7	BAFF21UMLNFRSC1033	2021-08-10	13:22	Tissue	1																	X																									
8	BAFF21UMLNFRSC1036	2021-08-10	14:24	Tissue	1																	X																									
9																																															
10																																															

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
Collin Arens	2021/09/22	13:15				

C171211_COC

COC-1020

08497711

Bureau Veritas

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:		Quotation	C00599	☑ 5 - 7 Days Regular (Most analyses)
Contact Name:	Collin Arens	Contact Name:		P.O. #/AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	16820 107 Ave.	Address:				Rush TAT (Surcharges will be applied)
	Edmonton, AB PC: T5P 4C3		PC:	Project #:	1663724/44000/03	☐ Same Day ☐ 2 Days
Phone/Fax:	(780) 237-9638	Phone/Fax:		Site Location:	Baffinland Iron Mine	☐ 1 Day ☐ 3-4 Days
Email:	carens@golder.com	Email:		Site #:	Milne Port/Reference Site	Date Required:
Copies:	rsharpe@golder.com	Copies:		Sampled By:	Bradley Cox, Daniel Vicente	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present		✓	Temp	4	3	3
Seal Intact		✓				
Cooling Media	✓					
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						

Depot Reception

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	BTEXS / VPH	BTEX F1	PAH	EPH	Dissolved Metals	Dissolved Mercury	Total Metals	Total Mercury	Chloride	TSS	pH	Nitrite	Alkylated PAHs						HOLD - DO NOT ANALYZE
1	BAFF21UMLNGN03ARCH03	2021-08-06	13:28	Tissue	1							X												
2	BAFF21UMLNGN05ARCH03	2021-08-07	14:58	Tissue	1							X												
3	BAFF21UMLNGN06ARCH09	2021-08-07	15:12	Tissue	1							X												
4	BAFF21UMLNGN09ARCH03	2021-08-10	9:00	Tissue	1							X												
5	BAFF21UMLNGN10ARCH10	2021-08-11	16:09	Tissue	1							X												
6	BAFF21UMLNGN20ARCH02	2021-08-17	12:50	Tissue	1							X												
7	BAFF21UMLNGN2SARCH03	2021-08-18	16:15	Tissue	1							X												
8	BAFF21UMLNGN2SARCH05	2021-08-18	16:15	Tissue	1							X												
9																								
10																								

	MTBE	VOC / BTEX / F1	LEPH / HEPH / PAH	F2 - F4	Preserved?	Preserved?	Field Preserved?	Field Preserved?	Sulphate	COD	Alkalinity	Ammonia
	VOC / BTEXS / VPH			TEH	Filtered?	Filtered?			Fluoride	BOD		
									TDS	Conductivity	Nitrate	

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Special Instructions

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
Collin Arens. Collin Arens	2021/09/22	13:15	Reagie Langoy	2021/09/23	08:00	C171211_COC

COC-1020

Your Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Your C.O.C. #: 08497715

Attention: Collin Arens

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2021/10/27
Report #: R3091169
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C171217
Received: 2021/09/23, 08:00

Sample Matrix: Tissue
Samples Received: 16

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
PAH in Tissue by GC/MS (SIM) (1, 2)	16	2021/10/19	2021/10/20	ATL SOP 00104	EPA 8270E R6 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Bedford, Bureau Veritas Bedford, 200 Bluewater Rd. Suite 105, Bedford, NS, Canada, B4B 1G9
(2) Results are reported on an as received basis unless otherwise indicated.

Your Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Your C.O.C. #: 08497715

Attention: Collin Arens

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2021/10/27
Report #: R3091169
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C171217
Received: 2021/09/23, 08:00

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Cynny Hagen, Key Account Specialist
Email: Cynny.HAGEN@bureauveritas.com
Phone# (403)735-2273
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Job #: C171217
Report Date: 2021/10/27

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Sampler Initials: CA

RESULTS OF CHEMICAL ANALYSES OF TISSUE

Bureau Veritas ID		AGP071	AGP072	AGY779		
Sampling Date		2021/08/06 13:28	2021/08/08 13:40	2021/08/07 14:58		
COC Number		08497715	08497715	08497715		
	UNITS	BAFF21UMLNGN03ARCH03	BAFF21UMLNFRSC1003	BAFF21UMLNGN05ARCH03	RDL	QC Batch
Polycyclic Aromatics						
1-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
2-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(j)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Perylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Naphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Fluorene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Phenanthrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Chrysene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(b)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(k)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Indeno(1,2,3-cd)pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Dibenz(a,h)anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(g,h,i)perylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Surrogate Recovery (%)						
D10-ANTHRACENE (sur.)	%	83	90	89	N/A	A396942
D8-ACENAPHTHYLENE (sur.)	%	88	90	91	N/A	A396942
TERPHENYL-D14 (sur.)	%	83	89	87	N/A	A396942

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C171217
Report Date: 2021/10/27

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Sampler Initials: CA

RESULTS OF CHEMICAL ANALYSES OF TISSUE

Bureau Veritas ID		AGY781		AGY809	AGY826		
Sampling Date		2021/08/07 15:12		2021/08/10 09:00	2021/08/11 16:09		
COC Number		08497715		08497715	08497715		
	UNITS	BAFF21UMLNGN06ARCH09	RDL	BAFF21UMLNGN09ARCH03	BAFF21UMLNGN10ARCH10	RDL	QC Batch
Polycyclic Aromatics							
1-Methylnaphthalene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
2-Methylnaphthalene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Benzo(j)fluoranthene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Perylene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Naphthalene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Acenaphthylene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Acenaphthene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Fluorene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Phenanthrene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Anthracene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Fluoranthene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Pyrene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Benzo(a)anthracene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Chrysene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Benzo(b)fluoranthene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Benzo(k)fluoranthene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Benzo(a)pyrene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Indeno(1,2,3-cd)pyrene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Dibenz(a,h)anthracene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Benzo(g,h,i)perylene	mg/kg	<0.070	0.070	<0.050	<0.050	0.050	A396942
Surrogate Recovery (%)							
D10-ANTHRACENE (sur.)	%	94	N/A	96	93	N/A	A396942
D8-ACENAPHTHYLENE (sur.)	%	94	N/A	98	96	N/A	A396942
TERPHENYL-D14 (sur.)	%	91 (1)	N/A	95	93	N/A	A396942

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Elevated PAH RDL(s) due to limited sample.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C171217
Report Date: 2021/10/27

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Sampler Initials: CA

RESULTS OF CHEMICAL ANALYSES OF TISSUE

Bureau Veritas ID		AGY827	AGY828	AGY829	AGY840		
Sampling Date		2021/08/17 12:50	2021/08/18 16:15	2021/08/18 16:15	2021/08/08 14:33		
COC Number		08497715	08497715	08497715	08497715		
	UNITS	BAFF21UMLNGN20ARCH02	BAFF21UMLNGN25ARCH03	BAFF21UMLNGN25ARCH05	BAFF21UMLNFRSC1006	RDL	QC Batch
Polycyclic Aromatics							
1-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
2-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Benzo(j)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Perylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Naphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Fluorene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Phenanthrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Chrysene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Benzo(b)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Benzo(k)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Indeno(1,2,3-cd)pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Dibenz(a,h)anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Benzo(g,h,i)perylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A396942
Surrogate Recovery (%)							
D10-ANTHRACENE (sur.)	%	81	90	88	91	N/A	A396942
D8-ACENAPHTHYLENE (sur.)	%	82	93	89	94	N/A	A396942
TERPHENYL-D14 (sur.)	%	76	87	86	90	N/A	A396942

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N/A = Not Applicable

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Bureau Veritas Job #: C171217
Report Date: 2021/10/27

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Sampler Initials: CA

RESULTS OF CHEMICAL ANALYSES OF TISSUE

Bureau Veritas ID		AGY841	AGY842	AGY843		
Sampling Date		2021/08/09 11:22	2021/08/09 14:53	2021/08/10 12:32		
COC Number		08497715	08497715	08497715		
	UNITS	BAFF21UMLNFRSC1019	BAFF21UMLNFRSC1029	BAFF21UMLNFRSC1030	RDL	QC Batch
Polycyclic Aromatics						
1-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
2-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(j)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Perylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Naphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Fluorene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Phenanthrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Chrysene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(b)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(k)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Indeno(1,2,3-cd)pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Dibenz(a,h)anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(g,h,i)perylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Surrogate Recovery (%)						
D10-ANTHRACENE (sur.)	%	85	88	80	N/A	A396942
D8-ACENAPHTHYLENE (sur.)	%	86	90	79	N/A	A396942
TERPHENYL-D14 (sur.)	%	83	86	78	N/A	A396942

