MICROPLASTICS IN YUKON FRESHWATER

2021-2022 SAMPLING REPORT

FINAL

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Prepared for:

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CORE GEOSCIENCE SERVICES INC.

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EXECUTIVE SUMMARY

This study represents Phase 2 of a microplastics (MP) pilot sampling program initiated in March 2021 by Yukon Government Water Resources Branch and Core Geoscience Services. It incorporates recommendations from Phase 1 and has for objectives to test and evaluate the proposed sampling methodology (1L grab samples with several replicates), and to investigate MP concentrations along the Yukon River (upstream and downstream of communities).

Two rounds of sampling were completed (September 2021 and January 2022) and five 1L grab samples were collected at each of the five sampling sites along the Yukon River: Tagish, Marsh Lake, just upstream of the Takhini River confluence, Carmacks and Dawson, in addition to QA/QC samples. Samples were sent to ALS Cincinnati for analysis by fluorescent tagging and microscopy static image analysis. Results for total particle count and particle size distribution were compared using ANOVA or non-parametric statistical tests.

As was found during the March 2021 Phase 1 pilot study (CoreGeo, 2021), MP particles were present in all blanks. Different types of blanks were collected during this Phase 2 investigation to try to identify potential sources of blank contamination. Given that no significant difference was found between the total MP particle count means of the various blanks, except for Blank6 (held for 30 days prior to analysis), it can be hypothesized that the main source of contamination is from the deionized water itself (where the deionization process may not be entirely successful at removing MP particles) or blank preparation process in the lab (rather than from the sampling bottles, sample handling, or air deposition during sampling). Interpreting field results when blanks are non-zero can be challenging. There is no standard practice for interpreting such data. No correction accounting for non-zero blanks have therefore been applied to the field results as part of the current study.

Results from September 2021 and January 2022 both show a significantly higher total particle count at Tagish, suggesting a local source. Elevated results at Takhini in January 2022 also indicate a possible temporally isolated source. Other locations do not show a significant difference with the blanks or between sites.

September 2021 results at Dawson show a greater proportion of small particle size, which could indicate a source far upstream (e.g. Whitehorse), allowing for deposition and degradation of larger particles by the time they reach Dawson. The total MP count did not, however, point to an obvious source upstream, although there would have been significant dilution as the Yukon River flow increases moving downstream. January 2022 results at Tagish show a larger percentage of larger particles, consistent with the hypothesis of a local source.

Total particle count was higher in January at Marsh Lake, Tagish and Takhini compared to September, and January samples had a higher percentage of larger particles in January at Dawson and Tagish. The fact that January samples were collected under ice could have resulted in lower particle count if atmospheric deposition was an important source, however this was not the case. Smaller particles

are expected to be more readily transported via atmospheric circulation and the fact that some sites saw less smaller particles in the water samples in the winter could be consistent with that hypothesis, but more evidence is needed to understand this process.

It is recommended that next steps include:

- Continue seasonal monitoring the Yukon River for microplastics during open water and under ice cover to further document the presence or absence of microplastics and particle size distribution to characterize existing conditions.
- Continue to use a sample size of 5 replicates per sites for future sampling events in 1 litre HDPE bottles (blanks collected in glass jars didn't return a lower MP count).
- Sample water from potential MP sources in communities (e.g., water treatment plant discharge, storm sewers, snow dump runoff), as well as the Yukon River immediately upstream and immediately downstream of source discharge points.
- Sample the southern lakes water and sediment, and precipitation and glacier fed tributaries to the southern lakes.
- Send some samples/subsambles to be analyzed using Raman, lFT-IR spectroscopy, or (py-GC-MS) to confirm reliable MP identification using fluorescent tagging and microscopy.
- Work with laboratories to conduct further research on blank contamination, including the effects of sample agitation prior to analysis, rigorous analysis and characterization of laboratory deionized water, and development of a LOD and LOQ.
- Work with the MP research community and laboratories towards the development of a standardized MP reporting unit (i.e., mass or volume/unit volume).
- Work with laboratories to better understand particle size distribution (i.e., through additional size categories), and how particle such as filaments are classified in terms of size.
- Investigate for potential sources of microplastics near or upstream of the Tagish and Takhini sampling location to explain the higher particle counts at these locations.
- Sample atmospheric deposition (dustfall) for microplastics to better understand contribution from atmospheric transport.

LIST OF ACRONYMS

ANOVA	Analysis of Variance
AS	Analytical Sensitivity
FB	Field Blank
HDPE	High Density Polyethylene
IFT-IR	Indirect Fourier Transform - Infrared Spectroscopy
L	Liter
LOD	Limit of Detection
LOQ	Limit of Quantification
MP	Microplastic(s)
MPP/L	Microplastic Particles per Liter
QA/QC	Quality Assurance Quality Control
RCL	Replicate Control Limit
RWL	Replicate Warning Limit
SOP	Standard Operating Protocol
T	Non-zero duplicates/replicates
UTM	Universal Transverse Mercator
V	Variance
WRB	Water Resources Branch (Yukon Government)
YG	Yukon Government

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1 INTRODUCTION

Microplastics (MP) in water and aquatic ecosystems are a growing concern for which there are little data, especially within freshwater systems. Currently, there are no standardized protocols for MP sampling (other than for microbeads) and quantification in Canada. Yukon Government's - Water Resources Branch (WRB) has been spearheading MP investigations in freshwater systems, within the Yukon Territory and has retained Core Geoscience Services Inc. (CoreGeo) to support the initiative.

1.1 BACKGROUND

A literature review and the first phase of a microplastics (MP) pilot sampling program were conducted by WRB and CoreGeo in 2021 (CoreGeo, 2021). The first phase of the study was designed based on findings from a state of science review. Samples were collected from the Yukon River in March 2021 using two different methods (grab samples through sieves; and filter samples using a submersible pump) and sent to three different labs using different analytical methods (microscopy particle count, low level particle size analysis, and elemental composition analysis). Quality assurance/quality control (QA/QC) samples were also collected (trip blanks, field blanks, method blanks, and positive controls).

Both sampling methods presented challenges, particularly for winter sampling. Apart from trying to prevent water from freezing in the sieves or filters, one of the biggest challenges was to prevent contamination, as MP are ubiquitous in the environment (Smith and Rochman, 2021). MP were found in the blanks and in the control samples, despite numerous precautions to prevent contamination. Another challenge was with laboratory analyses and differentiating MP from other particles. There is currently no standard analytical method, and results from different labs are difficult to compare. Microscopy appeared to be the most suitable laboratory technique to obtain MP-specific particle count and size distribution. Fluorescent tagging conducted by ALS Laboratories (ALS) appeared to have a higher detection power than the sole use of a 10x dissecting microscope at WRB lab.

Based on the Phase 1 findings, and with a focus on trying to streamline sampling methodology and reduce MP contamination, it was recommended that 1L grab samples be used (compared to the 100L samples were collected during Phase 1), and that a larger number of replicates be collected to compensate for the greater variability in smaller sample volumes. Samples were recommended to be analyzed using microscopy and fluorescent tagging (ALS). To better understand MP sources and fate in the environment, it was recommended that samples be collected in additional locations on the Yukon River, including upstream and downstream of communities on the Yukon River.

1.2 OBJECTIVES

This study represents the next phase of the microplastics sampling program and incorporates recommendations from Phase 1. The objectives are to:

- Test and evaluate the proposed sampling methodology (1L grab samples with several replicates), moving towards the goal of standardizing sampling methodology; and
- Investigate MP concentrations along the Yukon River (upstream and downstream of communities) to establish a baseline data set for microplastics.

2 METHODS

2.1 SAMPLE COLLECTION

Two rounds of sampling were completed: one on September 13-14 and 29, 2021, and one on January 20 and 25, 2022. Sampling locations included the Yukon River at (from upstream to downstream): Tagish, Marsh Lake, just upstream of the Takhini River confluence, Carmacks, and Dawson. Locations are shown in Figure 2-1 with close-ups of each site in Figures 2-2 to 2-6. Coordinates are provided in Table 2-1 and photos in Appendix A. Five replicates were collected at each site, in 1-litre HDPE bottles provided by the lab.

Figure 2-1: Microplastics Sampling Locations

Figure 2-2: Tagish Sampling Location

Figure 2-3: Marsh Lake Sampling Location

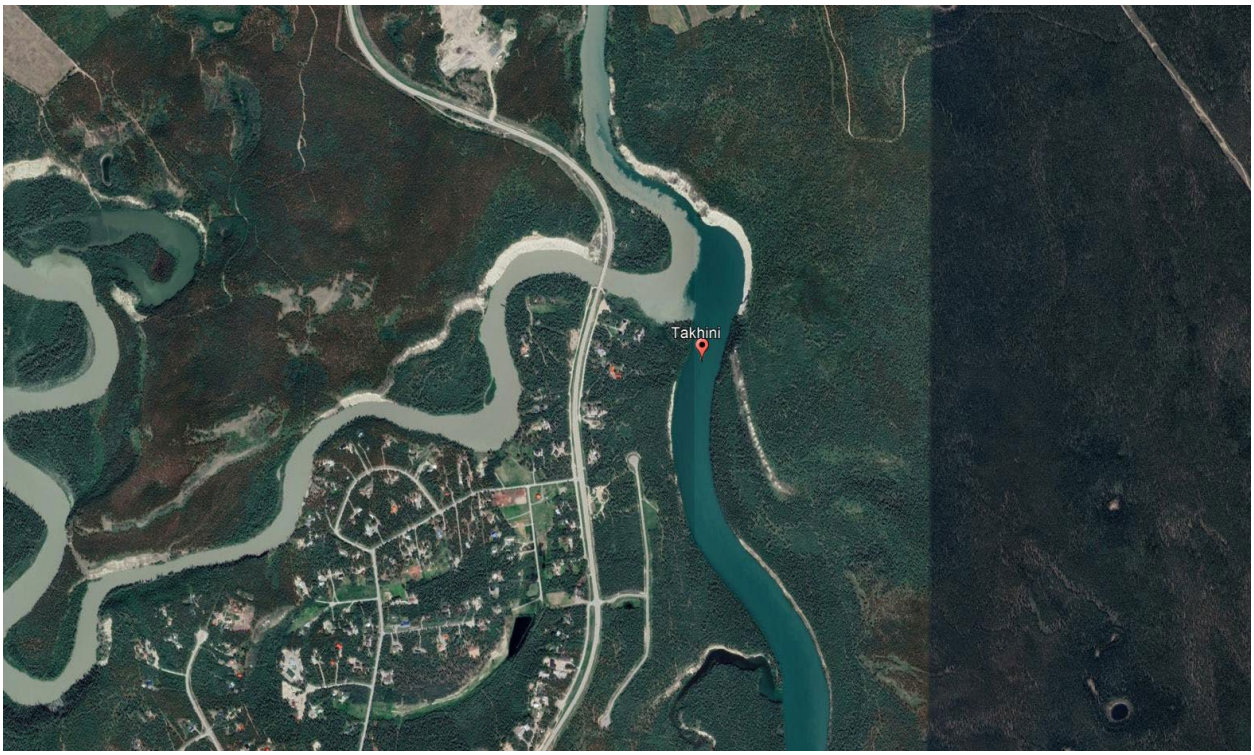

Figure 2-4: Takhini Confluence Sampling Location

Figure 2-5: Carmacks Sampling Location

Figure 2-6: Dawson Sampling Location

Table 2-1: Sampling Locations Coordinates

Site	Water Body/Water Course	UTM
Tagish	Tagish River (6 mile River)	07W 871425 6705613
Marsh Lake	Yukon River (YEC Gates)	07W 845607 6732432
Takhini Confluence	Yukon River upstream of Takhini Confluence	07W 816056 6758892
Carmacks	Yukon River	07W 746692 6894442
Dawson	Yukon River	07W 576356 7105615

2.2 SAMPLE ANALYSIS

Samples were sent to ALS Cincinnati for analysis. Samples were analyzed according to ALS Standard Operating Procedure (SOP) Micro-Fluor-001 for the detection of MP particles using fluorescent tagging and static image analysis. With this method, fluorescent dye is added to the samples. After activation time, samples are filtered, and filters are viewed under the microscope. The fluorescent dye targets polymers like polyethylene, polypropylene, polystyrene, and nylon 6; though it cannot differentiate between them. Particle sizing is performed using static image analysis of representative calibrated two-dimensional photomicrographs.

Analytical sensitivity (AS) - the smallest amount of substance in a sample that can accurately be measured based on the volume and clarity of the sample - was reported by ALS for each sample. The AS ranged from 1 to 3 MP particles per litre (MPP/L) for all samples except for the September Dawson samples, where the AS was 54 MPP/L. The AS is dependant on a number of factors, but primarily the volume of sample analyzed. For most samples, a volume of 500 mL was analyzed, but because the September Dawson samples contained significant visible suspended solids which interfered with the detection of MP, only 25 mL of these samples could be filtered without obscuring the view of fluorescing MP, resulting in a higher AS. The September Dawson MP count results are all <AS; they are still considered valid, but less statistically accurate than higher concentrations.

2.3 QA/QC

2.3.1 Field QA/QC

During the September 2021 sampling event, one trip blank and two field blanks were collected. The trip blank was provided by the lab, carried in the field for the duration of the sampling event and returned to the lab for analysis without being opened. The two field blanks (FB-01 and FB-02) were processed at the Tagish site, where deionized water from the lab was transferred into the sampling bottles and returned to the lab for analysis.

In January 2022, additional blanks were collected to investigate potential sources/causes of MP particles detected in the blanks during previous sampling events (September 2021 and March 2021 pilot study). The following QA/QC samples were collected:

- TBA-1 to TBA-5: Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab for analysis.
- TBB-1 to TBB-5: Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab and held for 30 days prior to analysis.
- TBG-1 to TBG-5: Trip blanks in glass jars, brought into the field with WRB crew for the duration of the sampling event.
- TBP-1 to TBP-5, TB-01, TB-02: Trip blanks in plastic bottles, brought into the field with WRB crew for the duration of the sampling event.
- FBG-1 to FBG-5: Field blanks transferred into glass jars, completed at Tagish site by WRB crew.
- FBP-1 to FB-5, FB-01, FB-02 and FB-03: Field blank transferred into plastic bottles, completed at Tagish site by WRB crew.

2.3.2 Laboratory QA/QC

In microscopy, laboratory QA/QC is performed to ensure and monitor analyst accuracy and precision (rather than that of the instrument in analytical chemistry). Precision is calculated using 2-point relative percent difference (RPD) based on analyses of the same sample under the same conditions. The ALS analyst provided the below information in November 2021. Variance (V), based on the analysis of 52 non-zero duplicates/replicates (T), was 0.0054, which was below the warning (RWL) and control limits (RCL).

Table 2-2: ALS MP Analyst Precision, November 2021

ANALYST A PRECISION								
T	RPD Sum	RPD Mean	D^2 Sum	V	SD	RWL	RCL	P/F
52	12.950	0.249	2.832	**0.054**	0.233	0.467	0.700	**PASS**

2.4 DATA ANALYSIS

Statistical tests were conducted using R software. If distributions were normal and variances equal after outliers (Studentized residuals <-4 or >4) were removed, ANOVA was used to determine significant differences (at α=0.05) between groups. Where distributions failed the normality test or variances were not equal, non-parametric statistics (Wilcoxon-Mann-Whitney) were used to compare groups. *Post hoc* power analyses were conducted for ANOVA tests, to determine the realized power to detect a significant difference. *A priori* power analyses were also conducted to determine the minimum sample size that would be needed to detect a difference at 0.95 and 0.90 power, for future sampling events.

3 RESULTS

Results are summarized and analyzed in the sections below. Complete lab reports are available in Appendix B and detailed statistical test results are available in Appendix C.

3.1 TOTAL MICROPLASTICS PARTICLE COUNT

3.1.1 Blanks

All blanks from September and January were compared to identify differences (if any) in total MP count between the different blank types. Descriptive statistics for total MP count are summarized in Table 3-1, and boxplots are presented in Figure 3-1. Boxplots show the minimum and maximum values (whiskers), first and third quartiles (bottom and top of the box) and the median value (bold line).