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C171217
Report Date: 2021/10/27

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Sampler Initials: CA

RESULTS OF CHEMICAL ANALYSES OF TISSUE

Bureau Veritas ID		AGY854	AGY855	AGY856		
Sampling Date		2021/08/10 12:50	2021/08/10 13:22	2021/08/10 14:24		
COC Number		08497715	08497715	08497715		
	UNITS	BAFF21UMLNFRSC1031	BAFF21UMLNFRSC1033	BAFF21UMLNFRSC1036	RDL	QC Batch
Polycyclic Aromatics						
1-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
2-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(j)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Perylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Naphthalene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Acenaphthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Fluorene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Phenanthrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Chrysene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(b)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(k)fluoranthene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(a)pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Indeno(1,2,3-cd)pyrene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Dibenz(a,h)anthracene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Benzo(g,h,i)perylene	mg/kg	<0.050	<0.050	<0.050	0.050	A396942
Surrogate Recovery (%)						
D10-ANTHRACENE (sur.)	%	92	94	101	N/A	A396942
D8-ACENAPHTHYLENE (sur.)	%	97	96	102	N/A	A396942
TERPHENYL-D14 (sur.)	%	92	93	99	N/A	A396942

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

GENERAL COMMENTS

Results relate only to the items tested.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A396942	LGE	Reagent Blank	1-Methylnaphthalene	2021/10/20	<0.050		mg/kg	
			2-Methylnaphthalene	2021/10/20	<0.050		mg/kg	
			Benzo(j)fluoranthene	2021/10/20	<0.050		mg/kg	
			D10-ANTHRACENE (sur.)	2021/10/20		89	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2021/10/20		84	%	50 - 130
			Perylene	2021/10/20	<0.050		mg/kg	
			TERPHENYL-D14 (sur.)	2021/10/20		91	%	50 - 130
			Naphthalene	2021/10/20	<0.050		mg/kg	
			Acenaphthylene	2021/10/20	<0.050		mg/kg	
			Acenaphthene	2021/10/20	<0.050		mg/kg	
			Fluorene	2021/10/20	<0.050		mg/kg	
			Phenanthrene	2021/10/20	<0.050		mg/kg	
			Anthracene	2021/10/20	<0.050		mg/kg	
			Fluoranthene	2021/10/20	<0.050		mg/kg	
			Pyrene	2021/10/20	<0.050		mg/kg	
			Benzo(a)anthracene	2021/10/20	<0.050		mg/kg	
			Chrysene	2021/10/20	<0.050		mg/kg	
			Benzo(b)fluoranthene	2021/10/20	<0.050		mg/kg	
			Benzo(k)fluoranthene	2021/10/20	<0.050		mg/kg	
			Benzo(a)pyrene	2021/10/20	<0.050		mg/kg	
			Indeno(1,2,3-cd)pyrene	2021/10/20	<0.050		mg/kg	
			Dibenz(a,h)anthracene	2021/10/20	<0.050		mg/kg	
			Benzo(g,h,i)perylene	2021/10/20	<0.050		mg/kg	
A396942	LGE	Matrix Spike [AGP071-01]	1-Methylnaphthalene	2021/10/20		82	%	50 - 130
			2-Methylnaphthalene	2021/10/20		85	%	50 - 130
			Benzo(j)fluoranthene	2021/10/20		73	%	50 - 130
			D10-ANTHRACENE (sur.)	2021/10/20		84	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2021/10/20		89	%	50 - 130
			Perylene	2021/10/20		72	%	50 - 130
			TERPHENYL-D14 (sur.)	2021/10/20		84	%	50 - 130
			Naphthalene	2021/10/20		85	%	50 - 130
			Acenaphthylene	2021/10/20		86	%	50 - 130
			Acenaphthene	2021/10/20		91	%	50 - 130
			Fluorene	2021/10/20		92	%	50 - 130
			Phenanthrene	2021/10/20		92	%	50 - 130
			Anthracene	2021/10/20		88	%	50 - 130
			Fluoranthene	2021/10/20		89	%	50 - 130
			Pyrene	2021/10/20		89	%	50 - 130
			Benzo(a)anthracene	2021/10/20		91	%	50 - 130
			Chrysene	2021/10/20		94	%	50 - 130
			Benzo(b)fluoranthene	2021/10/20		75	%	50 - 130
			Benzo(k)fluoranthene	2021/10/20		77	%	50 - 130
			Benzo(a)pyrene	2021/10/20		71	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2021/10/20		76	%	50 - 130
			Dibenz(a,h)anthracene	2021/10/20		75	%	50 - 130
			Benzo(g,h,i)perylene	2021/10/20		73	%	50 - 130
A396942	LGE	Spiked Blank	1-Methylnaphthalene	2021/10/20		82	%	50 - 130
			2-Methylnaphthalene	2021/10/20		85	%	50 - 130
			Benzo(j)fluoranthene	2021/10/20		74	%	50 - 130
			D10-ANTHRACENE (sur.)	2021/10/20		84	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2021/10/20		87	%	50 - 130
			Perylene	2021/10/20		74	%	50 - 130

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			TERPHENYL-D14 (sur.)	2021/10/20		82	%	50 - 130
			Naphthalene	2021/10/20		86	%	50 - 130
			Acenaphthylene	2021/10/20		85	%	50 - 130
			Acenaphthene	2021/10/20		90	%	50 - 130
			Fluorene	2021/10/20		91	%	50 - 130
			Phenanthrene	2021/10/20		93	%	50 - 130
			Anthracene	2021/10/20		87	%	50 - 130
			Fluoranthene	2021/10/20		87	%	50 - 130
			Pyrene	2021/10/20		87	%	50 - 130
			Benzo(a)anthracene	2021/10/20		85	%	50 - 130
			Chrysene	2021/10/20		90	%	50 - 130
			Benzo(b)fluoranthene	2021/10/20		81	%	50 - 130
			Benzo(k)fluoranthene	2021/10/20		75	%	50 - 130
			Benzo(a)pyrene	2021/10/20		72	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2021/10/20		76	%	50 - 130
			Dibenz(a,h)anthracene	2021/10/20		73	%	50 - 130
			Benzo(g,h,i)perylene	2021/10/20		75	%	50 - 130
A396942	LGE	Method Blank	1-Methylnaphthalene	2021/10/20	<0.050		mg/kg	
			2-Methylnaphthalene	2021/10/20	<0.050		mg/kg	
			Benzo(j)fluoranthene	2021/10/20	<0.050		mg/kg	
			D10-ANTHRACENE (sur.)	2021/10/20		95	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2021/10/20		97	%	50 - 130
			Perylene	2021/10/20	<0.050		mg/kg	
			TERPHENYL-D14 (sur.)	2021/10/20		95	%	50 - 130
			Naphthalene	2021/10/20	<0.050		mg/kg	
			Acenaphthylene	2021/10/20	<0.050		mg/kg	
			Acenaphthene	2021/10/20	<0.050		mg/kg	
			Fluorene	2021/10/20	<0.050		mg/kg	
			Phenanthrene	2021/10/20	<0.050		mg/kg	
			Anthracene	2021/10/20	<0.050		mg/kg	
			Fluoranthene	2021/10/20	<0.050		mg/kg	
			Pyrene	2021/10/20	<0.050		mg/kg	
			Benzo(a)anthracene	2021/10/20	<0.050		mg/kg	
			Chrysene	2021/10/20	<0.050		mg/kg	
			Benzo(b)fluoranthene	2021/10/20	<0.050		mg/kg	
			Benzo(k)fluoranthene	2021/10/20	<0.050		mg/kg	
			Benzo(a)pyrene	2021/10/20	<0.050		mg/kg	
			Indeno(1,2,3-cd)pyrene	2021/10/20	<0.050		mg/kg	
			Dibenz(a,h)anthracene	2021/10/20	<0.050		mg/kg	
			Benzo(g,h,i)perylene	2021/10/20	<0.050		mg/kg	
A396942	LGE	RPD [AGP071-01]	1-Methylnaphthalene	2021/10/20	NC		%	50
			2-Methylnaphthalene	2021/10/20	NC		%	50
			Benzo(j)fluoranthene	2021/10/20	NC		%	50
			Perylene	2021/10/20	NC		%	50
			Naphthalene	2021/10/20	NC		%	50
			Acenaphthylene	2021/10/20	NC		%	50
			Acenaphthene	2021/10/20	NC		%	50
			Fluorene	2021/10/20	NC		%	50
			Phenanthrene	2021/10/20	NC		%	50
			Anthracene	2021/10/20	NC		%	50
			Fluoranthene	2021/10/20	NC		%	50
			Pyrene	2021/10/20	NC		%	50

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(a)anthracene	2021/10/20	NC		%	50
			Chrysene	2021/10/20	NC		%	50
			Benzo(b)fluoranthene	2021/10/20	NC		%	50
			Benzo(k)fluoranthene	2021/10/20	NC		%	50
			Benzo(a)pyrene	2021/10/20	NC		%	50
			Indeno(1,2,3-cd)pyrene	2021/10/20	NC		%	50
			Dibenz(a,h)anthracene	2021/10/20	NC		%	50
			Benzo(g,h,i)perylene	2021/10/20	NC		%	50

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Reagent Blank: A blank matrix containing all reagents used in the analytical procedure. Used to determine any analytical contamination.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C171217
Report Date: 2021/10/27

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFINLAND IRON MINE MILNE PORT/REFERENCE SITE
Sampler Initials: CA

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Phil Deveau, Scientific Specialist (Organics)

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:		Quotation	C00599	☑ 5 - 7 Days Regular (Most analyses)
Contact Name:	Collin Arens	Contact Name:		P.O. #/AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	16820 107 Ave.	Address:				Rush TAT (Surcharges will be applied)
	Edmonton, AB PC: T5P 4C3		PC:	Project #:	1663724/44000/03	☐ Same Day ☐ 2 Days
Phone/Fax:	(780) 237-9638	Phone/Fax:		Site Location:	Baffinland Iron Mine	☐ 1 Day ☐ 3-4 Days
Email:	carens@golder.com	Email:		Site #:	Milne Port/Reference Site	Date Required:
Copies:	rsharpe@golder.com	Copies:		Sampled By:	Bradley Cox, Daniel Vicente	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

Depot Reception

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	☐ BTEXS / VPH	☐ VOC / BTEXS / VPH	☐ BTEX F1	☐ VOC / BTEX / F1	☐ PAH	☐ LEPH / HEPH / PAH	☐ EPH	☐ TEH	☐ F2 - F4	☐ Dissolved Metals	☐ Preserved?	☐ Filtered?	☐ Dissolved Mercury	☐ Preserved?	☐ Filtered?	☐ Total Metals	☐ Field Preserved?	☐ Total Mercury	☐ Field Preserved?	☐ Chloride	☐ Fluoride	☐ Sulphate	☐ TSS	☐ BOD	☐ COD	☐ TDS	☐ pH	☐ Alkalinity	☐ Conductivity	☐ Nitrite	☐ Ammonia	☐ Nitrate	☐ Alkylated PAHs						HOLD - DO NOT ANALYZE
1	BAFF21UMLNFRSC1003	2021-08-08	13:40	Tissue	1					X																												X						
2	BAFF21UMLNFRSC1006	2021-08-08	14:33	Tissue	1					X																												X						
3	BAFF21UMLNFRSC1019	2021-08-09	11:22	Tissue	1					X																												X						
4	BAFF21UMLNFRSC1029	2021-08-09	14:53	Tissue	1					X																												X						
5	BAFF21UMLNFRSC1030	2021-08-10	12:32	Tissue	1					X																												X						
6	BAFF21UMLNFRSC1031	2021-08-10	12:50	Tissue	1					X																												X						
7	BAFF21UMLNFRSC1033	2021-08-10	13:22	Tissue	1					X																												X						
8	BAFF21UMLNFRSC1036	2021-08-10	14:24	Tissue	1					X																												X						
9																																													
10																																													

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Special Instructions

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
Collin Arens / Collin Arens	2021/09/22	13:15				

COC-1020

C171217_COC

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

08497715

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:		Quotation	C00599	☑ 5 - 7 Days Regular (Most analyses)
Contact Name:	Collin Arens	Contact Name:		P.O. #/AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	16820 107 Ave.	Address:				Rush TAT (Surcharges will be applied)
	Edmonton, AB PC: T5P 4C3		PC:	Project #:	1663724/44000/03	☐ Same Day ☐ 2 Days
Phone/Fax:	(780) 237-9638	Phone/Fax:		Site Location:	Baffinland Iron Mine	☐ 1 Day ☐ 3-4 Days
Email:	carens@golder.com	Email:		Site #:	Milne Port/Reference Site	Date Required:
Copies:	rsharpe@golder.com	Copies:		Sampled By:	Bradley Cox, Daniel Vicente	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present		✓				
Seal Intact		✓	Temp	4	3	3
Cooling Media	✓					
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

Depot Reception

Analysis Requested

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Special Instructions

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	VOC / BTEX / VPH	MTBE	VOC / BTEX / F1	LEPH / HEPH / PAH	F2 - F4	Preserved?	Preserved?	Sulphate	COD	Alkalinity	Ammonia	HOLD - DO NOT ANALYZE
						BTEX / VPH		BTEX F1	PAH	EPH	Dissolved Metals	Dissolved Mercury	Total Metals	Total Mercury	Chloride	TSS	pH	Nitrite	Alkylated PAHs							
1	BAFF21UMLNGN03ARCH03	2021-08-06	13:28	Tissue	1				X										X							
2	BAFF21UMLNGN05ARCH03	2021-08-07	14:58	Tissue	1				X										X							
3	BAFF21UMLNGN06ARCH09	2021-08-07	15:12	Tissue	1				X										X							
4	BAFF21UMLNGN09ARCH03	2021-08-10	9:00	Tissue	1				X										X							
5	BAFF21UMLNGN10ARCH10	2021-08-11	16:09	Tissue	1				X										X							
6	BAFF21UMLNGN20ARCH02	2021-08-17	12:50	Tissue	1				X										X							
7	BAFF21UMLNGN25ARCH03	2021-08-18	16:15	Tissue	1				X										X							
8	BAFF21UMLNGN25ARCH05	2021-08-18	16:15	Tissue	1				X										X							
9																										
10																										

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
Collin Arens Collin Arens	2021/08/22	13:15	Renee Lapp	2021/08/23	08:00	
					08:00	

COC-1020

C171217_COC

Your Project #: 1663724/44000/03
Site#: MILNE PART/REFERENCE SITE
Site Location: BAFFLINLAND IRON MINE
Your C.O.C. #: 08502167

Attention: Collin Arens

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2022/01/25
Report #: R3125981
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C191378
Received: 2021/12/08, 08:25

Sample Matrix: Tissue
Samples Received: 16

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS - Tissue Plug Wet Wt	8	2022/01/18	2022/01/22	BBY WI-00033	Auto Calc
Moisture in Tissue - Freeze Drying	8	2022/01/18	2022/01/20	BBY7SOP-00021	BCMOE BCLM Aug 2014
PAH in Tissue by GC/MS (SIM) (1, 2)	8	2022/01/21	2022/01/21	ATL SOP 00104	EPA 8270E R6 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Bedford, Bureau Veritas Bedford, 200 Bluewater Rd. Suite 105, Bedford, NS, Canada, B4B 1G9
(2) Results are reported on an as received basis unless otherwise indicated.