Table 3-1: Blanks Descriptive Statistics (Total MP Count)

	Blank1	Blank2	Blank3	Blank4	Blank5	Blank6
Description	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab	Trip blanks in plastic bottles, brought into the field with WRB crew for the duration of the sampling event	Trip blanks in glass jars, brought into the field with WRB crew for the duration of the sampling event	Field blanks transferred into plastic bottles, completed at Tagish site by WRB crew	Field blanks transferred into glass jars, completed at Tagish site by WRB crew	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab and held for 30 days prior to analysis
Samples	January: TBA-1, TBA-2, TBA-3, TBA-4, TBA-5	September: Travel Blank January: TBP-1, TBP-2, TBP-3, TBP-4, TBP-5, TB-01, TB-02	January: TBG-1, TBG-2, TBG-3, TBG-4, TBG-5	September: FB-01, FB-02 January: FBP-1, FBP-2, FBP-3, FBP-4, FBP-5, FB-01, FB-02, FB-03	January: FBG-1, FBG-2, FBG-3, FBG-4, FBG-5	January: TBB-1, TBB-2, TBB-3, TBB-4, TBB-5
Total Number of Samples	5	8	5	10	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	5	8	5	10	5	5
Minimum (MP count)	8	7	24	4	25	0
Median (MP count)	12	21	39	29	40	**1**
Mean (MP count)	12	23	39	33	41	2
Maximum (MP count)	16	48	62	67	60	4
Standard Deviation (MP count)	3	12	16	18	14	1
Standard Error (MP count)	1	4	7	6	6	1

**Bolded values indicate a significant difference with at least one other site*

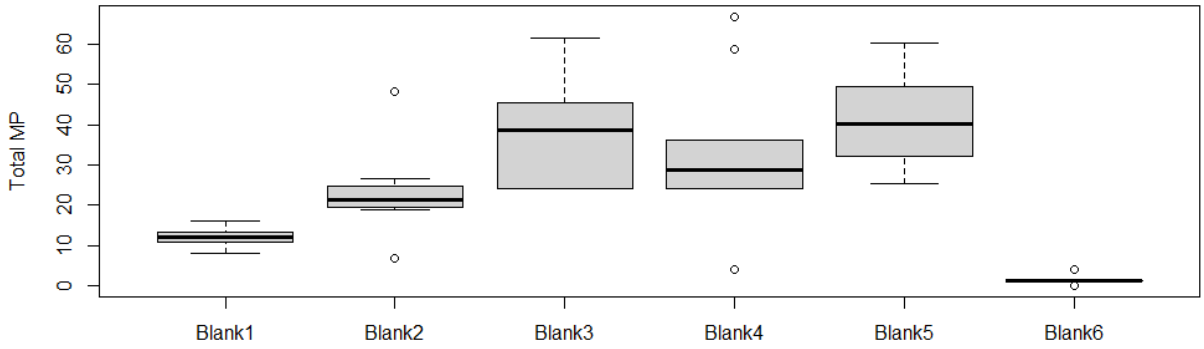

Figure 3-1: Blanks Boxplots (Total MP count)

Non-parametric statistical tests (Wilcoxon-Mann-Whitney) indicated that Blank6's median was significantly lower than all other medians except Blank3, and that all other medians were not significantly different from each other. Blank6 samples were held for 30 days prior to analysis. The intent of these samples was to evaluate whether the HDPE plastic bottles would leach MP particles into the samples over time. Since the median value for these samples was much lower than that of the other blanks, it is hypothesized that MP particles settled during the hold period and were not captured in the analysis. Blank3 and Blank5 were collected in glass jars to investigate whether the contribution of MP particles from plastic HDPE bottles in the sample was significant. Contrary to what was expected, the median MP count was higher for Blank3 and Blank5 compared to blanks collected in HDPE bottles; however, the difference is not statistically significant. The glass jars had plastics lids, and it is suspected that MP particles found in those blanks could have originated in part from the lids, or were already present in the glass bottles, or in the deionized water.

Given these results, and to strengthen our analyses with a larger sample size, all blanks were grouped together, except for Blank6 which was not used in further analyses. This new "Blank" group was used for total MP count comparisons with the different sampling sites presented in sections 3.1.2 and 3.1.3.

3.1.2 September 2021

Results from September 2021 were compared to identify differences (if any) in total MP count between the sites and with blanks. Descriptive statistics for total MP count are summarized in Table 3-2, and boxplots are presented in Figure 3-2.

Table 3-2: September 2021 Sample Descriptive Statistics (Total MP Count)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	34	5	5	5	5	5
Outliers Removed	0	0	0	0	1 (YCAR-5)	0
N (Number of samples used in the analysis)	34	5	5	5	4	5

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Minimum (MP count)	4	40	11	11	19	19
Median (MP count)	25	70	24	43	32	27
Mean (MP count)	30	**72**	22	34	36	31
Maximum (MP count)	67	104	35	51	62	45
Standard Deviation (MP count)	17	24	10	18	18	11
Standard Error (MP count)	3	11	4	8	9	5

**Bolded values indicate a significant difference with at least one other site*

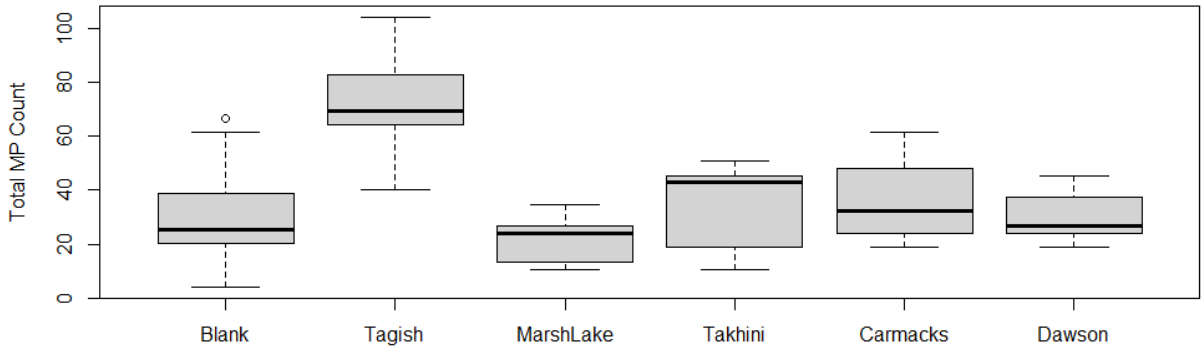

Figure 3-2: September 2021 Boxplots (Total MP count)

Statistical tests (ANOVA) indicated that Tagish mean total MP count was significantly higher than all other means, and that all other means were not significantly different from each other, or from the blanks. The mean MP count for Tagish was higher than at other sites, indicating a potential source of MP near the sampling location or at the time of sampling. Given that this site is the most upstream of the five sampling locations, the MP source may be localized in space and/or time.

3.1.3 January 2022

Results from January 2022 were compared to identify differences (if any) in total MP count between the sites and with blanks. Descriptive statistics for total MP counts are summarized in Table 3-3, and boxplots are presented in Figure 3-3.

Table 3-3: January 2022 Sample Descriptive Statistics (Total MP Count)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	34	5	5	5	5	5
Outliers Removed	0	2 (TRBD-3, TRBD-1)	0	2 (YRUTR-3, YRUTR-5)	0	0
N (Number of samples used in the analysis)	34	3	5	3	5	5

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	34	5	5	5	5	5
Outliers Removed	0	2 (TRBD-3, TRBD-1)	0	2 (YRUTR-3, YRUTR-5)	0	0
Minimum (MP count)	4	515	29	297	23	19
Median (MP count)	25	**582**	48	**298**	29	28
Mean (MP count)	30	563	54	303	32	29
Maximum (MP count)	67	593	76	314	43	44
Standard Deviation (MP count)	17	42	21	10	8	11
Standard Error (MP count)	3	24	9	6	4	5

**Bolded values indicate a significant difference with at least one other site*

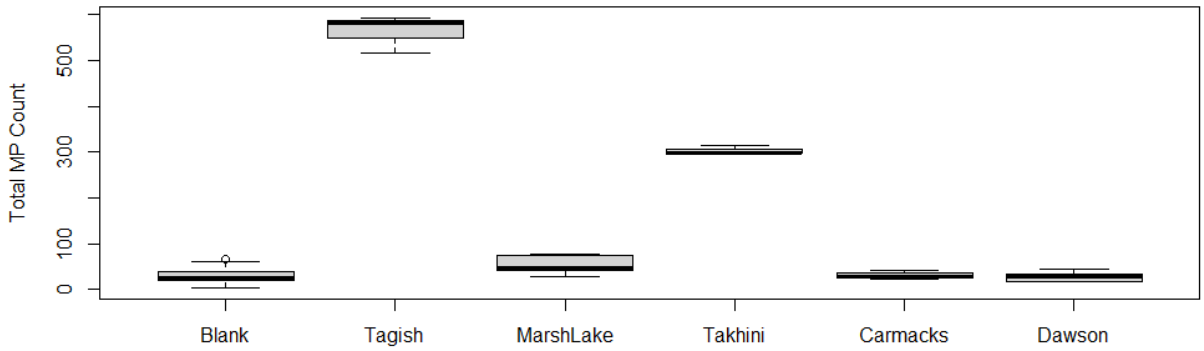

Figure 3-3: January 2022 Boxplots (Total MP count)

Statistical tests (ANOVA) indicated that Tagish and Takhini mean total MP counts were significantly higher than all other means and different from each other, and that all other means were not significantly different from each other or the blanks. In other words, total MP count at Marsh Lake, Carmacks and Dawson cannot be distinguished from the blanks count, indicating that MP contamination is roughly the same in the Yukon River and those sites than in deionized water. The mean MP count for Tagish was the highest followed by Takhini. Tagish total MP count was also found to be elevated in September, indicating a potential source of MP near the sampling location. Takhini was elevated in January but not in September, possibly indicating a temporally isolated source of contamination. Given that this sampling site is located downstream of Whitehorse, the source could be associated with discharge (e.g. storm sewer) or other influence(s) from the city. Air temperature reached a maximum of 5.1°C in Whitehorse on January 25, 2022 (when the Takhini site was sampled), which could have led to snowmelt and increased runoff.

3.1.4 Temporal variation

Comparisons were made between January and September results at each site. Total MP count was not significantly different between January and September at Carmacks and Dawson, but was

significantly higher in January at Marsh Lake, Tagish and Takhini. Boxplots for each site are shown in Figure 3-4 to Figure 3-8. Red asterisks indicate a statistically significant difference between September 2021 and January 2022.

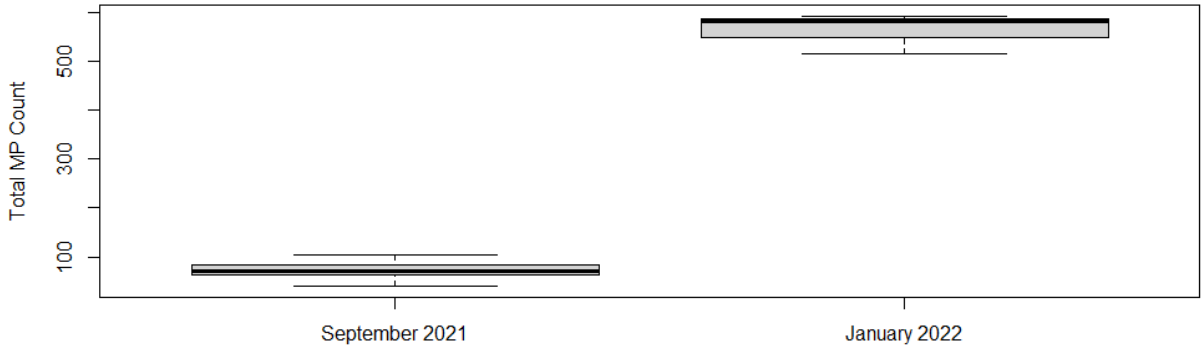

Figure 3-4: Tagish Boxplots (Total MP count) *

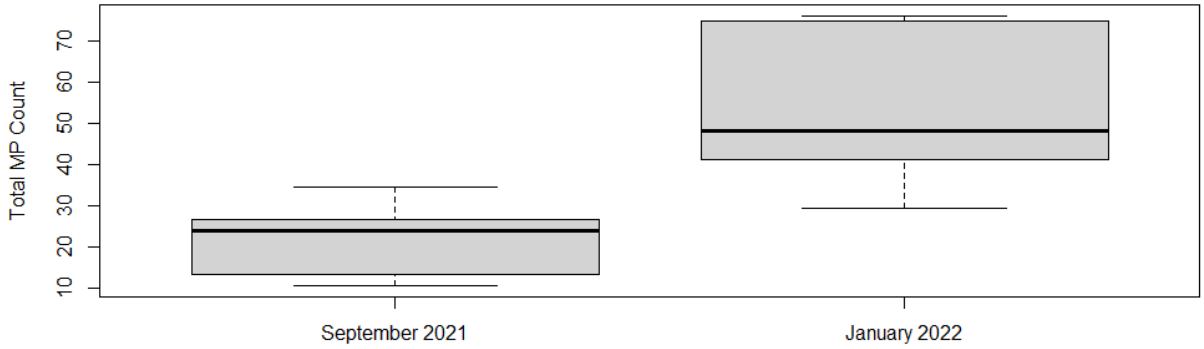

Figure 3-5: Marsh Lake Boxplots (Total MP count) *

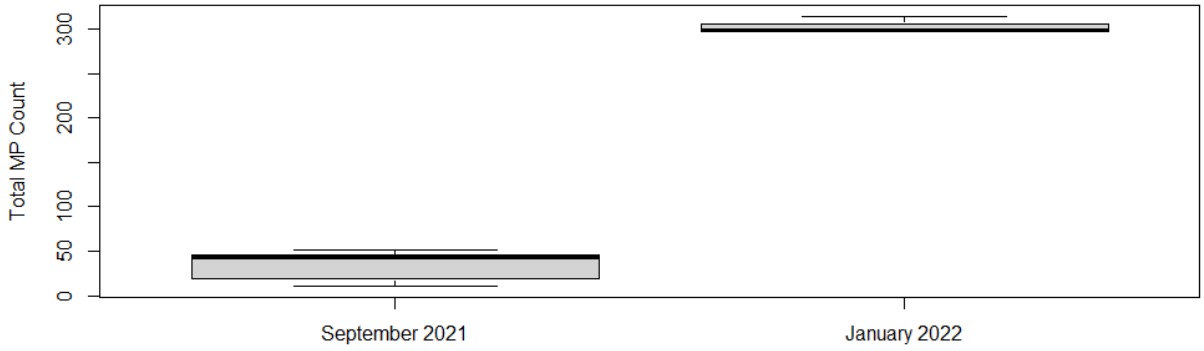

Figure 3-6: Takhini Boxplots (Total MP count) *

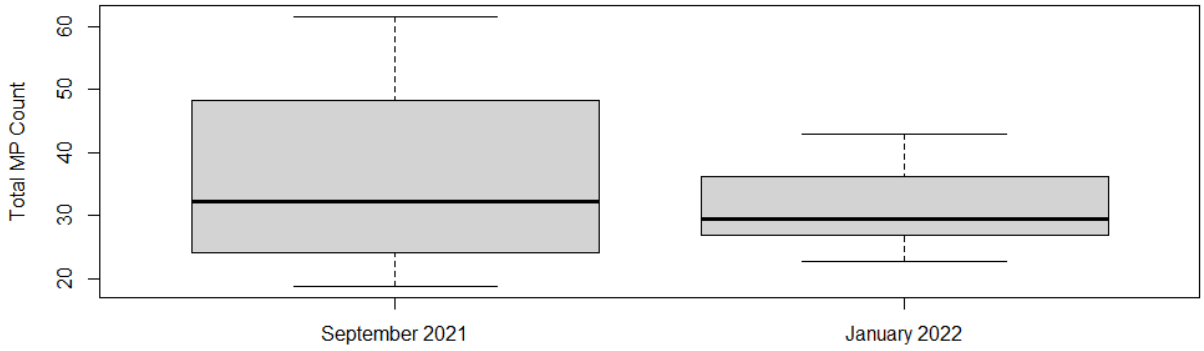

Figure 3-7: Carmacks Boxplots (Total MP count)

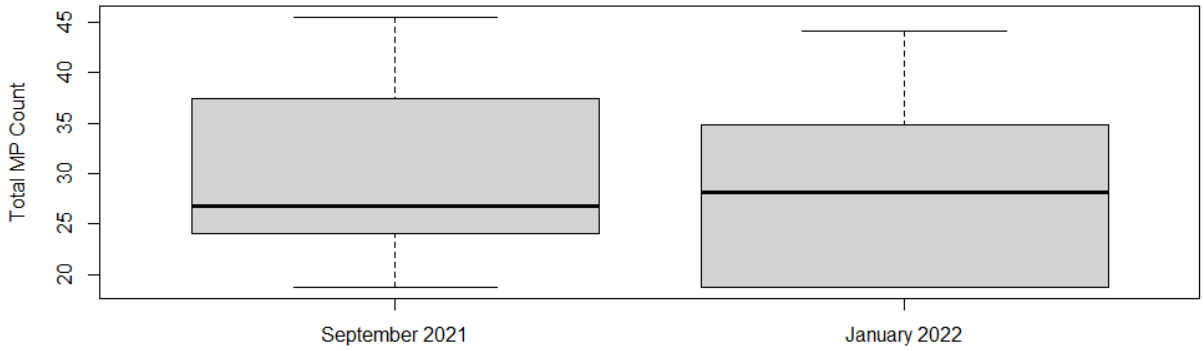

Figure 3-8: Dawson Boxplots (Total MP count)

3.2 PARTICLE SIZE DISTRIBUTION

MP particle count was broken down into 5 size categories. For all samples, the majority (≥67%) of MP particles fell either in the >6.5≤10µm or the >10≤100µm size category, with a smaller fraction in the >100≤500µm. Very few particles were found to be in the >500µm≤1mm category and none were in the >1≤5mm range. The proportion of total MP count that fell in the smaller size category (>6.5≤10µm) was compared between sites, as it may be an indication of potential MP sources.