Your Project #: 1663724/44000/03
Site#: MILNE PART/REFERENCE SITE
Site Location: BAFFLINLAND IRON MINE
Your C.O.C. #: 08502167

Attention: Collin Arens

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2022/01/25
Report #: R3125981
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C191378
Received: 2021/12/08, 08:25

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Cynny Hagen, Key Account Specialist
Email: Cynny.HAGEN@bureauveritas.com
Phone# (403)735-2273
==========
This report has been generated and distributed using a secure automated process.
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Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C191378
Report Date: 2022/01/25

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFLINLAND IRON MINE
Sampler Initials: BL

RESULTS OF CHEMICAL ANALYSES OF TISSUE

Bureau Veritas ID		ALJ041	ALJ042	ALJ043	ALJ044		
Sampling Date							
COC Number		08502167	08502167	08502167	08502167		
	UNITS	BAFF21UMLNHTARCOMP9_PAHS	BAFF21UMLNHTARCOMP10_PAHS	BAFF21UMLNHTARCOMP11_PAHS	BAFF21UMLNHTARCOMP12_PAHS	RDL	QC Batch
Polycyclic Aromatics							
1-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
2-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(j)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Perylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Naphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Acenaphthylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Acenaphthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Fluorene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Phenanthrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(a)anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Chrysene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(b)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(k)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(a)pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Indeno(1,2,3-cd)pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Dibenz(a,h)anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(g,h,i)perylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Surrogate Recovery (%)							
D10-ANTHRACENE (sur.)	%	101	104	102	107	N/A	A479138
D8-ACENAPHTHYLENE (sur.)	%	98	99	97	104	N/A	A479138
TERPHENYL-D14 (sur.)	%	98	103	99	105	N/A	A479138

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C191378
Report Date: 2022/01/25

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFLINLAND IRON MINE
Sampler Initials: BL

RESULTS OF CHEMICAL ANALYSES OF TISSUE

Bureau Veritas ID		ALJ045	ALJ046	ALJ047	ALJ048		
Sampling Date							
COC Number		08502167	08502167	08502167	08502167		
	UNITS	BAFF21UMLNHTARCOMP13_PAHS	BAFF21UMLNHTARCOMP14_PAHS	BAFF21UMLNHTARCOMP15_PAHS	BAFF21UMLNHTARCOMP16_PAHS	RDL	QC Batch
Polycyclic Aromatics							
1-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
2-Methylnaphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(j)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Perylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Naphthalene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Acenaphthylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Acenaphthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Fluorene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Phenanthrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(a)anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Chrysene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(b)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(k)fluoranthene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(a)pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Indeno(1,2,3-cd)pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Dibenz(a,h)anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Benzo(g,h,i)perylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	A479138
Surrogate Recovery (%)							
D10-ANTHRACENE (sur.)	%	98	101	102	100	N/A	A479138
D8-ACENAPHTHYLENE (sur.)	%	95	99	98	99	N/A	A479138
TERPHENYL-D14 (sur.)	%	96	99	99	99	N/A	A479138

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C191378
Report Date: 2022/01/25

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFLINLAND IRON MINE
Sampler Initials: BL

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		ALJ033	ALJ034	ALJ035		
Sampling Date						
COC Number		08502167	08502167	08502167		
	UNITS	BAFF21UMLNHTARCOMP1_METALS	BAFF21UMLNHTARCOMP2_METALS	BAFF21UMLNHTARCOMP3_METALS	RDL	QC Batch
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	1380	923	439	0.50	A475543
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0244	0.0161	0.0121	0.0020	A475543
Total (Wet Wt) Arsenic (As)	mg/kg	5.61	2.98	3.19	0.0050	A475543
Total (Wet Wt) Barium (Ba)	mg/kg	13.9	6.72	8.79	0.010	A475543
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0718	0.0466	0.0250	0.0020	A475543
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0133	0.0119	0.0059	0.0013	A475543
Total (Wet Wt) Boron (B)	mg/kg	11.8	8.04	5.17	0.20	A475543
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.524	0.937	0.540	0.0013	A475543
Total (Wet Wt) Calcium (Ca)	mg/kg	12200	6790	4790	4.0	A475543
Total (Wet Wt) Chromium (Cr)	mg/kg	4.50	2.72	1.20	0.025	A475543
Total (Wet Wt) Cobalt (Co)	mg/kg	1.62	1.54	0.708	0.0013	A475543
Total (Wet Wt) Copper (Cu)	mg/kg	2.49	3.16	1.66	0.013	A475543
Total (Wet Wt) Iron (Fe)	mg/kg	5170	2050	1570	0.25	A475543
Total (Wet Wt) Lead (Pb)	mg/kg	1.51	1.83	0.668	0.0013	A475543
Total (Wet Wt) Magnesium (Mg)	mg/kg	5660	3760	2010	0.40	A475543
Total (Wet Wt) Manganese (Mn)	mg/kg	194	192	84.3	0.010	A475543
Total (Wet Wt) Mercury (Hg)	mg/kg	0.033	0.031	0.033	0.013	A475543
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.402	0.356	0.222	0.0080	A475543
Total (Wet Wt) Nickel (Ni)	mg/kg	2.93	2.21	1.15	0.010	A475543
Total (Wet Wt) Phosphorus (P)	mg/kg	1350	1510	1100	2.0	A475543
Total (Wet Wt) Potassium (K)	mg/kg	1780	1740	1250	2.5	A475543
Total (Wet Wt) Selenium (Se)	mg/kg	1.44	1.36	1.38	0.010	A475543
Total (Wet Wt) Silver (Ag)	mg/kg	0.0078	0.0107	0.0039	0.0013	A475543
Total (Wet Wt) Sodium (Na)	mg/kg	3540	3860	2950	2.5	A475543
Total (Wet Wt) Strontium (Sr)	mg/kg	44.7	19.8	25.4	0.013	A475543
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0358	0.0242	0.0109	0.00040	A475543
Total (Wet Wt) Tin (Sn)	mg/kg	0.123	0.083	0.054	0.020	A475543
Total (Wet Wt) Titanium (Ti)	mg/kg	67.8	32.9	16.7	0.13	A475543
Total (Wet Wt) Uranium (U)	mg/kg	0.279	0.164	0.138	0.00040	A475543
Total (Wet Wt) Vanadium (V)	mg/kg	5.38	3.79	2.09	0.020	A475543
Total (Wet Wt) Zinc (Zn)	mg/kg	13.6	15.1	11.9	0.20	A475543

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C191378
Report Date: 2022/01/25

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFLINLAND IRON MINE
Sampler Initials: BL

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		ALJ036	ALJ037	ALJ038		
Sampling Date						
COC Number		08502167	08502167	08502167		
	UNITS	BAFF21UMLNHTARCOMP4_METALS	BAFF21UMLNHTARCOMP5_METALS	BAFF21UMLNHTARCOMP6_METALS	RDL	QC Batch
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	1500	390	784	0.50	A475543
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0237	0.0105	0.0169	0.0020	A475543
Total (Wet Wt) Arsenic (As)	mg/kg	2.91	2.19	3.41	0.0050	A475543
Total (Wet Wt) Barium (Ba)	mg/kg	9.38	12.3	9.06	0.010	A475543
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0808	0.0209	0.0400	0.0020	A475543
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0167	0.0055	0.0085	0.0013	A475543
Total (Wet Wt) Boron (B)	mg/kg	11.6	4.75	6.90	0.20	A475543
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.918	1.00	0.608	0.0013	A475543
Total (Wet Wt) Calcium (Ca)	mg/kg	12300	4330	6390	4.0	A475543
Total (Wet Wt) Chromium (Cr)	mg/kg	4.04	1.15	1.98	0.025	A475543
Total (Wet Wt) Cobalt (Co)	mg/kg	1.69	0.679	0.786	0.0013	A475543
Total (Wet Wt) Copper (Cu)	mg/kg	3.91	2.16	2.21	0.013	A475543
Total (Wet Wt) Iron (Fe)	mg/kg	3560	1290	2010	0.25	A475543
Total (Wet Wt) Lead (Pb)	mg/kg	2.06	0.557	0.967	0.0013	A475543
Total (Wet Wt) Magnesium (Mg)	mg/kg	5720	2010	3000	0.40	A475543
Total (Wet Wt) Manganese (Mn)	mg/kg	201	77.5	134	0.010	A475543
Total (Wet Wt) Mercury (Hg)	mg/kg	0.023	0.029	0.030	0.013	A475543
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.466	0.264	0.216	0.0080	A475543
Total (Wet Wt) Nickel (Ni)	mg/kg	2.93	1.36	1.56	0.010	A475543
Total (Wet Wt) Phosphorus (P)	mg/kg	1340	1430	1700	2.0	A475543
Total (Wet Wt) Potassium (K)	mg/kg	2090	1440	1560	2.5	A475543
Total (Wet Wt) Selenium (Se)	mg/kg	1.20	1.54	1.32	0.010	A475543
Total (Wet Wt) Silver (Ag)	mg/kg	0.0413	0.0062	0.0071	0.0013	A475543
Total (Wet Wt) Sodium (Na)	mg/kg	3420	2950	3840	2.5	A475543
Total (Wet Wt) Strontium (Sr)	mg/kg	28.0	17.3	24.0	0.013	A475543
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0332	0.0102	0.0153	0.00040	A475543
Total (Wet Wt) Tin (Sn)	mg/kg	0.105	0.055	0.092	0.020	A475543
Total (Wet Wt) Titanium (Ti)	mg/kg	53.8	13.7	27.6	0.13	A475543
Total (Wet Wt) Uranium (U)	mg/kg	0.281	0.126	0.141	0.00040	A475543
Total (Wet Wt) Vanadium (V)	mg/kg	5.42	1.76	2.90	0.020	A475543
Total (Wet Wt) Zinc (Zn)	mg/kg	14.3	17.3	11.6	0.20	A475543