3.2.1 Blanks

All blanks from September and January were compared to identify differences (if any) between the different blank types. Descriptive statistics for proportion of MP counts in the >6.5≤10µm size category are summarized in Table 3-4, and boxplots are presented in Figure 3-9. Average percent for each size category and each blank type are shown in Figure 3-10.

Table 3-4: Blanks Descriptive Statistics (% of MP count in the >6.5≤10µm size category)

	Blank1	Blank2	Blank3	Blank4	Blank5	Blank6
Description	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab	Trip blanks in plastic bottles, brought into the field with WRB crew for the duration of the sampling event	Trip blanks in glass jars, brought into the field with WRB crew for the duration of the sampling event	Field blanks transferred into plastic bottles, completed at Tagish site by WRB crew	Field blanks transferred into glass jars, completed at Tagish site by WRB crew	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab and held for 30 days prior to analysis
Samples	January: TBA-1, TBA-2, TBA-3, TBA-4, TBA-5	September: Travel Blank January: TBP-1, TBP-2, TBP-3, TBP-4, TBP-5, TB-01, TB-02	January: TBG-1, TBG-2, TBG-3, TBG-4, TBG-5	September: FB-01, FB-02 January: FBP-1, FBP-2, FBP-3, FBP-4, FBP-5, FB-01, FB-02, FB-03	January: FBG-1, FBG-2, FBG-3, FBG-4, FBG-5	January: TBB-1, TBB-2, TBB-3, TBB-4, TBB-5
Total Number of Samples	5	8	5	10	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	5	8	5	10	5	5
Minimum (%)	50	0	24	33	33	0
Median (%)	67	71	38	66	47	100
Mean (%)	68	63	45	60	53	60
Maximum (%)	88	86	61	80	84	100
Standard Deviation (%)	13	27	16	17	20	55
Standard Error (%)	6	10	7	5	9	25

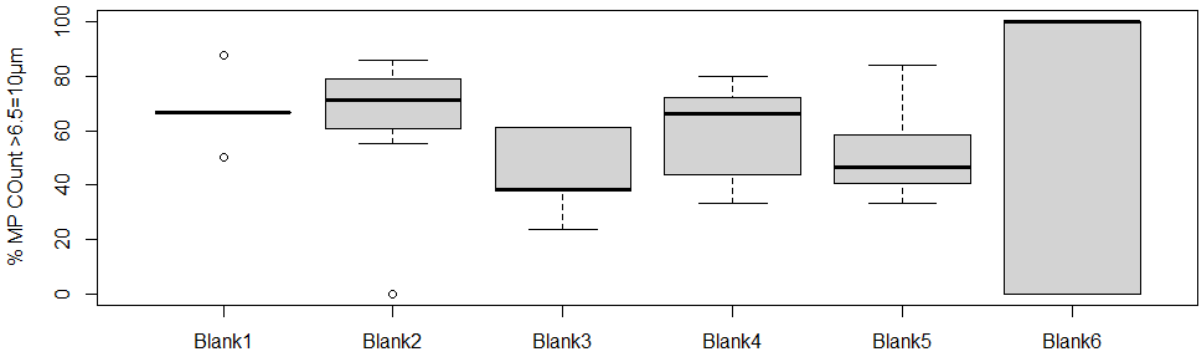

Figure 3-9: Blanks Boxplots (% of MP count in the >6.5≤10µm size category)

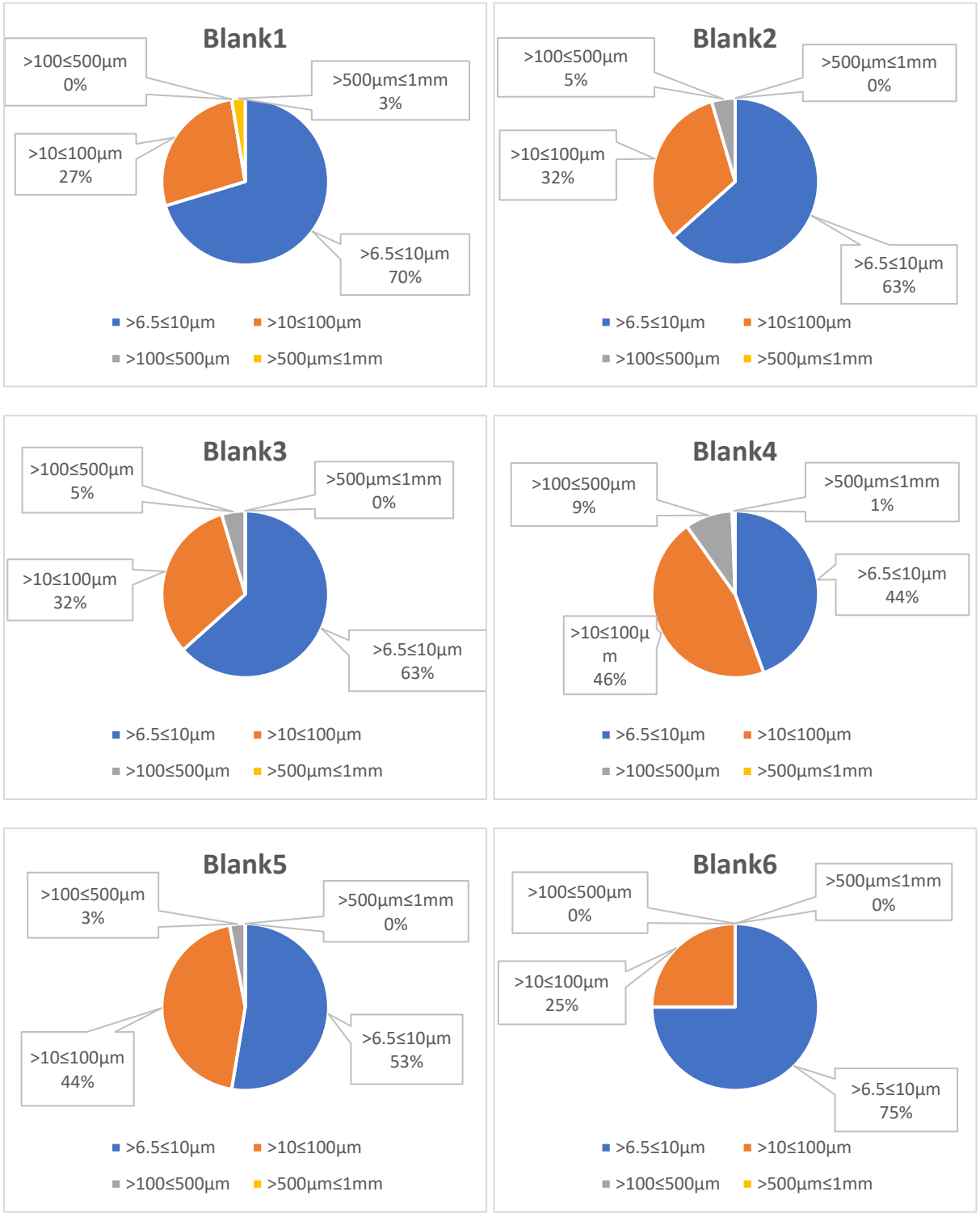

Figure 3-10: Mean MP Particle Size Distribution per Blank Type

Non-parametric statistical tests (Wilcoxon-Mann-Whitney) indicated no statistically significant differences between medians. Given this result and to strengthen our analyses with a larger sample size, all blanks were grouped together, and this new "Blank" group was used for in % of MP count in the >6.5≤10µm size category comparisons with the different sampling sites (presented in sections 3.2.2 and 3.2.3).

3.2.2 September 2021

Results from September 2021 were compared to identify differences (if any) in proportion of MP count in the >6.5≤10µm size category between the sites and with blanks. Descriptive statistics for proportion (%) of MP count in the >6.5≤10µm size category are summarized in Table 3-5, and boxplots are presented in Figure 3-11. Average percent for each size category and each blank type are shown in Figure 3-12.

Table 3-5: September 2021 Sample Descriptive Statistics (% of MP count in the >6.5≤10µm size category)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	38	5	5	5	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	38	5	5	5	5	5
Minimum (%)	0	26	0	0	8	65
Median (%)	65	29	33	47	38	86
Mean (%)	59	33	38	38	38	**86**
Maximum (%)	100	47	100	57	71	100
Standard Deviation (%)	26	9	39	23	23	15
Standard Error (%)	4	4	18	10	10	7

**Bolded values indicate a significant difference with at least one other site*

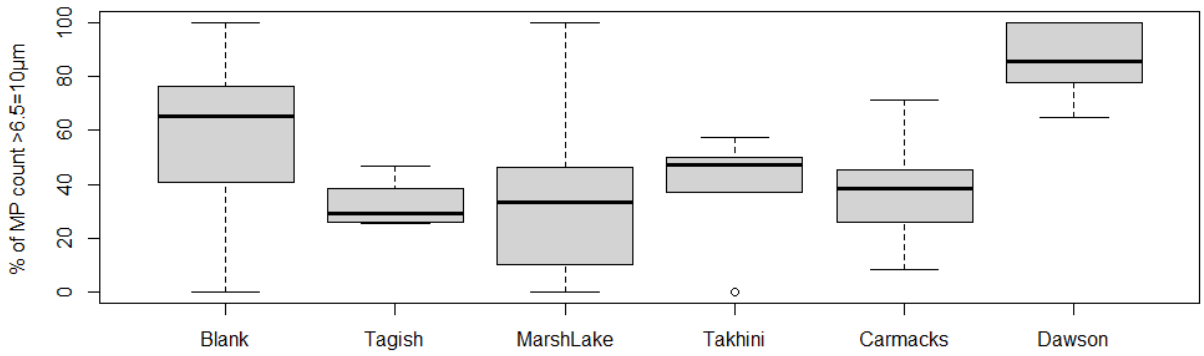

Figure 3-11: September 2021 Boxplots (% of MP count in the >6.5≤10µm size category)

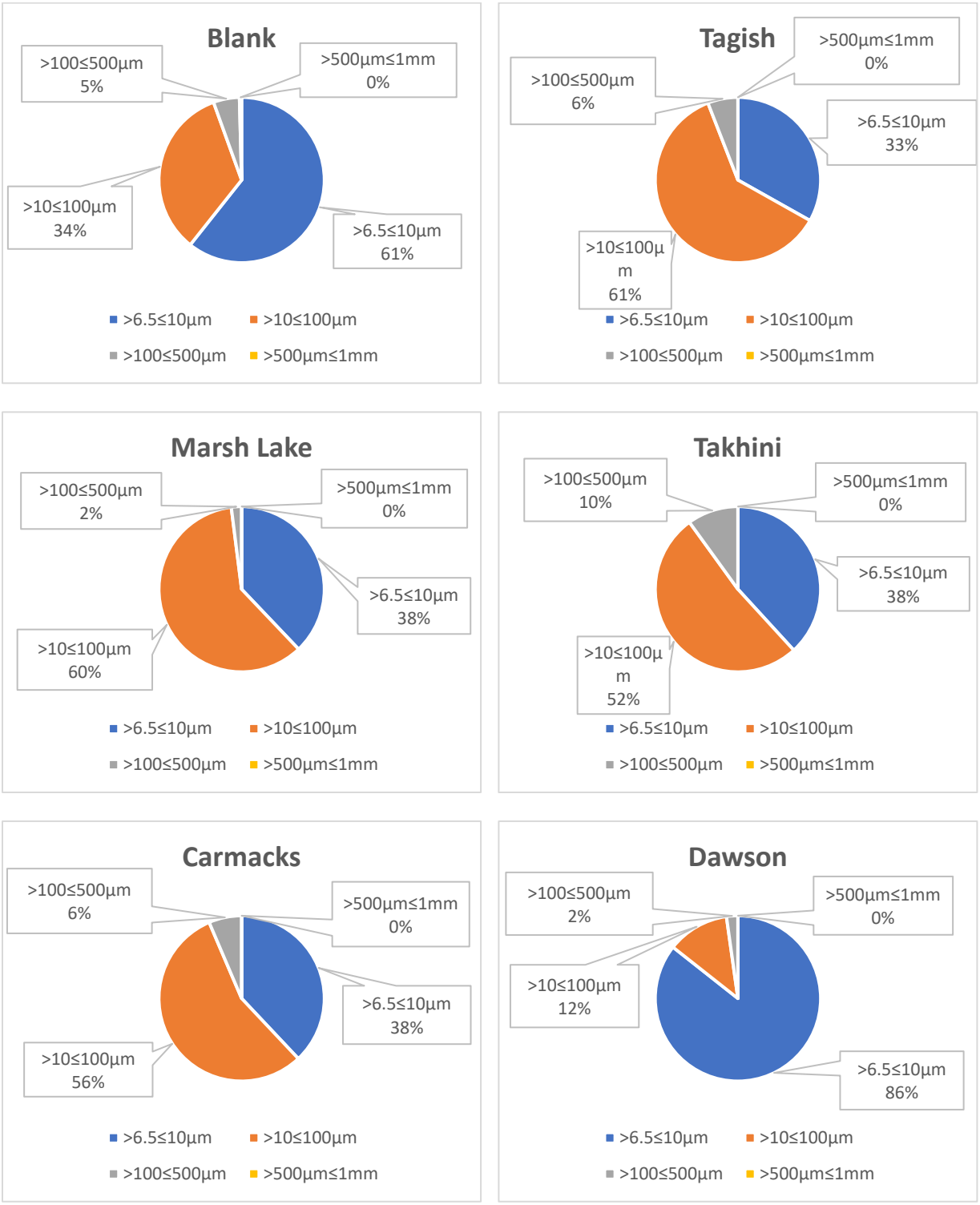

Figure 3-12: Mean MP Particle Size Distribution per Site, September 2021

Statistical tests (ANOVA) indicated mean proportion of MP count in the >6.5≤10µm size category for Dawson was significantly higher than the means for other sites but was not significantly different from the mean for blanks (which are dominated by smaller particle sizes). If the main source of MP is far upstream (e.g., Whitehorse), the greater fraction of smaller particles at Dawson could indicate that deposition and degradation of larger particles may have occurred between the source and sample location. While the total MP count did not indicate an obvious source upstream (section 3.1.2), there would have been significant dilution as the Yukon River flow increases from Whitehorse to Dawson.

3.2.3 January 2022

Results from January 2022 were compared to identify differences (if any) in proportion of MP count in the >6.5≤10µm size category between the sites and with blanks. Descriptive statistics for percent of MP count in the >6.5≤10µm size category are summarized in Table 3-6, and boxplots are presented in Figure 3-13.

Table 3-6: January 2022 Sample Descriptive Statistics (% of MP count in the >6.5≤10µm size category)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	38	5	5	5	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	38	5	5	5	5	5
Minimum (MP count)	0	3	21	6	44	31
Median (MP count)	65	**6**	39	8	64	38
Mean (MP count)	59	7	37	8	64	43
Maximum (MP count)	100	14	64	14	82	57
Standard Deviation (MP count)	26	4	18	3	15	13
Standard Error (MP count)	4	2	8	1	7	6

**Bolded values indicate a significant difference with at least one other site*

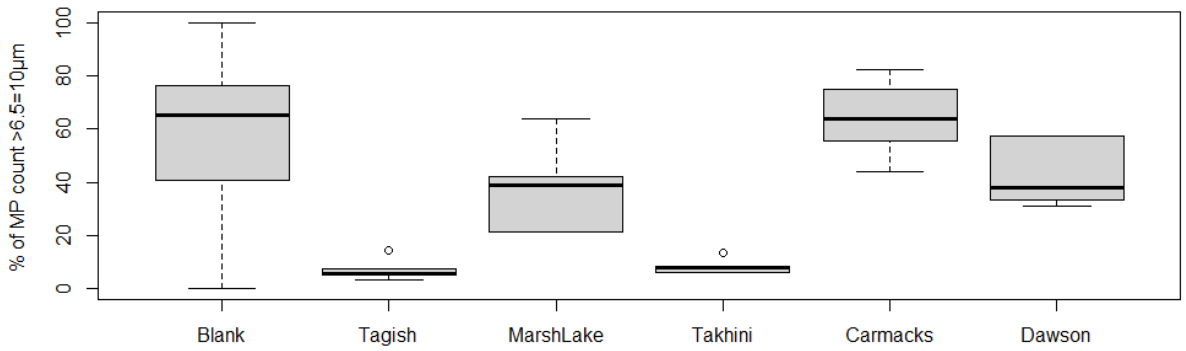

Figure 3-13: January 2022 Boxplots (% of MP count in the >6.5≤10µm size category)

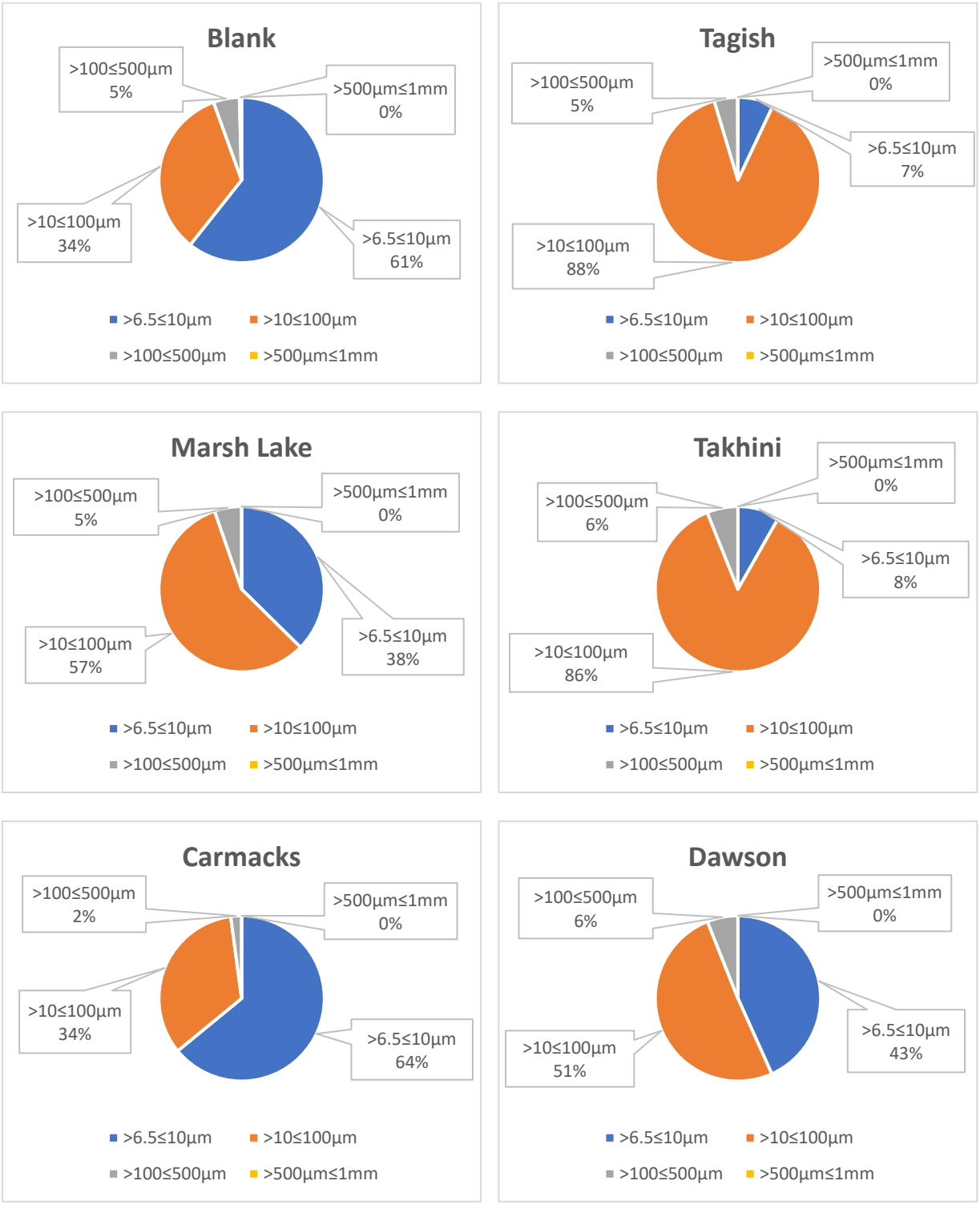

Figure 3-14: Mean MP Particle Size Distribution per Site, January 2022

Statistical tests (Wilcoxon-Mann-Whitney) indicated that Tagish median proportion of MP count in the >6.5≤10µm size category was significantly lower than the blanks, but not significantly different from the other sites. Tagish samples are dominated by larger particles sizes (>10≤100µm). This result is consistent with the elevated total count at Tagish in January 2022, suggesting less settlement and degradation of larger particles between a nearby source and the sampling location.

3.2.1 Temporal variation

Comparisons were made between January and September results at each site. The proportion of MP count in the >6.5≤10µm size category was not significantly different between January and September at Carmacks, Marsh Lake and Takhini, but was significantly higher in September at Dawson and Tagish. Boxplots for each site are shown in Figure 3-15 to Figure 3-19. Red asterisks indicate a statistically significant difference between September 2021 and January 2022.

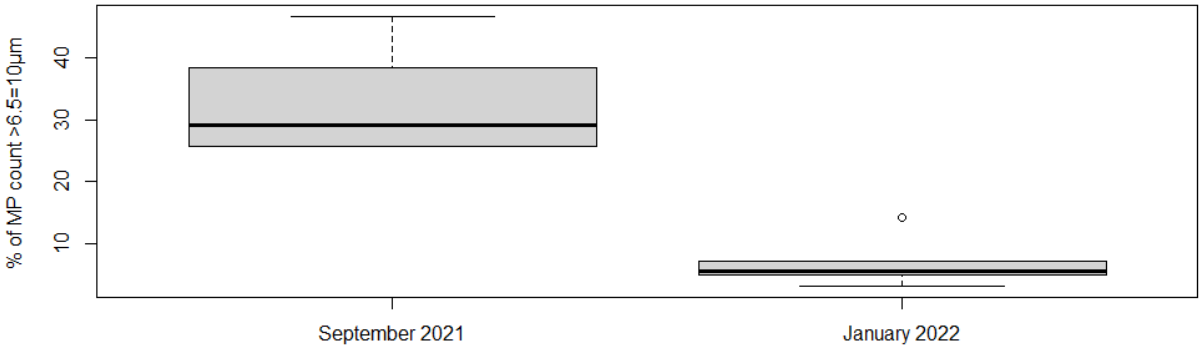

Figure 3-15: Tagish Boxplots (% of MP count in the >6.5≤10µm size category) *

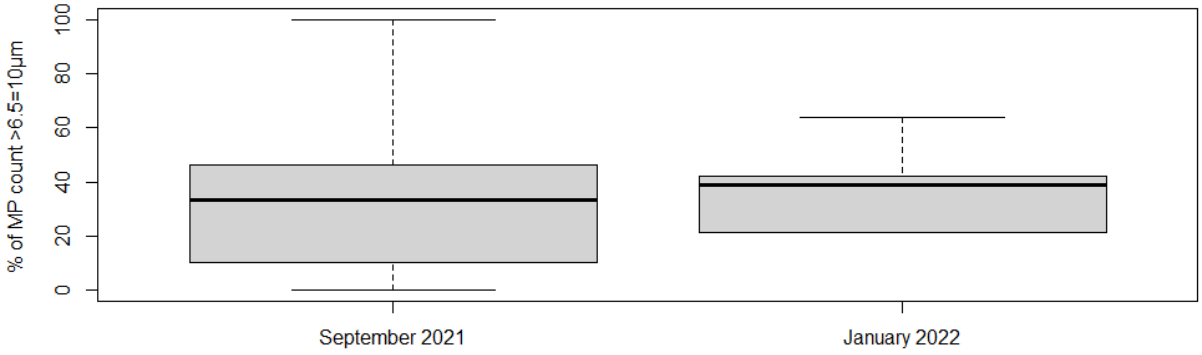

Figure 3-16: Marsh Lake Boxplots (% of MP count in the >6.5≤10µm size category)

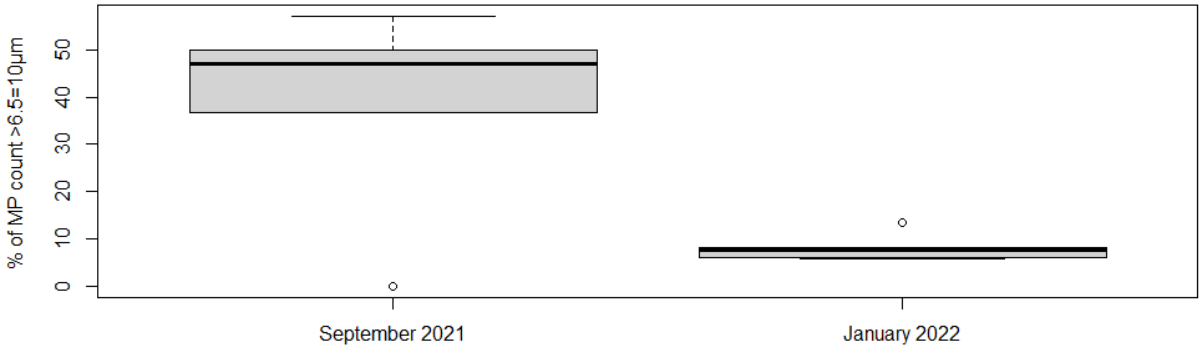

Figure 3-17: Takhini Boxplots (% of MP count in the >6.5≤10µm size category)

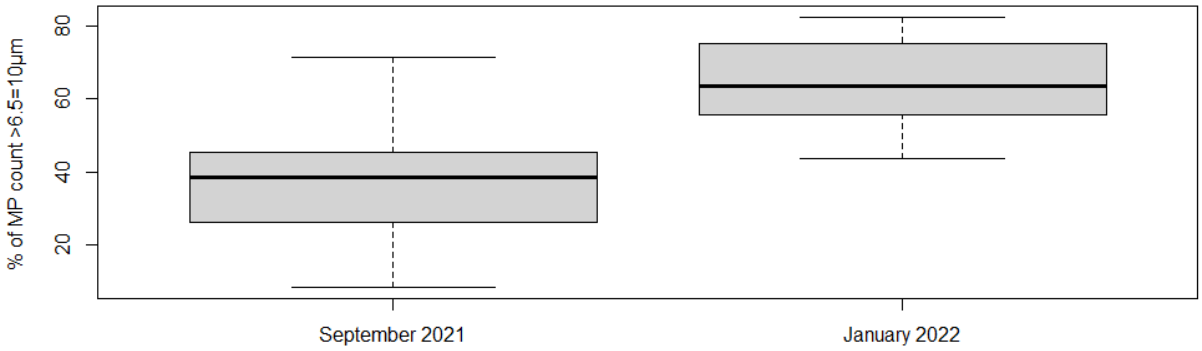

Figure 3-18: Carmacks Boxplots (% of MP count in the >6.5≤10µm size category)

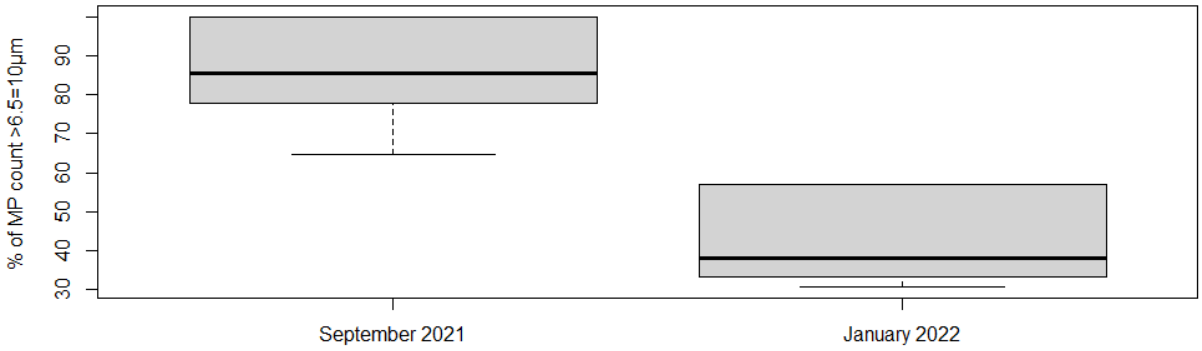

Figure 3-19: Dawson Boxplots (% of MP count in the >6.5≤10µm size category) *

As described in section 3.2.3, the higher proportion of larger particles at Tagish in January is consistent with the higher total particle count and a potential local source, while it is unclear why the proportion of smaller particles at Dawson was higher in September (see section 3.2.2). A possible explanation is that there was a greater contribution from atmospheric deposition (likely to consist of smaller particles) during open water season, although the total particle count was not significantly different between September and January at Dawson.

4 DISCUSSION

4.1 BLANKS

As was found during the March 2021 Phase 1 study, MP particles were present in all blanks (CoreGeo, 2021). Different types of blanks were collected during this Phase 2 investigation to try to identify potential sources of blank contamination. Given that no significant difference was found between the total MP particle count means of the various blanks, except for Blank6 (held for 30 days prior to analysis), it can be hypothesized that the main source of contamination is from the deionized water itself (where the deionization process may not be entirely successful at removing MP particles) or blank preparation process in the lab (rather than from the sampling bottles, sample handling, or air deposition during sampling). ALS laboratory Cincinnati analyzed their own deionized water and found 10 MPP/L on average (Pamela Hizar, 2022, pers. comm.), which is below the average total MP count across our blanks (29.7 MP/L), excluding Blank 6 (1.6 MP/L). It is unknown however how many replicate analyses of deionized water were conducted by ALS or whether they were representative of the deionized water from the ALS Whitehorse depot where the blanks for our study were prepared. Further conversation with the laboratory is needed.