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Bureau Veritas ID		ALJ039	ALJ040		
Sampling Date					
COC Number		08502167	08502167		
	UNITS	BAFF21UMLNHTARCOMP7_METALS	BAFF21UMLNHTARCOMP8_METALS	RDL	QC Batch
Total Metals by ICPMS					
Total (Wet Wt) Aluminum (Al)	mg/kg	867	551	0.50	A475543
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0323	0.0111	0.0020	A475543
Total (Wet Wt) Arsenic (As)	mg/kg	6.24	2.43	0.0050	A475543
Total (Wet Wt) Barium (Ba)	mg/kg	13.4	5.20	0.010	A475543
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0465	0.0279	0.0020	A475543
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0105	0.0065	0.0013	A475543
Total (Wet Wt) Boron (B)	mg/kg	8.73	4.95	0.20	A475543
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.877	0.932	0.0013	A475543
Total (Wet Wt) Calcium (Ca)	mg/kg	9880	4050	4.0	A475543
Total (Wet Wt) Chromium (Cr)	mg/kg	2.55	1.47	0.025	A475543
Total (Wet Wt) Cobalt (Co)	mg/kg	3.25	0.567	0.0013	A475543
Total (Wet Wt) Copper (Cu)	mg/kg	2.98	1.61	0.013	A475543
Total (Wet Wt) Iron (Fe)	mg/kg	3380	969	0.25	A475543
Total (Wet Wt) Lead (Pb)	mg/kg	1.41	0.682	0.0013	A475543
Total (Wet Wt) Magnesium (Mg)	mg/kg	3940	2490	0.40	A475543
Total (Wet Wt) Manganese (Mn)	mg/kg	611	54.9	0.010	A475543
Total (Wet Wt) Mercury (Hg)	mg/kg	0.036	0.029	0.013	A475543
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.681	0.253	0.0080	A475543
Total (Wet Wt) Nickel (Ni)	mg/kg	2.93	1.21	0.010	A475543
Total (Wet Wt) Phosphorus (P)	mg/kg	1700	1490	2.0	A475543
Total (Wet Wt) Potassium (K)	mg/kg	1600	1560	2.5	A475543
Total (Wet Wt) Selenium (Se)	mg/kg	1.68	1.25	0.010	A475543
Total (Wet Wt) Silver (Ag)	mg/kg	0.0094	0.0042	0.0013	A475543
Total (Wet Wt) Sodium (Na)	mg/kg	2790	3270	2.5	A475543
Total (Wet Wt) Strontium (Sr)	mg/kg	41.2	11.0	0.013	A475543
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0547	0.0112	0.00040	A475543
Total (Wet Wt) Tin (Sn)	mg/kg	0.064	0.053	0.020	A475543
Total (Wet Wt) Titanium (Ti)	mg/kg	33.1	19.5	0.13	A475543
Total (Wet Wt) Uranium (U)	mg/kg	0.204	0.107	0.00040	A475543
Total (Wet Wt) Vanadium (V)	mg/kg	4.96	2.09	0.020	A475543
Total (Wet Wt) Zinc (Zn)	mg/kg	14.1	12.6	0.20	A475543

RDL = Reportable Detection Limit

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PHYSICAL TESTING (TISSUE)

Bureau Veritas ID		ALJ033	ALJ034	ALJ035	ALJ036		
Sampling Date							
COC Number		08502167	08502167	08502167	08502167		
	UNITS	BAFF21UMLNHTARCOMP1_METALS	BAFF21UMLNHTARCOMP2_METALS	BAFF21UMLNHTARCOMP3_METALS	BAFF21UMLNHTARCOMP4_METALS	RDL	QC Batch
Physical Properties							
Moisture	%	66	77	78	70	0.30	A474979
RDL = Reportable Detection Limit							

Bureau Veritas ID		ALJ037	ALJ038	ALJ039	ALJ040		
Sampling Date							
COC Number		08502167	08502167	08502167	08502167		
	UNITS	BAFF21UMLNHTARCOMP5_METALS	BAFF21UMLNHTARCOMP6_METALS	BAFF21UMLNHTARCOMP7_METALS	BAFF21UMLNHTARCOMP8_METALS	RDL	QC Batch
Physical Properties							
Moisture	%	75	76	68	76	0.30	A474979
RDL = Reportable Detection Limit							