Interpreting field results with non-zero blanks is difficult as there is no standard practice. Some studies subtract the average of blanks from each sample to account for procedural contamination (Gies et al., 2018). In the case of our study however, it is hypothesized that the main source of contamination is not procedural (from sample collection) but from the deionized water or blank preparation, making this approach irrelevant as field samples do not contain deionized water. Other approaches involve reporting the limit of detection (LOD), which in the field of microplastics is used as a threshold for the number or mass of microplastics that can be measured with certainty above laboratory and/or field blanks (Brander at al., 2020). Similarly, the limit of quantification (LOQ) is the minimum number or mass of microplastics of a specified size range that can be reliably counted and that are statistically distinguishable from the study blanks (Brander at al., 2020). The LOD and LOQ are determined using procedural blanks and quantification methods typically used in analytical chemistry, to see if data from environmental samples are sufficiently higher and thus usable, or flagged when below a threshold determined by the average contamination in field and/or laboratory blanks, (Brander et al., 2020) This approach would likely be the most appropriate for our study, however, ALS Laboratory has indicated that:

> "*There is as [of] yet no standard method for micro plastic analysis and therefore no established limit of detection (LOD). The LOD is the lowest quantity of a substance that can be distinguished from the absence of that substance with a stated confidence level. A method LOD is determined by the analysis of samples with known concentrations of the analyte and establishing a minimum level at which it can be quantified with acceptable accuracy and precision. Since we have no samples with known concentrations of micro plastic particles, we cannot calculate a method LOD.*

Rather, we use the term Analytical Sensitivity (AS) which is the smallest amount of analyte that can be detected by this method. Obviously, the smallest number of micro plastic particles that can be detected by microscopy is 1. […] the AS calculated is based on the detection of 1 micro plastic particle detected in the total area analyzed and is dependent upon a number of factors including the volume of sample filtered, the filter area, the image area, and the number of images analyzed." (Pamela Hizar, 2021, pers. comm.)

In analytical chemistry, there are different methods for calculating the LOD and LOQ, such as visual definition, calculation from the signal-to-noise ratio, calculation from the standard deviation of the blank, or calculation from the calibration line at low concentrations. (Shrivastava and Gupta, 2015) While LOD and LOQ are successfully applied within analytical chemistry, their application to MP is not as straightforward, as steps are needed to differentiate between sample type and MP types (microplastics are highly diverse in color, size, morphology, and composition). For example, LOD for a brightly colored 200 µm red fiber may be very different from that of a 200 µm translucent film or a 50 µm blue particle. (Brander at al., 2020) Also, because larger MP particles are susceptible to breaking down within the sample (resulting in a higher count of smaller particles), applying a LOD or LOQ to the total particle count may not be meaningful. "Systematic correction for secondary contamination of microplastic samples is important in producing robust data; however, the most accurate procedure for such a correction is still under development." (Brander, 2020) Therefore, no correction or interpretation accounting for non-zero blanks have been applied to the field results for the current study.

The much lower particle count in Blank6 (held for 30 days prior to analysis), suggests that MP particles settle over time and that time between sample collection and analysis may impact results unless the sample is agitated prior to analysis. The objective of Blank6 was to see if MP particles leach out of the plastic bottle over time; however, this could not be determined due to the apparent settlement that occurred over the course of the 30 days.

4.2 TOTAL PARTICLE COUNT

Results from September 2021 and January 2022 both show a significantly higher total particle count at Tagish compared to other locations, at both times of the year, which points to a localized source. It is also possible that MP sources exist upstream of Tagish, and further investigation at the southern lakes and in precipitation and glacier fed tributaries of the southern lakes could provide additional insight. Furthermore, given the findings associated with Blank6 (MP particles settle over time), sampling lake sediment in the southern lakes would be of interest in advancing our understanding of sources and fate of MP particles.

Elevated results at the Takhini confluence in January 2022 indicate a possible temporally isolated source. Other locations did not show a significant difference with the blanks or between sites during the 2021-2022 sampling program.

The results of the two sampling events suggest that MP counts in the Yukon River are very low and comparable to blanks count along the reach between Marsh Lake and Dawson in both sampling events, except in January, at the confluence of the Takhini River. These results also suggest that the communities along the Yukon River were not significant sources of MP (e.g., by water treatment plant discharge, storm sewers, etc.) as total particle count per liter was not typically found to be higher downstream of communities, compared to upstream. It is also possible that potential MP contribution from communities did not result in increased MP particle concentration due to dilution in the Yukon River as flow increases moving downstream.

It is likely that total particle count alone may not be representative of MP abundance or concentration; a single particle could break down and be identified as several particles over time and/or through transport. For example, as measured by particle count, larger particles closer to a deposition point could represent a lower "concentration" of MP per unit volume than the same MP sampled downstream if degradation of MP during transport results in a greater number of MP particles. Quantification of MP by mass or volume would improve the representativeness of MP analyses; however, refinement of the sampling and/or analytical methods will be necessary. Development of a standardized unit for MP concentration should be a focus of future research. In the interim, an estimate of MP volume could be obtained by assigning an average size for each size category, multiplying by the count for each size category and adding the results for all size categories.

Also, while fluorescent tagging microscopy targets a number of plastic types, "it is now common practice and expected that a minimum amount of suspected synthetic particles across sample types are confirmed using Raman, lFT-IR spectroscopy, or pyrolysis–gas chromatography–mass spectrometry (py-GC-MS)". (Brander et al., 2020) This would add confidence to result interpretation, knowing that all particles counted are indeed MP, and seeing if fluorescent tagging effectively captures the majority of MP particles.

4.3 PARTICLE SIZE DISTRIBUTION

September 2021 results at Dawson show a greater proportion of small particle MPs, which could indicate deposition and/or degradation of larger particles may have occurred from a source far upstream (e.g. Whitehorse) by the time they reached Dawson. While the total MP count did not suggest an obvious source upstream, increased dilution as flows increase moving downstream on the Yukon River may limit the ability to identify an upstream source. January 2022 results at Tagish show a larger percentage of larger particles, consistent with the hypothesis of a local source.

The size categories provided by the lab are fairly wide (>6.5≤10µm, >10≤100µm, >100≤500µm, >500µm≤1mm, >1≤5mm range) and do not allow for a detailed analysis of particle sizes. As such, most particles observed fell within the two smaller size categories, which is expected given that larger particles are likely to either settle or breakdown into smaller particles over time. Because of this, comparing particle count between samples may not be a reliable comparison as one large particle may represent the same amount of plastic as several smaller particles.

4.4 TEMPORAL VARIATION

Total particle count was higher in samples collected under ice in January at Marsh Lake, Tagish and Takhini compared to samples collected from open water in September. This result suggests that atmospheric inputs may not have been a significant source of MP as the particle count was higher in January when atmospheric deposition would have been inhibited by ice cover. Also, flow is typically lower in winter, resulting in less dilution, which could in part explain some of the higher concentrations observed in winter.

January samples had a lower percentage of larger particles in January at Dawson and Tagish. Smaller particles are expected to be more readily transported by atmospheric circulation, perhaps explaining the lower counts of smaller particles in winter samples at some sites. Further study is required to better understand temporal variation in particle count and size.

4.5 POWER ANALYSIS

Post hoc power analyses were conducted for ANOVA tests (see detailed results in Appendix C). Power ranged from 0.78 to 1 depending on the groups tested. The lowest power was achieved for temporal comparison of total particle count at Marsh Lake. *A priori* power analyses were also conducted to determine the minimum sample size that would be required in future sampling events to achieve a given power. The minimum sample size to ensure a power of 0.95 found to be 8 for the temporal comparison of total particle count at Marsh Lake. Samples sizes of 7 or 5 were however sufficient for other comparisons. To achieve a power of 0.90, a minimum sample size of 7 would have been needed for the temporal comparisons of total particle count at Marsh Lake, but 6 or 4 were sufficient elsewhere. Details are available in Appendix C. Given that for most comparisons, a sample size of 5 or less was sufficient to achieve 0.95 power, this sample size is deemed appropriate for future sampling events.

5 RECOMMENDATIONS

In consideration of the results and discussion presented herein, CoreGeo suggests the following recommendations to improve the understanding of the fate and transport of MP in the Yukon:

- Continue seasonal monitoring the Yukon River for microplastics during open water and under ice cover to further document the presence or absence of microplastics and particle size distribution to characterize existing conditions.

- Continue to use a sample size of 5 replicates per sites for future sampling events in 1 litre HDPE bottles (blanks collected in glass jars didn't return a lower MP count).

- Sample water from potential MP sources in communities (e.g., water treatment plant discharge, storm sewers, snow dump runoff), as well as the Yukon River immediately upstream and immediately downstream of source discharge points.

- Sample the southern lakes water and sediment, and precipitation and glacier fed tributaries to the southern lakes.

- Send some samples/subsambles to be analyzed using Raman, lFT-IR spectroscopy, or (py-GC-MS) to confirm reliable MP identification using fluorescent tagging and microscopy.

- Work with laboratories to conduct further research on blank contamination, including the effects of sample agitation prior to analysis, rigorous analysis and characterization of laboratory deionized water, and development of a LOD and LOQ.

- Work with the MP research community and laboratories towards the development of a standardized MP reporting unit (i.e., mass or volume/unit volume).

- Work with laboratories to better understand particle size distribution (i.e., through additional size categories), and how particle such as filaments are classified in terms of size.

- Investigate for potential sources of microplastics near or upstream of the Tagish and Takhini sampling location to explain the higher particle counts at these locations.

- Sample atmospheric deposition (dustfall) for microplastics to better understand contribution from atmospheric transport.

6 CLOSURE

We trust this work meets your requirements. If you desire any additional information regarding the contents of this memo or wish to discuss any of the results, please contact CoreGeo at (867) 334-2673, or info@coregeo.ca.

7 REFERENCES

Brander, Susanne M., Violet C. Renick, Melissa M. Foley, Clare Steele, Mary Woo, Amy Lusher, Steve Carr, Paul Helm, Carolynn Box, Sam Cherniak, Robert C. Andrews, and Chelsea M. Rochman. 2020. Sampling and Quality Assurance and Quality Control: A Guide for Scientists Investigation the Occurrence of Microplastics Across Matrices. Applied Spectroscopy. Vol. 74(9) 1099-1125.

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APPENDIX A

PHOTO LOG

Photo A-1: Tagish September 2021

Photo A-2: Marsh Lake September 2021

Photo A-3: Takhini September 2021

Photo A-4: Carmacks September 2021

Photo A-5: Carmacks January 2022

Photo A-6: Dawson January 2022

APPENDIX B

CERTIFICATES OF ANALYSIS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **WR2101403**	Page	: 1 of 4
Client	: **Government of Yukon**	Laboratory	: Whitehorse - Environmental
Contact	: Devon O'Connor	Account Manager	: Ashton Ostrander
Address	: Department of Environment, Environmental Protection and Assessment Branch 10 Burns Road Whitehorse YT Canada	Address	: #12 151 Industrial Road Whitehorse YT Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 29-Sep-2021 13:17
PO	: ----	Date Analysis Commenced	: 15-Oct-2021
C-O-C number	: ----	Issue Date	: 21-Oct-2021 16:52
Sampler	: ----		
Site	: ----		
Quote number	: VA21-GPYT100-011		
No. of samples received	: 28		
No. of samples analysed	: 28		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Kaitlyn Gardner	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	TRDB-01	TRDB-02	TRDB-03	TRDB-04	TRDB-05
					Client sampling date / time	13-Sep-2021 13:10	13-Sep-2021 13:10	13-Sep-2021 13:10	13-Sep-2021 13:10	13-Sep-2021 13:10
Analyte	CAS Number	Method	LOR	Unit		WR2101403-001	WR2101403-002	WR2101403-003	WR2101403-004	WR2101403-005
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	FB-01	FB-02	Travel Blank	YRMLD-01	YRMLD-02
					Client sampling date / time	13-Sep-2021 13:20	13-Sep-2021 13:20	13-Sep-2021	13-Sep-2021 11:45	13-Sep-2021 11:45
Analyte	CAS Number	Method	LOR	Unit		WR2101403-006	WR2101403-007	WR2101403-008	WR2101403-009	WR2101403-010
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	YRMLD-03	YRMLD-04	YRMLD-05	YCAR-01	YCAR-02
					Client sampling date / time	13-Sep-2021 11:45	13-Sep-2021 11:45	13-Sep-2021 11:45	14-Sep-2021 16:50	14-Sep-2021 16:50
Analyte	CAS Number	Method	LOR	Unit		WR2101403-011	WR2101403-012	WR2101403-013	WR2101403-014	WR2101403-015
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	YCAR-03	YCAR-04	YCAR-05	YRUTR-01	YRUTR-02
					Client sampling date / time	14-Sep-2021 16:50	14-Sep-2021 16:50	14-Sep-2021 16:50	13-Sep-2021 09:45	13-Sep-2021 09:45
Analyte	CAS Number	Method	LOR	Unit		WR2101403-016	WR2101403-017	WR2101403-018	WR2101403-019	WR2101403-020
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	YRUTR-03	YRUTR-04	YRUTR-05	YRDRAW-01	YRDRAW-02
					Client sampling date / time	13-Sep-2021 09:45	13-Sep-2021 09:45	13-Sep-2021 09:45	14-Sep-2021 16:45	29-Sep-2021
Analyte	CAS Number	Method	LOR	Unit		WR2101403-021	WR2101403-022	WR2101403-023	WR2101403-024	WR2101403-025
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	YRDRAW-03	YRDRAW-04	YRDRAW-05	----	----
					Client sampling date / time	29-Sep-2021	29-Sep-2021	29-Sep-2021	----	----
Analyte	CAS Number	Method	LOR	Unit		WR2101403-026	WR2101403-027	WR2101403-028	--------	--------
						Result	Result	Result	----	----
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2101403**	Page	: 1 of 7
Client	: **Government of Yukon**	Laboratory	: Whitehorse - Environmental
Contact	: Devon O'Connor	Account Manager	: Ashton Ostrander
Address	: Department of Environment, Environmental Protection and Assessment Branch 10 Burns Road Whitehorse YT Canada	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 29-Sep-2021 13:17
PO	: ----	Issue Date	: 21-Oct-2021 16:52
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: VA21-GPYT100-011		
No. of samples received	: 28		
No. of samples analysed	: 28		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FB-01	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FB-02	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE Travel Blank	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-01	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-02	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-03	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-04	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-05	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-01	MicroPlasticSRN	14-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-02	MicroPlasticSRN	14-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-03	MicroPlasticSRN	14-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-04	MicroPlasticSRN	14-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-05	MicroPlasticSRN	14-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDRAW-01	MicroPlasticSRN	14-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDRAW-02	MicroPlasticSRN	29-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDRAW-03	MicroPlasticSRN	29-Sep-2021	----	----	----		15-Oct-2021	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDRAW-04	MicroPlasticSRN	29-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDRAW-05	MicroPlasticSRN	29-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-01	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-02	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-03	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-04	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-05	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRUTR-01	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRUTR-02	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-03	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-04	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-05	MicroPlasticSRN	13-Sep-2021	----	----	----		15-Oct-2021	----	----	

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

- **No Quality Control data available for this section.**

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Microplastic Particles Screening in pure water by SEM	MicroPlasticSRN Cincinnati - Environmental - 4388 Glendale-Milford Road Cincinnati Ohio United States 45242	Water	See attached.	Samples were prepared and analyzed according to ALS SOP Micro-Fluor-001 for the detection of microplastic particles in drinking water using Nile Red dye for fluorescent tagging. See attached report for details.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **WR2101403**	Page	: 1 of 2
Client	: Government of Yukon	Laboratory	: Whitehorse - Environmental
Contact	: Devon O'Connor	Account Manager	: Ashton Ostrander
Address	: Department of Environment, Environmental Protection and Assessment Branch 10 Burns Road Whitehorse YT Canada	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 29-Sep-2021 13:17
PO	: ----	Date Analysis Commenced	: 15-Oct-2021
C-O-C number	: ----	Issue Date	: 21-Oct-2021 16:52
Sampler	: ----		
Site	: ----		
Quote number	: VA21-GPYT100-011		
No. of samples received	: 28		
No. of samples analysed	: 28		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits
- Reference Material (RM) Report; Recovery and Acceptance Limits
- Method Blank (MB) Report; Recovery and Acceptance Limits
- Laboratory Control Sample (LCS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Kaitlyn Gardner	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percentage Difference
# = Indicates a QC result that did not meet the ALS DQO.

Contact: Heather McKenzie
Company: ALS Whitehorse
Address: 12-151 Industrial Rd,
Whitehorse, YT, Y1A2V3

Project / Location: WR2101403
PO Number: WR2101403
ALS Work Order: 21100154

NARRATIVE: This method was based on the study, "Synthetic Polymer Contamination in Bottled Water" conducted at the State University of New York at Fredonia which found an average of 325 MPP/L in bottled water brands from around the globe. The efficacy of this method for the detection of MPP in non-potable waters or other matrices has not been determined. Samples were analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles (MPP) using fluorescent tagging and static image analysis. This method has been shown to be sufficient for the rapid detection of polymerics including polyethylene, polypropylene, polystyrene and nylon 6 though it cannot differentiate between them.

Particle sizing is performed using static image analysis of representative calibrated two dimensional photomicrographs. The minimum caliper is the shortest distance between any 2 points along a single particle boundary and represents the approximate width/diameter of the particle/fiber. The maximum caliper is the longest distance between any 2 points along a single particle boundary and represents the length of the particle/fiber. The smallest single particle dimension confidently resolved by this method at the lowest available magnification has been determined to be approximately 6.5µm. Additionally, particles whose largest single dimension is greater than 5mm fall outside the generally accepted definition of MPP. Therefore, the total MPP concentration reported includes only fluorescing particles >6.5µm<5mm.

The dimension of interest (DOI) is selected based on observation of dominant particle morphology and determines the particle dimensions reported herein. Samples observed to contain primarily fibrous MPP exhibiting a length to width aspect ratio of 3:1 or greater are categorized according to maximum caliper (length). Samples observed to contain primarily non-fibrous MPP are categorized according to minimum caliper (diameter or width). Samples observed to contain an approximately equal mixture of both fibrous and non-fibrous MPP are categorized according to total area in square µm or mm.

The analytical sensitivity (AS) for this method is based on the detection of one particle in the total area analyzed. When possible sufficient sample is analyzed to yield an AS<10 MPP/L. However, the volume of sample that can be analyzed is dependent upon clarity. Therefore, samples containing significant concentrations of interferences may not attain the desired AS. Interferences such as opaque suspended solids may result in a negative bias and lipid-rich interferences such as fats, waxes, and oils may result in a positive bias.

All sample collection is performed outside ALS and is the sole responsibility of the client. Filtered samples are archived for 60 days prior to disposal. Results apply only to portions analyzed. Microscopy is not suitable for the examination of all types of materials. Additional testing may be required.

IDENTIFICATION

Client Sample ID:	WR2101403-001 / TRDB-01	WR2101403-002 / TRDB-02	WR2101403-003 / TRDB-03	WR2101403-004 / TRDB-04	WR2101403-005 / TRDB-05
ALS Sample ID:	21100154-01	21100154-02	21100154-03	21100154-04	21100154-05
Collection Date:	9/13/2021	9/13/2021	9/13/2021	9/13/2021	9/13/2021
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	500	500	500	500	500
AS (MPP/L):	2.68	2.68	2.68	2.68	2.68
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	26.75	21.40	18.73	18.73	26.75
>10≤100µm:	40.13	56.18	34.78	21.40	74.91
>100≤500µm:	2.68	5.35	10.70	0.00	2.68
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**69.56**	**82.94**	**64.21**	**40.13**	**104.34**

IDENTIFICATION

Client Sample ID:	WR2101403-006 / FB-01	WR2101403-007 / FB-02	WR2101403-008 / Travel Blank	WR2101403-009 / YRMLD-01	WR2101403-010 / YRMLD-02
ALS Sample ID:	21100154-06	21100154-07	21100154-08	21100154-09	21100154-10
Collection Date:	9/13/2021	9/13/2021	9/13/2021	9/13/2021	9/13/2021
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	1000	1000	1000	500	500
AS (MPP/L):	1.34	1.34	1.34	2.68	2.68
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	21.40	29.43	32.10	2.68	0.00
>10≤100µm:	34.78	37.46	13.38	21.40	10.70
>100≤500µm:	2.68	0.00	2.68	2.68	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**58.86**	**66.88**	**48.16**	**26.75**	**10.70**

IDENTIFICATION

Client Sample ID:	WR2101403-011 / YRMLD-03	WR2101403-012 / YRMLD-04	WR2101403-013 / YRMLD-05	WR2101403-014 / YCAR-01	WR2101403-015 / YCAR-02
ALS Sample ID:	21100154-11	21100154-12	21100154-13	21100154-14	21100154-15
Collection Date:	9/13/2021	9/13/2021	9/13/2021	9/14/2021	9/14/2021
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	500	500	500	500	500
AS (MPP/L):	2.68	2.68	2.68	2.68	2.68
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	8.03	13.38	16.05	16.05	13.38
>10≤100µm:	16.05	0.00	18.73	40.13	21.40
>100≤500µm:	0.00	0.00	0.00	5.35	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**24.08**	**13.38**	**34.78**	**61.53**	**34.78**

IDENTIFICATION

Client Sample ID:	WR2101403-016 / YCAR-03	WR2101403-017 / YCAR-04	WR2101403-018 / YCAR-05	WR2101403-019 / YRUTR-01	WR2101403-020 / YRUTR-02
ALS Sample ID:	21100154-16	21100154-17	21100154-18	21100154-19	21100154-20
Collection Date:	9/14/2021	9/14/2021	9/14/2021	9/13/2021	9/13/2021
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	500	500	500	500	500
AS (MPP/L):	2.68	2.68	2.68	2.68	2.68
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	13.38	13.38	13.38	0.00	21.40
>10≤100µm:	2.68	13.38	144.47	8.03	24.08
>100≤500µm:	2.68	2.68	0.00	2.68	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**18.73**	**29.43**	**157.85**	**10.70**	**45.48**

IDENTIFICATION					
Client Sample ID:	WR2101403-021 / YRUTR-03	WR2101403-022 / YRUTR-04	WR2101403-023 / YRUTR-05	WR2101403-024 / YRDRAW-01	WR2101403-025 / YRDRAW-02
ALS Sample ID:	21100154-21	21100154-22	21100154-23	21100154-24	21100154-25
Collection Date:	9/13/2021	9/13/2021	9/13/2021	9/14/2021	9/29/2021
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	500	500	500	25	25
AS (MPP/L):	2.68	2.68	2.68	53.51	53.51
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	21.40	10.70	18.73	18.73	26.75
>10≤100µm:	21.40	5.35	26.75	2.68	0.00
>100≤500µm:	0.00	2.68	5.35	2.68	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**42.81**	**18.73**	**50.83**	**24.08**	**26.75**

IDENTIFICATION			
Client Sample ID:	WR2101403-026 / YRDRAW-03	WR2101403-027 / YRDRAW-04	WR2101403-028 / YRDRAW-05
ALS Sample ID:	21100154-26	21100154-27	21100154-28
Collection Date:	9/29/2021	9/29/2021	9/29/2021
ANALYSIS			
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	25	25	25
AS (MPP/L):	53.51	53.51	53.51
DOI:	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)			
>6.5≤10µm:	18.73	32.10	29.43
>10≤100µm:	0.00	5.35	16.05
>100≤500µm:	0.00	0.00	0.00
>500µm≤1mm:	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00
TOTAL:	**18.73**	**37.46**	**45.48**

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

COC Number: 21 -

Page 1 of 3

Environmental Division
Whitehorse
Work Order Reference
WR2101403

Telephone : +1 867 668 6689

Report To	Contact and company name below will appear on the final report
Company:	Yukon Government
Contact:	Devon O'Connor
Phone:	867-689-1894
Company address below will appear on the final report	
Street:	
City/Province:	
Postal Code:	

Reports / Recipients	
Select Report Format:	☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA	☐ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	Devon.O'Connor@Yukon.ca
Email 2	
Email 3	

Turnaround Time (TAT) Requested
☐ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimu
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minim
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minim
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minim
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge
Additional fees may apply to rush requests on weeken
Date and Time Required for all E&P TATs:

Invoice To		
	Same as Report To	☐ YES ☐ NO
	Copy of Invoice with Report	☐ YES ☐ NO
Company:		
Contact:		

Invoice Recipients	
Select Invoice Distribution:	☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (ALS use only):		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Microplastics	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
1	TRDB-01	13-Sep-21	13:10	water	1	✓			
	TRDB-02	13-Sep-21	13:10	water					
	TRDB-03	13-Sep-21	13:10	water					
	TRDB-04	13-Sep-21	13:10	water					
	TRDB-05	13-Sep-21	13:10	water					
	FB-01	13-Sep-21	13:20	water					
	FB-02	13-Sep-21	13:20	water					
8	Travel Blank	13-Sep-21	0:00	water					

Drinking Water (DW) Samples[1] (client use)	Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE RECEIPT DETAIL

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS

Submission Comments identified on Sample Receipt Noti

Cooler Custody Seals Intact: ☐ YES ☐ N/A Samp

INITIAL COOLER TEMPERATURES °C			
26	26		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT REC	
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:
Devon O'Connor	Sep 29, 2021	12:25	D	Sept 29/21	12:25		

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 2 of 3

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Canada Toll Free: 1 800 668 9878

Report To	Contact and company name below will appear on the final report
Company:	
Contact:	
Phone:	
Company address below will appear on the final report	
Street:	
City/Province:	
Postal Code:	

Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	
LSD:	
ALS Lab Work Order # (ALS use only):	

Reports / Recipients

Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: Sampler:

Turnaround Time (TAT) Requested

☐ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Analysis Request

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
9	YRMLD-01	13-Sep-21	11:45	Water		Microplastics			
	YRMLD-02	13-Sep-21	11:45	Water					
	YRMLD-03	13-Sep-21	11:45	Water					
	YRMLD-04	13-Sep-21	11:45	Water					
	YRMLD-05	13-Sep-21	11:45	Water					
	YCAR-01	14-Sep-21	16:50	Water					
	YCAR-02	14-Sep-21	16:50	Water					
	YCAR-03	14-Sep-21	16:50	Water					
	YCAR-04	14-Sep-21	16:50	Water					
18	YCAR-05	14-Sep-21	16:50	Water					

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

COC Number: 21 -

Page 3 of 3

Report To	Contact and company name below will appear on the final report
Company:	
Contact:	
Phone:	
	Company address below will appear on the final report
Street:	
City/Province:	
Postal Code:	
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Turnaround Time (TAT) Requested

☐ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Project Information		**Oil and Gas Required Fields (client use)**	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (ALS use only):		**ALS Contact:**	**Sampler:**

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	**Sample Identification and/or Coordinates** (This description will appear on the report)	**Date** (dd-mmm-yy)	**Time** (hh:mm)	**Sample Type**	**NUMBER OF CONTAINERS**	Microplastics	**SAMPLES ON HOLD**	**EXTENDED STORAGE REQUIRED**	**SUSPECTED HAZARD (see notes)**
19	YRUTR-01	13-Sep-21	9:45	Water					
	YRUTR-02	13-Sep-21	9:45	Water					
	YRUTR-03	13-Sep-21	9:45	Water					
	YRUTR-04	13-Sep-21	9:45	Water					
	YRUTR-05	13-Sep-21	9:45	Water					
	YRDAW-01	14-Sep-21	16:45	Water					
	YRDAW-02	14-Sep-21	16:45	Water					
	YRDAW-03	14-Sep-21	16:45	Water					
	YRDAW-04	14-Sep-21	16:45	Water					
28	YRDAW-05	14-Sep-21	16:45	Water					

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
26							

SHIPMENT RELEASE (client use)			**INITIAL SHIPMENT RECEPTION (ALS use only)**			**FINAL SHIPMENT RECEPTION (ALS use only)**		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:

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Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 1 of 3

Canada Toll Free: 1 800 668 9878

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Environmental Division Whitehorse

Work Order Reference WR2101403

Telephone :-+1 867 668 6689

Report To	Contact and company name below will appear on the final report	Reports / Recipients	Turnaround Time (TAT) Requested
Company:	Yukon Government	Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)	☐ Routine [R] if received by 3pm M-F - no surcharges apply
Contact:	Devon O'Connor	Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A	☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minim
Phone:	867-689-1894	☐ Compare Results to Criteria on Report - provide details below if box checked	☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minim
	Company address below will appear on the final report	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minim
Street:		Email 1 or Fax Devon.O'Connor@Yukon.ca	☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minim
City/Province:		Email 2	☐ Same day [E2] if received by 10am M-S - 200% rush surcharge
Postal Code:		Email 3	Additional fees may apply to rush requests on weeken
Invoice To	Same as Report To ☐ YES ☐ NO	**Invoice Recipients**	Date and Time Required for all E&P TATs:
	Copy of Invoice with Report ☐ YES ☐ NO	Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	For all tests with rush TATs requested, please contact your AM to confirm availability.
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (ALS use only):		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Microplastics	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
1	TRDB-01	13-Sep-21	13:10	water	1	✓			
	TRDB-02	13-Sep-21	13:10	water					
	TRDB-03	13-Sep-21	13:10	water					
	TRDB-04	13-Sep-21	13:10	water					
	TRDB-05	13-Sep-21	13:10	water					
	FB-01	13-Sep-21	13:20	water					
	FB-02	13-Sep-21	13:20	water					
8	Travel Blank	13-Sep-21	0:00	water					

Drinking Water (DW) Samples[1] (client use)	Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE RECEIPT DETAIL

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS

Submission Comments identified on Sample Receipt Noti

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sam

INITIAL COOLER TEMPERATURES °C				
2.6	2.6			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT REC		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	
Devon O'Connor	Sep 29, 2021	12:25	D	Sept 29/21	12:25	JC 10 °C	OCT - 1 2021	8:20am

2.5

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Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 2 of 3

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Canada Toll Free: 1 800 668 9878

Report To	Contact and company name below will appear on the final report
Company:	
Contact:	
Phone:	
	Company address below will appear on the final report
Street:	
City/Province:	
Postal Code:	
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Turnaround Time (TAT) Requested

☐ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (ALS use only):		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

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	YRMLD-04	13-Sep-21	11:45	Water					
	YRMLD-05	13-Sep-21	11:45	Water					
	YCAR-01	14-Sep-21	16:50	Water					
	YCAR-02	14-Sep-21	16:50	Water					
	YCAR-03	14-Sep-21	16:50	Water					
	YCAR-04	14-Sep-21	16:50	Water					
18	YCAR-05	14-Sep-21	16:50	Water					

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				10	10		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: JC	Date: OCT - 1 2021	Time: 820 am

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Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 3 of 3

Canada Toll Free: 1 800 668 9878

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Report To	Contact and company name below will appear on the final report
Company:	
Contact:	
Phone:	
	Company address below will appear on the final report
Street:	
City/Province:	
Postal Code:	
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

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☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
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Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	
LSD:	
ALS Lab Work Order # (ALS use only):	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

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	YRUTR-05	13-Sep-21	9:45	Water					
	YRDAW-01	14-Sep-21	16:45	Water					
	YRDAW-02	14-Sep-21	16:45	Water					
	YRDAW-03	14-Sep-21	16:45	Water					
	YRDAW-04	14-Sep-21	16:45	Water					
28	YRDAW-05	14-Sep-21	16:45	Water					

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
26				10	10		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: JC	Date: OCT - 1 2021	Time: 820am