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GENERAL COMMENTS

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A474979	CG5	RPD	Moisture	2022/01/20	0.60		%	20
A475543	SOM	QC Standard	Total (Wet Wt) Aluminum (Al)	2022/01/22		100	%	N/A
			Total (Wet Wt) Arsenic (As)	2022/01/22		92	%	N/A
			Total (Wet Wt) Cadmium (Cd)	2022/01/22		90	%	N/A
			Total (Wet Wt) Chromium (Cr)	2022/01/22		84	%	N/A
			Total (Wet Wt) Cobalt (Co)	2022/01/22		88	%	N/A
			Total (Wet Wt) Copper (Cu)	2022/01/22		85	%	N/A
			Total (Wet Wt) Iron (Fe)	2022/01/22		92	%	N/A
			Total (Wet Wt) Lead (Pb)	2022/01/22		71	%	N/A
			Total (Wet Wt) Mercury (Hg)	2022/01/22		86	%	N/A
			Total (Wet Wt) Molybdenum (Mo)	2022/01/22		100	%	N/A
			Total (Wet Wt) Nickel (Ni)	2022/01/22		148	%	N/A
			Total (Wet Wt) Phosphorus (P)	2022/01/22		89	%	N/A
			Total (Wet Wt) Selenium (Se)	2022/01/22		93	%	N/A
			Total (Wet Wt) Sodium (Na)	2022/01/22		89	%	N/A
			Total (Wet Wt) Uranium (U)	2022/01/22		147	%	N/A
			Total (Wet Wt) Zinc (Zn)	2022/01/22		87	%	N/A
A475543	SOM	Spiked Blank	Total (Wet Wt) Aluminum (Al)	2022/01/22		100	%	80 - 120
			Total (Wet Wt) Antimony (Sb)	2022/01/22		101	%	80 - 120
			Total (Wet Wt) Arsenic (As)	2022/01/22		102	%	80 - 120
			Total (Wet Wt) Barium (Ba)	2022/01/22		103	%	80 - 120
			Total (Wet Wt) Beryllium (Be)	2022/01/22		94	%	80 - 120
			Total (Wet Wt) Bismuth (Bi)	2022/01/22		98	%	80 - 120
			Total (Wet Wt) Boron (B)	2022/01/22		99	%	80 - 120
			Total (Wet Wt) Cadmium (Cd)	2022/01/22		99	%	80 - 120
			Total (Wet Wt) Calcium (Ca)	2022/01/22		104	%	80 - 120
			Total (Wet Wt) Chromium (Cr)	2022/01/22		98	%	80 - 120
			Total (Wet Wt) Cobalt (Co)	2022/01/22		100	%	80 - 120
			Total (Wet Wt) Copper (Cu)	2022/01/22		96	%	80 - 120
			Total (Wet Wt) Iron (Fe)	2022/01/22		105	%	80 - 120
			Total (Wet Wt) Lead (Pb)	2022/01/22		100	%	80 - 120
			Total (Wet Wt) Magnesium (Mg)	2022/01/22		101	%	80 - 120
			Total (Wet Wt) Manganese (Mn)	2022/01/22		99	%	80 - 120
			Total (Wet Wt) Mercury (Hg)	2022/01/22		101	%	80 - 120
			Total (Wet Wt) Molybdenum (Mo)	2022/01/22		105	%	80 - 120
			Total (Wet Wt) Nickel (Ni)	2022/01/22		98	%	80 - 120
			Total (Wet Wt) Phosphorus (P)	2022/01/22		97	%	80 - 120
			Total (Wet Wt) Potassium (K)	2022/01/22		104	%	80 - 120
			Total (Wet Wt) Selenium (Se)	2022/01/22		101	%	80 - 120
			Total (Wet Wt) Silver (Ag)	2022/01/22		99	%	80 - 120
			Total (Wet Wt) Sodium (Na)	2022/01/22		100	%	80 - 120
			Total (Wet Wt) Strontium (Sr)	2022/01/22		102	%	80 - 120
			Total (Wet Wt) Thallium (Tl)	2022/01/22		99	%	80 - 120
			Total (Wet Wt) Tin (Sn)	2022/01/22		100	%	80 - 120
			Total (Wet Wt) Titanium (Ti)	2022/01/22		103	%	80 - 120
			Total (Wet Wt) Uranium (U)	2022/01/22		104	%	80 - 120
			Total (Wet Wt) Vanadium (V)	2022/01/22		99	%	80 - 120
			Total (Wet Wt) Zinc (Zn)	2022/01/22		97	%	80 - 120
A475543	SOM	Method Blank	Total (Wet Wt) Aluminum (Al)	2022/01/22	<0.50		mg/kg	
			Total (Wet Wt) Antimony (Sb)	2022/01/22	<0.0020		mg/kg	
			Total (Wet Wt) Arsenic (As)	2022/01/22	<0.0050		mg/kg	
			Total (Wet Wt) Barium (Ba)	2022/01/22	<0.010		mg/kg	
			Total (Wet Wt) Beryllium (Be)	2022/01/22	<0.0020		mg/kg	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total (Wet Wt) Bismuth (Bi)	2022/01/22	<0.0013		mg/kg	
			Total (Wet Wt) Boron (B)	2022/01/22	<0.20		mg/kg	
			Total (Wet Wt) Cadmium (Cd)	2022/01/22	<0.0013		mg/kg	
			Total (Wet Wt) Calcium (Ca)	2022/01/22	<4.0		mg/kg	
			Total (Wet Wt) Chromium (Cr)	2022/01/22	<0.025		mg/kg	
			Total (Wet Wt) Cobalt (Co)	2022/01/22	<0.0013		mg/kg	
			Total (Wet Wt) Copper (Cu)	2022/01/22	<0.013		mg/kg	
			Total (Wet Wt) Iron (Fe)	2022/01/22	<0.25		mg/kg	
			Total (Wet Wt) Lead (Pb)	2022/01/22	<0.0013		mg/kg	
			Total (Wet Wt) Magnesium (Mg)	2022/01/22	<0.40		mg/kg	
			Total (Wet Wt) Manganese (Mn)	2022/01/22	<0.010		mg/kg	
			Total (Wet Wt) Mercury (Hg)	2022/01/22	<0.013		mg/kg	
			Total (Wet Wt) Molybdenum (Mo)	2022/01/22	<0.0080		mg/kg	
			Total (Wet Wt) Nickel (Ni)	2022/01/22	<0.010		mg/kg	
			Total (Wet Wt) Phosphorus (P)	2022/01/22	<2.0		mg/kg	
			Total (Wet Wt) Potassium (K)	2022/01/22	<2.5		mg/kg	
			Total (Wet Wt) Selenium (Se)	2022/01/22	<0.010		mg/kg	
			Total (Wet Wt) Silver (Ag)	2022/01/22	<0.0013		mg/kg	
			Total (Wet Wt) Sodium (Na)	2022/01/22	<2.5		mg/kg	
			Total (Wet Wt) Strontium (Sr)	2022/01/22	<0.013		mg/kg	
			Total (Wet Wt) Thallium (Tl)	2022/01/22	<0.00040		mg/kg	
			Total (Wet Wt) Tin (Sn)	2022/01/22	<0.020		mg/kg	
			Total (Wet Wt) Titanium (Ti)	2022/01/22	<0.13		mg/kg	
			Total (Wet Wt) Uranium (U)	2022/01/22	<0.00040		mg/kg	
			Total (Wet Wt) Vanadium (V)	2022/01/22	<0.020		mg/kg	
			Total (Wet Wt) Zinc (Zn)	2022/01/22	<0.20		mg/kg	
A475543	SOM	RPD	Total (Wet Wt) Aluminum (Al)	2022/01/22	NC		%	40
			Total (Wet Wt) Antimony (Sb)	2022/01/22	30		%	40
			Total (Wet Wt) Arsenic (As)	2022/01/22	12		%	40
			Total (Wet Wt) Barium (Ba)	2022/01/22	55 (1)		%	40
			Total (Wet Wt) Beryllium (Be)	2022/01/22	NC		%	40
			Total (Wet Wt) Bismuth (Bi)	2022/01/22	NC		%	40
			Total (Wet Wt) Boron (B)	2022/01/22	NC		%	40
			Total (Wet Wt) Cadmium (Cd)	2022/01/22	2.1		%	40
			Total (Wet Wt) Calcium (Ca)	2022/01/22	41		%	60
			Total (Wet Wt) Chromium (Cr)	2022/01/22	16		%	40
			Total (Wet Wt) Cobalt (Co)	2022/01/22	6.5		%	40
			Total (Wet Wt) Copper (Cu)	2022/01/22	0.71		%	40
			Total (Wet Wt) Iron (Fe)	2022/01/22	11		%	40
			Total (Wet Wt) Lead (Pb)	2022/01/22	21		%	40
			Total (Wet Wt) Magnesium (Mg)	2022/01/22	8.1		%	40
			Total (Wet Wt) Manganese (Mn)	2022/01/22	26		%	40
			Total (Wet Wt) Mercury (Hg)	2022/01/22	NC		%	40
			Total (Wet Wt) Molybdenum (Mo)	2022/01/22	7.1		%	40
			Total (Wet Wt) Nickel (Ni)	2022/01/22	NC		%	40
			Total (Wet Wt) Phosphorus (P)	2022/01/22	7.8		%	40
			Total (Wet Wt) Potassium (K)	2022/01/22	2.6		%	40
			Total (Wet Wt) Selenium (Se)	2022/01/22	5.8		%	40
			Total (Wet Wt) Silver (Ag)	2022/01/22	NC		%	40
			Total (Wet Wt) Sodium (Na)	2022/01/22	5.0		%	40
			Total (Wet Wt) Strontium (Sr)	2022/01/22	41		%	60
			Total (Wet Wt) Thallium (Tl)	2022/01/22	4.4		%	40
			Total (Wet Wt) Tin (Sn)	2022/01/22	NC		%	40