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ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **WR2200058**	Page	: 1 of 6
Client	: **Government of Yukon**	Laboratory	: Whitehorse - Environmental
Contact	: Devon O'Connor	Account Manager	: Tasnia Tarannum
Address	: 113 Industrial Road Whitehorse YT Canada Y1A 2T7	Address	: #12 151 Industrial Road Whitehorse YT Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 27-Jan-2022 12:30
PO	: ----	Date Analysis Commenced	: 15-Feb-2022
C-O-C number	: ----	Issue Date	: 07-Mar-2022 11:51
Sampler	: ----		
Site	: ----		
Quote number	: VA21-GPYT100-011		
No. of samples received	: 60		
No. of samples analysed	: 55		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Kaitlyn Gardner	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio
Trace Chometsky	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Workorder Comments

Wait 30 days from receipt to analyse tbb 1-5

Analytical Results

Sub-Matrix: **Drinking Water** (Matrix: **Water**)					Client sample ID	TBA-1	TBA-2	TBA-3	TBA-4	TBA-5
					Client sampling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		**WR2200058-001**	**WR2200058-002**	**WR2200058-003**	**WR2200058-004**	**WR2200058-005**
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Drinking Water** (Matrix: **Water**)					Client sample ID	YRDAW-1	YRDAW-2	YRDAW-3	YRDAW-4	YRDAW-5
					Client sampling date / time	20-Jan-2022 10:00	20-Jan-2022 10:00	20-Jan-2022 10:00	20-Jan-2022 10:00	20-Jan-2022 10:00
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		**WR2200058-011**	**WR2200058-012**	**WR2200058-013**	**WR2200058-014**	**WR2200058-015**
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Drinking Water** (Matrix: **Water**)					Client sample ID	TBP-1	TBP-2	TBP-3	TBP-4	TBP-5
					Client sampling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		**WR2200058-016**	**WR2200058-017**	**WR2200058-018**	**WR2200058-019**	**WR2200058-020**
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Drinking Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	TBG-1	TBG-2	TBG-3	TBG-4	TBG-5
					Client sampling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022
						WR2200058-021	WR2200058-022	WR2200058-023	WR2200058-024	WR2200058-025
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Drinking Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	TB-01	TB-02	FB-01	FB-02	FB-03
					Client sampling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15
						WR2200058-026	WR2200058-027	WR2200058-028	WR2200058-029	WR2200058-030
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Drinking Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	YRMLD-01	YRMLD-02	YRMLD-03	YRMLD-04	YRMLD-05
					Client sampling date / time	25-Jan-2022 14:15	25-Jan-2022 14:15	25-Jan-2022 14:15	25-Jan-2022 14:15	25-Jan-2022 14:15
						WR2200058-031	WR2200058-032	WR2200058-033	WR2200058-034	WR2200058-035
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Drinking Water (Matrix: Water)					Client sample ID	TRDB-01	TRDB-02	TRDB-03	TRDB-04	TRDB-05
					Client sampling date / time	25-Jan-2022 15:10	25-Jan-2022 15:10	25-Jan-2022 15:10	25-Jan-2022 15:10	25-Jan-2022 15:10
Analyte	CAS Number	Method	LOR	Unit		WR2200058-036	WR2200058-037	WR2200058-038	WR2200058-039	WR2200058-040
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Drinking Water (Matrix: Water)					Client sample ID	YCAR-01	YCAR-02	YCAR-03	YCAR-04	YCAR-05
					Client sampling date / time	25-Jan-2022 10:45	25-Jan-2022 10:45	25-Jan-2022 10:45	25-Jan-2022 10:45	25-Jan-2022 10:45
Analyte	CAS Number	Method	LOR	Unit		WR2200058-041	WR2200058-042	WR2200058-043	WR2200058-044	WR2200058-045
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: Drinking Water (Matrix: Water)					Client sample ID	YRUTR-01	YRUTR-02	YRUTR-03	YRUTR-04	YRUTR-05
					Client sampling date / time	25-Jan-2022 13:00	25-Jan-2022 13:00	25-Jan-2022 13:00	25-Jan-2022 13:00	25-Jan-2022 13:00
Analyte	CAS Number	Method	LOR	Unit		WR2200058-046	WR2200058-047	WR2200058-048	WR2200058-049	WR2200058-050
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Drinking Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	FBP-01	FBP-02	FBP-03	FBP-04	FBP-05
					Client sampling date / time	25-Jan-2022 15:25	25-Jan-2022 15:25	25-Jan-2022 15:25	25-Jan-2022 15:25	25-Jan-2022 15:25
						WR2200058-051	WR2200058-052	WR2200058-053	WR2200058-054	WR2200058-055
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Drinking Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	FBG-1	FBG-2	FBG-3	FBG-4	FBG-5
					Client sampling date / time	25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15
						WR2200058-056	WR2200058-057	WR2200058-058	WR2200058-059	WR2200058-060
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlasticSRN	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2200058**	Page	: 1 of 10
Client	: **Government of Yukon**	Laboratory	: Whitehorse - Environmental
Contact	: Devon O'Connor	Account Manager	: Tasnia Tarannum
Address	: 113 Industrial Road Whitehorse YT Canada Y1A 2T7	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 27-Jan-2022 12:30
PO	: ----	Issue Date	: 07-Mar-2022 11:51
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: VA21-GPYT100-011		
No. of samples received	: 60		
No. of samples analysed	: 55		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FB-01	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FB-02	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FB-03	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container FBG-1	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container FBG-2	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container FBG-3	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container FBG-4	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container FBG-5	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FBP-01	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FBP-02	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FBP-03	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FBP-04	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FBP-05	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TB-01	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TB-02	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBA-1	MicroPlasticSRN	25-Jan-2022	----	----	----		04-Mar-2022	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBA-2	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBA-3	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBA-4	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBA-5	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container TBG-1	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container TBG-2	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container TBG-3	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container TBG-4	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container TBG-5	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBP-1	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBP-2	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBP-3	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBP-4	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TBP-5	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-01	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-02	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-03	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-04	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-05	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-01	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-02	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-03	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-04	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YCAR-05	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDAW-1	MicroPlasticSRN	20-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDAW-2	MicroPlasticSRN	20-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDAW-3	MicroPlasticSRN	20-Jan-2022	----	----	----		15-Feb-2022	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDAW-4	MicroPlasticSRN	20-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRDAW-5	MicroPlasticSRN	20-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-01	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-02	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-03	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-04	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRMLD-05	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRUTR-01	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRUTR-02	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-03	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-04	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-05	MicroPlasticSRN	25-Jan-2022	----	----	----		15-Feb-2022	----	----	

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

- **No Quality Control data available for this section.**

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Microplastic Particles Screening in pure water by SEM	MicroPlasticSRN Cincinnati - Environmental - 4388 Glendale-Milford Road Cincinnati Ohio United States 45242	Water	See attached.	Samples were prepared and analyzed according to ALS SOP Micro-Fluor-001 for the detection of microplastic particles in drinking water using Nile Red dye for fluorescent tagging. See attached report for details.

QUALITY CONTROL REPORT

Work Order	: **WR2200058**	Page	: 1 of 2
Client	: Government of Yukon	Laboratory	: Whitehorse - Environmental
Contact	: Devon O'Connor	Account Manager	: Tasnia Tarannum
Address	: 113 Industrial Road Whitehorse YT Canada Y1A 2T7	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 27-Jan-2022 12:30
PO	: ----	Date Analysis Commenced	: 15-Feb-2022
C-O-C number	: ----	Issue Date	: 07-Mar-2022 11:51
Sampler	: ----		
Site	: ----		
Quote number	: VA21-GPYT100-011		
No. of samples received	: 60		
No. of samples analysed	: 55		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits
- Reference Material (RM) Report; Recovery and Acceptance Limits
- Method Blank (MB) Report; Recovery and Acceptance Limits
- Laboratory Control Sample (LCS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Kaitlyn Gardner	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio
Trace Chometsky	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percentage Difference
# = Indicates a QC result that did not meet the ALS DQO.

Contact: Tasnia Tarannum
Company: ALS Whitehorse
Address: 12-151 Industrial Rd,
Whitehorse, YT, Y1A2V3

Project / Location: WR2200058
PO Number: WR2200058
ALS Work Order: 22020139

The samples herein were analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles (MPP) using fluorescent tagging with Nile Red (NR) stain and static image analysis. This method, based on the study, "Synthetic Polymer Contamination in Bottled Water" which was conducted at the State University of New York (SUNY) at Fredonia, found an average of 325 MPP/L in bottled water brands from around the globe and has been shown to be sufficient for the rapid detection of polymerics including polyethylene (PE), polypropylene (PP), polystyrene (PS) and nylon 6 (PA6) though it cannot differentiate between them.

The efficacy of this method for the detection of MPP in non-potable waters including waste, effluent, influent, ground, surface, or marine waters has not yet been determined.

Particle sizing is performed using static image analysis of a series of representative two dimensional photomicrographs. Minimum caliper is the shortest distance between any 2 points along a single particle boundary and represents the approximate width/diameter of the particle/fiber. Maximum caliper is the longest distance between any 2 points along a single particle boundary and represents the length of the particle/fiber. The smallest single particle dimension confidently resolved by this method at the lowest available magnification has been determined to be approximately 6.5µm. Additionally, particles whose largest single dimension is greater than 5mm fall outside the generally accepted definition of MPP. Therefore, the total MPP concentration reported includes only fluorescing particles >6.5µm<5mm in the dimension of interest (DOI).

DOI is selected by the analyst based on observation of the dominant particle morphology. Samples observed to contain primarily fibrous MPP exhibiting a length to width aspect ratio of 3:1 or greater are categorized according to maximum caliper. Samples containing primarily non-fibrous MPP are categorized according to minimum caliper. Samples containing an approximately equal mixture of fibrous and non-fibrous MPP are categorized according to total area in units squared.

The analytical sensitivity (AS) for this method is based on the detection of one particle in the total area analyzed. When possible, sufficient sample is analyzed to yield an AS<10 MPP/L. However, the volume of sample that can be analyzed is dependent upon water clarity. Therefore, samples with significant concentrations of interferences may not attain the desired AS.

Interferences such as opaque suspended solids may result in a negative bias while lipid-rich interferences such as fats, waxes, and oils may result in a positive bias. For this reason, the filtered aliquot selected for analysis is one that exhibits the greatest number of adequately dispersed fluorescing MPP affected by the least interference possible.

All sample collection is performed outside ALS and is the sole responsibility of the client. Filtered samples are archived for 60 days prior to disposal. Results apply only to portions analyzed. Microscopy is not suitable for the analysis of all types of materials. Therefore, additional testing may be required.

Representative photomicrographs and/or binary threshold images are not automatically included but may be made available upon request for an additional per item fee.

Pamela M. Hizar

Pamela M. Hizar
ALS Microscopy Technical Manager

IDENTIFICATION					
Client Sample ID:	WR2200058-001 / TBA-1	WR2200058-002 / TBA-2	WR2200058-003 / TBA-3	WR2200058-004 / TBA-4	WR2200058-005 / TBA-5
ALS Sample ID:	22020139-01	22020139-02	22020139-03	22020139-04	22020139-05
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/7/2022	2/7/2022	2/7/2022	2/7/2022	2/7/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	5.35	9.36	10.70	6.69	8.03
>10≤100µm:	2.68	0.00	5.35	4.01	4.01
>100≤500µm:	0.00	0.00	0.00	2.68	0.00
>500µm≤1mm:	0.00	1.34	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**8.03**	**10.70**	**16.05**	**13.38**	**12.04**

IDENTIFICATION					
Client Sample ID:	WR2200058-011 / YRDAW-1	WR2200058-012 / YRDAW-2	WR2200058-013 / YRDAW-3	WR2200058-014 / YRDAW-4	WR2200058-015 / YRDAW-5
ALS Sample ID:	22020139-06	22020139-07	22020139-08	22020139-09	22020139-10
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/7/2022	2/7/2022	2/7/2022	2/8/2022	2/8/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	10.70	10.70	10.70	14.71	10.70
>10≤100µm:	8.03	17.39	16.05	26.75	8.03
>100≤500µm:	0.00	6.69	1.34	2.68	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**18.73**	**34.78**	**28.09**	**44.14**	**18.73**

IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	016 / TBP-1	017 / TBP-2	018 / TBP-3	019 / TBP-4	020 / TBP-5
ALS Sample ID:	22020139-11	22020139-12	22020139-13	22020139-14	22020139-15
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/8/2022	2/8/2022	2/8/2022	2/8/2022	2/8/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	16.05	14.71	14.71	14.71	17.39
>10≤100µm:	2.68	6.69	10.70	5.35	4.01
>100≤500µm:	0.00	0.00	1.34	0.00	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**18.73**	**21.40**	**26.75**	**20.07**	**21.40**

IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	021 / TBG-1	022 / TBG-2	023 / TBG-3	024 / TBG-4	025 / TBG-5
ALS Sample ID:	22020139-16	22020139-17	22020139-18	22020139-19	22020139-20
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/8/2022	2/8/2022	2/8/2022	2/8/2022	2/8/2022
Filtered Volume (mL):	975	940	960	910	925
AS (MPP/L):	1.37	1.42	1.39	1.47	1.45
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	14.71	14.71	17.39	14.71	14.71
>10≤100µm:	17.39	41.47	20.07	8.03	9.36
>100≤500µm:	6.69	5.35	6.69	1.34	0.00
>500µm≤1mm:	0.00	0.00	1.34	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**38.79**	**61.53**	**45.48**	**24.08**	**24.08**

IDENTIFICATION

Client Sample ID:	WR2200058-026 / TB-01	WR2200058-028 / FB-01	WR2200058-029 / FB-02	WR2200058-031 / YRMLD-01	WR2200058-032 / YRMLD-02
ALS Sample ID:	22020139-21	22020139-22	22020139-23	22020139-24	22020139-25
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/9/2022	2/9/2022	2/9/2022	2/9/2022	2/9/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	17.39	20.07	20.07	16.05	16.05
>10≤100µm:	4.01	9.36	6.69	52.17	56.18
>100≤500µm:	1.34	6.69	1.34	6.69	4.01
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**22.74**	**36.12**	**28.09**	**74.91**	**76.25**

IDENTIFICATION

Client Sample ID:	WR2200058-033 / YRMLD-03	WR2200058-034 / YRMLD-04	WR2200058-035 / YRMLD-05	WR2200058-036 / TRDB-01	WR2200058-037 / TRDB-02
ALS Sample ID:	22020139-26	22020139-27	22020139-28	22020139-29	22020139-30
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/9/2022	2/9/2022	2/9/2022	2/9/2022	2/9/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	18.73	18.73	17.39	20.07	32.10
>10≤100µm:	8.03	29.43	22.74	243.46	523.03
>100≤500µm:	2.68	0.00	1.34	16.05	26.75
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**29.43**	**48.16**	**41.47**	**279.58**	**581.89**

IDENTIFICATION

Client Sample ID:	WR2200058-038 / TRDB-03	WR2200058-039 / TRDB-04	WR2200058-040 / TRDB-05	WR2200058-041 / YCAR-01	WR2200058-042 / YCAR-02
ALS Sample ID:	22020139-31	22020139-32	22020139-33	22020139-34	22020139-35
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/10/2022	2/10/2022	2/10/2022	2/10/2022	2/10/2022
Filtered Volume (mL):	800	1000	1000	1000	1000
AS (MPP/L):	1.67	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	13.38	25.42	18.73	18.73	20.07
>10≤100µm:	77.59	468.19	539.09	4.01	6.69
>100≤500µm:	2.68	20.07	34.78	0.00	0.00
>500µm≤1mm:	0.00	1.34	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**93.64**	**515.01**	**592.59**	**22.74**	**26.75**

IDENTIFICATION

Client Sample ID:	WR2200058-043 / YCAR-03	WR2200058-044 / YCAR-04	WR2200058-045 / YCAR-05	WR2200058-046 / YRUTR-01	WR2200058-047 / YRUTR-02
ALS Sample ID:	22020139-36	22020139-37	22020139-38	22020139-39	22020139-40
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/10/2022	2/10/2022	2/10/2022	2/11/2022	2/11/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	18.73	20.07	18.73	18.73	22.74
>10≤100µm:	10.70	13.38	22.74	287.60	250.15
>100≤500µm:	0.00	2.68	1.34	8.03	25.42
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**29.43**	**36.12**	**42.81**	**314.36**	**298.30**