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total (Wet Wt) Titanium (Ti)	2022/01/22	16		%	40
			Total (Wet Wt) Uranium (U)	2022/01/22	2.3		%	40
			Total (Wet Wt) Vanadium (V)	2022/01/22	NC		%	40
			Total (Wet Wt) Zinc (Zn)	2022/01/22	15		%	40
A479138	KKE	Reagent Blank	1-Methylnaphthalene	2022/01/21	<0.050		mg/kg	
			2-Methylnaphthalene	2022/01/21	<0.050		mg/kg	
			Benzo(j)fluoranthene	2022/01/21	<0.050		mg/kg	
			D10-ANTHRACENE (sur.)	2022/01/21		97	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2022/01/21		92	%	50 - 130
			Perylene	2022/01/21	<0.050		mg/kg	
			TERPHENYL-D14 (sur.)	2022/01/21		95	%	50 - 130
			Naphthalene	2022/01/21	<0.050		mg/kg	
			Acenaphthylene	2022/01/21	<0.050		mg/kg	
			Acenaphthene	2022/01/21	<0.050		mg/kg	
			Fluorene	2022/01/21	<0.050		mg/kg	
			Phenanthrene	2022/01/21	<0.050		mg/kg	
			Anthracene	2022/01/21	<0.050		mg/kg	
			Fluoranthene	2022/01/21	<0.050		mg/kg	
			Pyrene	2022/01/21	<0.050		mg/kg	
			Benzo(a)anthracene	2022/01/21	<0.050		mg/kg	
			Chrysene	2022/01/21	<0.050		mg/kg	
			Benzo(b)fluoranthene	2022/01/21	<0.050		mg/kg	
			Benzo(k)fluoranthene	2022/01/21	<0.050		mg/kg	
			Benzo(a)pyrene	2022/01/21	<0.050		mg/kg	
			Indeno(1,2,3-cd)pyrene	2022/01/21	<0.050		mg/kg	
			Dibenz(a,h)anthracene	2022/01/21	<0.050		mg/kg	
			Benzo(g,h,i)perylene	2022/01/21	<0.050		mg/kg	
A479138	KKE	Spiked Blank	1-Methylnaphthalene	2022/01/21		99	%	50 - 130
			2-Methylnaphthalene	2022/01/21		94	%	50 - 130
			Benzo(j)fluoranthene	2022/01/21		92	%	50 - 130
			D10-ANTHRACENE (sur.)	2022/01/21		95	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2022/01/21		93	%	50 - 130
			Perylene	2022/01/21		96	%	50 - 130
			TERPHENYL-D14 (sur.)	2022/01/21		92	%	50 - 130
			Naphthalene	2022/01/21		98	%	50 - 130
			Acenaphthylene	2022/01/21		100	%	50 - 130
			Acenaphthene	2022/01/21		98	%	50 - 130
			Fluorene	2022/01/21		100	%	50 - 130
			Phenanthrene	2022/01/21		99	%	50 - 130
			Anthracene	2022/01/21		99	%	50 - 130
			Fluoranthene	2022/01/21		98	%	50 - 130
			Pyrene	2022/01/21		96	%	50 - 130
			Benzo(a)anthracene	2022/01/21		101	%	50 - 130
			Chrysene	2022/01/21		98	%	50 - 130
			Benzo(b)fluoranthene	2022/01/21		96	%	50 - 130
			Benzo(k)fluoranthene	2022/01/21		90	%	50 - 130
			Benzo(a)pyrene	2022/01/21		90	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2022/01/21		91	%	50 - 130
			Dibenz(a,h)anthracene	2022/01/21		92	%	50 - 130
			Benzo(g,h,i)perylene	2022/01/21		88	%	50 - 130
A479138	KKE	Method Blank	1-Methylnaphthalene	2022/01/21	<0.050		mg/kg	
			2-Methylnaphthalene	2022/01/21	<0.050		mg/kg	
			Benzo(j)fluoranthene	2022/01/21	<0.050		mg/kg	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			D10-ANTHRACENE (sur.)	2022/01/21		111	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2022/01/21		108	%	50 - 130
			Perylene	2022/01/21	<0.050		mg/kg	
			TERPHENYL-D14 (sur.)	2022/01/21		111	%	50 - 130
			Naphthalene	2022/01/21	<0.050		mg/kg	
			Acenaphthylene	2022/01/21	<0.050		mg/kg	
			Acenaphthene	2022/01/21	<0.050		mg/kg	
			Fluorene	2022/01/21	<0.050		mg/kg	
			Phenanthrene	2022/01/21	<0.050		mg/kg	
			Anthracene	2022/01/21	<0.050		mg/kg	
			Fluoranthene	2022/01/21	<0.050		mg/kg	
			Pyrene	2022/01/21	<0.050		mg/kg	
			Benzo(a)anthracene	2022/01/21	<0.050		mg/kg	
			Chrysene	2022/01/21	<0.050		mg/kg	
			Benzo(b)fluoranthene	2022/01/21	<0.050		mg/kg	
			Benzo(k)fluoranthene	2022/01/21	<0.050		mg/kg	
			Benzo(a)pyrene	2022/01/21	<0.050		mg/kg	
			Indeno(1,2,3-cd)pyrene	2022/01/21	<0.050		mg/kg	
			Dibenz(a,h)anthracene	2022/01/21	<0.050		mg/kg	
			Benzo(g,h,i)perylene	2022/01/21	<0.050		mg/kg	

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Reagent Blank: A blank matrix containing all reagents used in the analytical procedure. Used to determine any analytical contamination.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Job #: C191378
Report Date: 2022/01/25

GOLDER ASSOCIATES LTD
Client Project #: 1663724/44000/03
Site Location: BAFFLINLAND IRON MINE
Sampler Initials: BL

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

David Huang, M.Sc., P.Chem., QP, Scientific Services Manager

Phil Deveau, Scientific Specialist (Organics)

Bureau Veritas Proprietary Software
Logiciel Propriétaire de Bureau Veritas

Automated Statchk

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

BUREAU VERITAS

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

08502167

CHAIN OF CUSTODY

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company :	Golder Associates Ltd.	Company:		Quotation	C00599	☑ 5 - 7 Days Regular (Most analyses)
Contact Name:	Collin Arens	Contact Name:		P.O. #/AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	16820 107 Ave.	Address:				Rush TAT (Surcharges will be applied)
	Edmonton, AB PC: T5P 4C3		PC:	Project #:	1663724/44000/03	☐ Same Day ☐ 2 Days
Phone/Fax:	(780) 237-9638	Phone/Fax:		Site Location:	Baffinland Iron Mine	☐ 1 Day ☐ 3-4 Days
Email:	carens@golder.com	Email:		Site #:	Milne Port/Reference Site	Date Required:
Copies:	rsharpe@golder.com	Copies:		Sampled By:	Bradley Cox, Daniel Vicente	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present		/				
Seal Intact		/	Temp	6	7	8
Cooling Media	/					
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

Depot Reception

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Special Instructions

Form a total of eight composite samples for PAH analysis from those included on this COC.

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	☐ BTEXS / VPH	☐ BTEX F1	☑ PAH	☐ EPH	☐ Dissolved Metals	☐ Dissolved Mercury	☐ Total Metals	☐ Total Mercury	☐ Chloride	☐ TSS	☐ pH	☐ Nitrite	☑ Alkylated PAHs	☐					HOLD - DO NOT ANALYZE
	☐ VOC / BTEXS / VPH	☐ VOC / BTEX / F1	☐ LEPH / HEPH / PAH	☐ TEH	☐ Filtered?	☐ Filtered?	☐ Field Preserved?	☐ Field Preserved?	☐ Fluoride	☐ TDS	☐ Conductivity	☐ Nitrate												
	☐ MTBE			☐ F2 - F4	☐ Preserved?	☐ Preserved?			☐ Sulphate	☐ COD	☐ Alkalinity	☐ Ammonia												
										☐ BOD														
1	BAFF21UMLNHTAR1501	8/9/2021	12:00	Tissue	1			X										X						
2	BAFF21UMLNHTAR1503	8/9/2021	12:00	Tissue	1			X										X						
3	BAFF21UMLNHTAR1505	8/9/2021	12:00	Tissue	1			X										X						
4	BAFF21UMLNHTAR1507	8/9/2021	12:00	Tissue	1			X										X						
5	BAFF21UMLNHTAR1509	8/9/2021	12:00	Tissue	1			X										X						
6	BAFF21UMLNHTAR1511	8/14/2021	12:00	Tissue	1			X										X						
7	BAFF21UMLNHTAR1513	8/14/2021	12:00	Tissue	1			X										X						
8	BAFF21UMLNHTAR1515	8/14/2021	12:00	Tissue	1			X										X						
9	BAFF21UMLNHTAR1517	8/14/2021	12:00	Tissue	1			X										X						
10	BAFF21UMLNHTAR1519	8/14/2021	12:00	Tissue	1			X										X						

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):
Maddie Bearge	2021/12/07	12:00	Renegade Courier	2021/12/08	08:25

COC-1020

C191378_COC

BUREAU VERITAS

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD 08502163

Invoice Information		Report Information (if differs from invoice)		Project Information	
Company:	Golder Associates Ltd.	Company:		Quotation	C00599
Contact Name:	Collin Arens	Contact Name:		P.O. #/AFE#:	
Address:	16820 107 Ave. Edmonton, AB PC: T5P 4C3	Address: PC:		Project #:	1663724/44000/03
Phone/Fax:	(780) 237-9638	Phone/Fax:		Site Location:	Baffinland Iron Mine
Email:	carens@golder.com	Email:		Site #:	Milne Port/Reference Site
Copies:	rsharpe@golder.com	Copies:		Sampled By:	Bradley Cox, Daniel Vicente

Turnaround Time (TAT) Required

☑ 5 - 7 Days Regular (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3-4 Days

Date Required:

Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						

Depot Reception

Analysis Requested: ☐ MTBE; ☐ VOC / BTEXS / VPH; ☐ VOC / BTEX / F1; ☐ LEPH / HEPH / PAH; ☐ F2 - F4; ☐ TEH; ☐ Preserved?; ☐ Filtered?; ☐ Preserved?; ☐ Filtered?; ☐ Field Preserved?; ☐ Field Preserved?; ☐ Sulphate; ☐ Fluoride; ☐ COD; ☐ BOD; ☐ TDS; ☐ Alkalinity; ☐ Conductivity; ☐ Ammonia; ☐ Nitrate

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	☐ BTEXS / VPH	☐ BTEX F1	☑ PAH	☐ EPH	☐ Dissolved Metals	☐ Dissolved Mercury	☐ Total Metals	☐ Total Mercury	☐ Chloride	☐ TSS	☐ pH	☐ Nitrite	☑ Alkylated PAHs	☐	HOLD - DO NOT ANALYZE
1	BAFF21UMLNHTAR1521	8/16/2021	12:00	Tissue	1			X										X		
2	BAFF21UMLNHTAR1523	8/16/2021	12:00	Tissue	1			X										X		
3	BAFF21UMLNHTAR1525	8/16/2021	12:00	Tissue	1			X										X		
4	BAFF21UMLNHTAR1527	8/17/2021	12:00	Tissue	1			X										X		
5	BAFF21UMLNHTAR1529	8/17/2021	12:00	Tissue	1			X										X		
6	BAFF21UMLNHTAR1531	8/18/2021	12:00	Tissue	1			X										X		
7	BAFF21UMLNHTAR1533	8/18/2021	12:00	Tissue	1			X										X		
8	BAFF21UMLNHTAR1535	8/18/2021	12:00	Tissue	1			X										X		
9								X										X		
10								X										X		

Special Instructions

Form a total of eight composite samples for PAH analysis from those included on this COC.

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):
Maddie Bearge	2021/12/07	12:00			

COC-1020

C191378_COC

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

08502082

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company :	Golder Associates Ltd.	Company:		Quotation	C00599	☑ 5 - 7 Days Regular (Most analyses)
Contact Name:	Collin Arens	Contact Name:		P.O. #/AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	16820 107 Ave.	Address:				Rush TAT (Surcharges will be applied)
	Edmonton, AB PC: T5P 4C3		PC:	Project #:	1663724/44000/03	☐ Same Day ☐ 2 Days
Phone/Fax:	(780) 237-9638	Phone/Fax:		Site Location:	Baffinland Iron Mine	☐ 1 Day ☐ 3-4 Days
Email:	carens@golder.com	Email:		Site #:	Milne Port	Date Required:
Copies:	rsharpe@golder.com	Copies:		Sampled By:	Bradley Cox, Daniel Vicente	Rush Confirmation #:

Laboratory Use Only

	YES	NO		
Seal Present		✓	Cooler ID	1
Seal Intact		-	Temp	6 7 8
Cooling Media	✓			
	YES	NO	Cooler ID	
Seal Present			Temp	
Seal Intact				
Cooling Media				
	YES	NO	Cooler ID	
Seal Present			Temp	
Seal Intact				
Cooling Media				

Depot Reception

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	☐ BTEXS / VPH	☐ VOC / BTEXS / VPH	☐ BTEX F1	☐ VOC / BTEX / F1	☐ PAH	☐ LEPH / HEPH / PAH	☐ EPH	☐ TEH	☐ F2 - F4	☑ Dissolved Metals	☐ Filtered?	☐ Dissolved Mercury	☐ Filtered?	☑ Total Metals	☐ Field Preserved?	☐ Total Mercury	☐ Field Preserved?	☐ Chloride	☐ Fluoride	☐ TSS	☐ TDS	☐ pH	☐ Conductivity	☐ Nitrite	☐ Nitrate	☐ Alkylated PAHs	☐ Sulphate	☐ BOD	☐ COD	☐ Alkalinity	☐ Ammonia	HOLD - DO NOT ANALYZE
1	BAFF21UMLNHTAR1502	8/9/2021	12:00	Tissue	1														X																	
2	BAFF21UMLNHTAR1504	8/9/2021	12:00	Tissue	1														X																	
3	BAFF21UMLNHTAR1506	8/10/2021	12:00	Tissue	1														X																	
4	BAFF21UMLNHTAR1508	8/10/2021	12:00	Tissue	1														X																	
5	BAFF21UMLNHTAR1510	8/10/2021	12:00	Tissue	1														X																	
6	BAFF21UMLNHTAR1512	8/14/2021	12:00	Tissue	1														X																	
7	BAFF21UMLNHTAR1514	8/14/2021	12:00	Tissue	1														X																	
8	BAFF21UMLNHTAR1516	8/14/2021	12:00	Tissue	1														X																	
9	BAFF21UMLNHTAR1518	8/14/2021	12:00	Tissue	1														X																	
10	BAFF21UMLNHTAR1520	8/14/2021	12:00	Tissue	1														X																	

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Special Instructions

Form a total of eight composite samples from those included in this COC for metals analysis.

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):
Maddie Beang	2021/12/07	12:00		2021/12/08	08:25

COC-1020

C191378_COC

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY

08502086

Invoice Information

Company : Golder Associates Ltd.
Contact Name: Collin Arens
Address: 16820 107 Ave.
Edmonton, AB PC: T5P 4C3
Phone/Fax: (780) 237-9638
Email: carens@golder.com
Copies: rsharpe@golder.com

Report Information (if differs from invoice)

Company:
Contact Name:
Address:
PC:
Phone/Fax:
Email:
Copies:

Project Information

Quotation: C00599
P.O. #/AFE#:
Project #: 1663724/44000/03
Site Location: Baffinland Iron Mine
Site #: Milne Port
Sampled By: Bradley Cox, Daniel Vicente

Turnaround Time (TAT) Required

☑ 5 - 7 Days Regular (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3-4 Days

Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						

Depot Reception

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Special Instructions

Form a total of eight composite samples from those included in this COC for metals analysis.

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	BTEXS / VPH	VOC / BTEXS / VPH	MTBE	BTEX F1	VOC / BTEX / F1	PAH	LEPH / HEPH / PAH	EPH	F2 - F4	Dissolved Metals	Preserved?	Filtered?	Dissolved Mercury	Preserved?	Filtered?	Total Metals	Field Preserved?	Total Mercury	Field Preserved?	Chloride	Fluoride	Sulphate	TSS	TDS	BOD	COD	pH	Conductivity	Alkalinity	Nitrite	Nitrate	Ammonia	Alkylated PAHs	HOLD - DO NOT ANALYZE
1	BAFF21UMLNHTAR1522	8/16/2021	12:00	Tissue	1																X																		
2	BAFF21UMLNHTAR1524	8/16/2021	12:00	Tissue	1																X																		
3	BAFF21UMLNHTAR1526	8/17/2021	12:00	Tissue	1																X																		
4	BAFF21UMLNHTAR1528	8/17/2021	12:00	Tissue	1																X																		
5	BAFF21UMLNHTAR1530	8/17/2021	12:00	Tissue	1																X																		
6	BAFF21UMLNHTAR1532	8/18/2021	12:00	Tissue	1																X																		
7	BAFF21UMLNHTAR1534	8/18/2021	12:00	Tissue	1																X																		
8																																						
9																																						
10																																						

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):
Maddie Beange	2021/12/07	12:00			

COC-1020

C191378_COC

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