IDENTIFICATION

Client Sample ID:	WR2200058-048 / YRUTR-03	WR2200058-049 / YRUTR-04	WR2200058-050 / YRUTR-05	WR2200058-051 / FBP-01	WR2200058-052 / FBP-02
ALS Sample ID:	22020139-41	22020139-42	22020139-43	22020139-44	22020139-45
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/11/2022	2/11/2022	2/11/2022	2/11/2022	2/11/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	20.07	17.39	17.39	18.73	20.07
>10≤100µm:	112.37	262.19	188.61	4.01	9.36
>100≤500µm:	16.05	17.39	5.35	1.34	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**148.48**	**296.97**	**211.35**	**24.08**	**29.43**

IDENTIFICATION

Client Sample ID:	WR2200058-053 / FBP-03	WR2200058-054 / FBP-04	WR2200058-055 / FBP-05	WR2200058-056 / FBG-01	WR2200058-057 / FBG-02
ALS Sample ID:	22020139-46	22020139-47	22020139-48	22020139-49	22020139-50
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/11/2022	2/11/2022	2/11/2022	2/11/2022	2/11/2022
Filtered Volume (mL):	1000	1000	1000	950	910
AS (MPP/L):	1.34	1.34	1.34	1.41	1.47
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	21.40	17.39	21.40	18.73	20.07
>10≤100µm:	9.36	6.69	1.34	10.70	36.12
>100≤500µm:	2.68	0.00	4.01	2.68	4.01
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**33.44**	**24.08**	**26.75**	**32.10**	**60.20**

IDENTIFICATION					
Client Sample ID:	WR2200058-058 / FBG-03	WR2200058-059 / FBG-04	WR2200058-060 / FBG-05	WR2200058-006 / TBB-1	WR2200058-007 / TBB-2
ALS Sample ID:	22020139-51	22020139-52	22020139-53	22020139-54	22020139-55
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	NA	NA
Date:	2/11/2022	2/11/2022	2/11/2022	NA	NA
Filtered Volume (mL):	975	915	920	NA	NA
AS (MPP/L):	1.37	1.46	1.45	NA	NA
DOI:	DIAMETER	DIAMETER	DIAMETER	NA	NA
CONCENTRATION (MPP/L)					
>6.5≤10µm:	20.07	18.73	21.40	NA	NA
>10≤100µm:	29.43	21.40	4.01	NA	NA
>100≤500µm:	0.00	0.00	0.00	NA	NA
>500µm≤1mm:	0.00	0.00	0.00	NA	NA
>1≤5mm:	0.00	0.00	0.00	NA	NA
TOTAL:	**49.49**	**40.13**	**25.42**	**NA**	**NA**

IDENTIFICATION					
Client Sample ID:	WR2200058-008 / TBB-3	WR2200058-009 / TBB-4	WR2200058-010 / TBB-5	WR00058-027 / TB-02	WR00058-030 / FB-03
ALS Sample ID:	22020139-56	22020139-57	22020139-58	22020139-59	22020139-60
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	NA	NA	NA	Pamela Hizar	Pamela Hizar
Date:	NA	NA	NA	2/11/2022	2/11/2022
Filtered Volume (mL):	NA	NA	NA	1000	1000
AS (MPP/L):	NA	NA	NA	1.34	1.34
DOI:	NA	NA	NA	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	NA	NA	NA	0.00	1.34
>10≤100µm:	NA	NA	NA	5.35	1.34
>100≤500µm:	NA	NA	NA	1.34	1.34
>500µm≤1mm:	NA	NA	NA	0.00	0.00
>1≤5mm:	NA	NA	NA	0.00	0.00
TOTAL:	**NA**	**NA**	**NA**	**6.69**	**4.01**

NOTES

Ten samples, WR2200058-021 / TBG-1 through WR2200058-25 and WR2200058-056 / FBG-1 through WR2200058-60 / FBG-5, arrived in wide mouth clear glass bottles which hold exactly 1L when filled to the brim with no head space. The addition of NR stain solution, head space required for ultra sonication, and minor sample loss while pouring resulted in a total volume filtered of less than 1L for these samples.

Filtration of sample WR2200058-038 was terminated with 800mL when the filter media became clogged with primarily organic solids from the aqueous sample.

Per client instructions, samples WR2200058-006 / TBB-1 through WR2200058-010 / TBB-5 were not analyzed but were placed on a 30 day hold. Samples will be disposed on 3/7/2022 unless the analyst listed herein is otherwise instructed.

Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 1 of 2

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Environmental Division
Whitehorse
Work Order Reference
WR2200058

Telephone : +1 867 668 6689

Report To	Contact and company name below will appear on the final report
Company:	Yukon Government, Water Resources Branch
Contact:	Devon O'Connor
Phone:	867-689-1894
	Company address below will appear on the final report
Street:	419 Range Road
City/Province:	Whitehore, YT
Postal Code:	Y1A 3V1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA	☐ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	devon.o'connor@yukon.ca
Email 2	amelie.janin@yukon.ca
Email 3	

Invoice Recipients	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Turnaround Time (TAT) Requested
☑ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimu
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minim
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minim
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minim
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge
Additional fees may apply to rush requests on weeken
Date and Time Required for all E&P TATs:
For all tests with rush TATs requested, please co...

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (ALS use only):	ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Microplastics	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	TBA-1 -> TBA-5	25-Jan-22	0:00	Water	5	R			
	TBB-1 -> TBB-5	25-Jan-22	0:00	Water		R			
	TRDAW-1 -> YRDAW-5	20-Jan-22	10:00	Water		R			
	TBP-1 -> TBP-5	25-Jan-22	0:00	Water		R			
	TBG-1 -> TBG-5	25-Jan-22	0:00	Water		R			
	TB-01 -> TB-02	25-Jan-22	0:00	Water	2	R			
	FB-01 -> FB-03	25-Jan-22	15:15	Water	3	R			
	YRMLD-01 -> YRMLD-05	25-Jan-22	14:15	Water	5	R			
	TRDB-01 -> TRDB-05	25-Jan-22	15:10	Water		R			
	YCAR-01 -> YCAR-05	25-Jan-22	10:45	Water		R			
	TRUTR-01 -> YRUTR-05	25-Jan-22	13:00	Water		R			
	FBP-1 -> FBP-5	25-Jan-22	15:25	Water		R			

Drinking Water (DW) Samples[1] (client use)	Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)
Are samples taken from a Regulated DW System? ☐ YES ☒ NO	See Yg Water Resources Quote #
Are samples for human consumption/ use? ☐ YES ☒ NO	**IMPORTANT** Please wait 30 days from receipt to analyse TBB-1 -> TBB-5

SAMPLE RECEIPT DETAILS (ALS use only)							
Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED							
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO							
Cooler Custody Seals Intact: ☐ YES ☐ N/A	Sample Custody Seals Intact: ☐ YES ☐ N/A						
INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
17	18	9	17	20			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Devon O'Connor	Jan-27-2022			JAN 27	1230			

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 2 of 2

Canada Toll Free: 1 800 668 9878

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Report To	Contact and company name below will appear on the final report
Company:	Yukon Government, Water Resources Branch
Contact:	Devon O'Connor
Phone:	867-689-1894
	Company address below will appear on the final report
Street:	419 Range Road
City/Province:	Whitehore, YT
Postal Code:	Y1A 3V1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: devon.o'connor@yukon.ca

Email 2: amelie.janin@yukon.ca

Email 3:

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply

☐ # day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (ALS use only):

ALS Contact:

Sampler: DO & AB

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Microplastics	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	FBG-1 -> FBG-5	25-Jan-22	15:15	Water	5	R			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☑ NO

Are samples for human consumption/ use?

☐ YES ☑ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

See YG Water Resources Quote #

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Devon O'Connor	Jan 27 - 2022							

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Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 1 of 2

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Canada Toll Free: 1 800 668 9878

Environmental Division Whitehorse

Work Order Reference WR2200058

Telephone : +1 867 668 6689

Report To	Contact and company name below will appear on the final report
Company:	Yukon Government, Water Resources Branch
Contact:	Devon O'Connor
Phone:	867-689-1894
	Company address below will appear on the final report
Street:	419 Range Road
City/Province:	Whitehore, YT
Postal Code:	Y1A 3V1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: devon.o'connor@yukon.ca

Email 2: amelie.janin@yukon.ca

Email 3:

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minim

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minim

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minim

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minim

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge

Additional fees may apply to rush requests on weeken

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please co...

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (ALS use only):		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Microplastics	SAMPLES ON HOLD*	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	TBA-1 -> TBA-5	25-Jan-22	0:00	Water	5	R			
	TBB-1 -> TBB-5	25-Jan-22	0:00	Water		R			
	TRDAW-1 -> YRDAW-5	20-Jan-22	10:00	Water		R			
	TBP-1 -> TBP-5	25-Jan-22	0:00	Water		R			
	TBG-1 -> TBG-5	25-Jan-22	0:00	Water		R			
	TB-01 -> TB-02	25-Jan-22	0:00	Water	2	R			
	FB-01 -> FB-03	25-Jan-22	15:15	Water	3	R			
	YRMLD-01 -> YRMLD-05	25-Jan-22	14:15	Water	5	R			
	TRDB-01 -> TRDB-05	25-Jan-22	15:10	Water		R			
	YCAR-01 -> YCAR-05	25-Jan-22	10:45	Water		R			
	TRUTR-01 -> YRUTR-05	25-Jan-22	13:00	Water		R			
	FBP-1 -> FBP-5	25-Jan-22	15:25	Water		R			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☒ NO

Are samples for human consumption/ use?

☐ YES ☒ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

See YG Water Resources Quote #

IMPORTANT

Please wait 30 days from receipt to analyse TBB-1 -> TBB-5

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☑ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C	
17	18	19	19	20	9.7

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
Devon O'Connor	Jan-27-2022	

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
	JAN 27	1230

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
	29/1/2022	2:50pm

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Chain of Custody (COC) / Analytical Request Form

COC Number: 21 -

Page 2 of 2

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Canada Toll Free: 1 800 668 9878

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Company:	Yukon Government, Water Resources Branch
Contact:	Devon O'Connor
Phone:	867-689-1894
	Company address below will appear on the final report
Street:	419 Range Road
City/Province:	Whitehore, YT
Postal Code:	Y1A 3V1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: devon.o'connor@yukon.ca

Email 2: amelie.janin@yukon.ca

Email 3:

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply

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☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Project Information

ALS Account # / Quote #:

Job #:

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (ALS use only):

ALS Contact:

Sampler: DO & AB

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Microplastics	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	FBG-1 -> FBG-5	25-Jan-22	15:15	Water	5	R			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☑ NO

Are samples for human consumption/ use?

☐ YES ☑ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

See YG Water Resources Quote #

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Devon OConnor	Jan 27-2022						29/1/2022	

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Contact: Tasnia Tarannum
Company: ALS Whitehorse
Address: 12-151 Industrial Rd,
Whitehorse, YT, Y1A2V3

Project / Location: WR2200058
PO Number: WR2200058
ALS Work Order: 22030808

The samples herein were analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles (MPP) using fluorescent tagging with Nile Red (NR) stain and static image analysis. This method, based on the study, "Synthetic Polymer Contamination in Bottled Water" which was conducted at the State University of New York (SUNY) at Fredonia, found an average of 325 MPP/L in bottled water brands from around the globe and has been shown to be sufficient for the rapid detection of polymerics including polyethylene (PE), polypropylene (PP), polystyrene (PS) and nylon 6 (PA6) though it cannot differentiate between them.

The efficacy of this method for the detection of MPP in non-potable waters including waste, effluent, influent, ground, surface, or marine waters has not yet been determined.

Particle sizing is performed using static image analysis of a series of representative two dimensional photomicrographs. Minimum caliper is the shortest distance between any 2 points along a single particle boundary and represents the approximate width/diameter of the particle/fiber. Maximum caliper is the longest distance between any 2 points along a single particle boundary and represents the length of the particle/fiber. The smallest single particle dimension confidently resolved by this method at the lowest available magnification has been determined to be approximately 6.5µm. Additionally, particles whose largest single dimension is greater than 5mm fall outside the generally accepted definition of MPP. Therefore, the total MPP concentration reported includes only fluorescing particles >6.5µm<5mm in the dimension of interest (DOI).

DOI is selected by the analyst based on observation of the dominant particle morphology. Samples observed to contain primarily fibrous MPP exhibiting a length to width aspect ratio of 3:1 or greater are categorized according to maximum caliper. Samples containing primarily non-fibrous MPP are categorized according to minimum caliper. Samples containing an approximately equal mixture of fibrous and non-fibrous MPP are categorized according to total area in units squared.

The analytical sensitivity (AS) for this method is based on the detection of one particle in the total area analyzed. When possible, sufficient sample is analyzed to yield an AS<10 MPP/L. However, the volume of sample that can be analyzed is dependent upon water clarity. Therefore, samples with significant concentrations of interferences may not attain the desired AS.

Interferences such as opaque suspended solids may result in a negative bias while lipid-rich interferences such as fats, waxes, and oils may result in a positive bias. For this reason, the filtered aliquot selected for analysis is one that exhibits the greatest number of adequately dispersed fluorescing MPP affected by the least interference possible.

All sample collection is performed outside ALS and is the sole responsibility of the client. Filtered samples are archived for 60 days prior to disposal. Results apply only to portions analyzed. Microscopy is not suitable for the analysis of all types of materials. Therefore, additional testing may be required.

Representative photomicrographs and/or binary threshold images are not automatically included but may be made available upon request for an additional per item fee.

Pamela M. Hizar

Pamela M. Hizar
ALS Microscopy Technical Manager

IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	006/ TBB-1	007/ TBB-2	008/ TBB-3	009/ TBB-4	010/ TBB-5
ALS Sample ID:	22030808-01A	22030808-02A	22030808-03A	22030808-04A	22030808-05A
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	3/21/2022	3/21/2022	3/21/2022	3/21/2022	3/21/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	4.01	0.00	1.34	0.00	0.00
>10≤100µm:	0.00	0.00	0.00	1.34	1.34
>100≤500µm:	0.00	0.00	0.00	0.00	0.00
>500µm≤1mm:	0.00	0.00	0.00	0.00	0.00
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**4.01**	**0.00**	**1.34**	**1.34**	**1.34**

NOTES

Samples were relogged from ALS WO 22020139 (samples 54-58) after being placed on hold for 42 days from receipt on 2/4/2022.

APPENDIX C

STATISTICAL TESTS RESULTS

Comparison	Distributions normal?	Variances equal?	Statistical test	Significant differences	% difference	Power (ANOVA only)	Minimum sample size for 0.95 power	Minimum sample size for 0.95 power
Total MP Count								
All Blanks	Y	N	Wilcoxon-Mann-Whitney	Blank6-Blank1	-88.9	n/a	n/a	n/a
				Blank6-Blank2	-93.7			
				Blank6-Blank4	-95.3			
				Blank6-Blank5	-96.7			
September 2021	Y	Y	ANOVA	Tagish-Blank	142.5	0.98	5	4
				Tagish-Carmacks	100.0			
				Tagish-Dawson	129.4			
				Tagish-MarshLake	229.3			
				Tagish-Takhini	114.3			
January 2022	Y	Y	ANOVA	Tagish-Blank	2189.1	1	5	5
				Tagish-Carmacks	1684.0			
				Tagish-Dawson	1849.5			
				Tagish-MarshLake	942.2			
				Tagish-Takhini	85.8			
				Tahkini-Blank	921.9			
				Takhini-Carmacks	860.4			
				Takhini-Dawson	949.5			
				Takhini-MarshLake	461.1			
Temporal	Y	Y	ANOVA	MarshLake Sept - MarskLake Jan	-59.4	0.78	8	7
				Tagish Sept - Tagish Jan	-87.2	1	3	3
	Y	N	Wilcoxon-Mann-Whitney	Takhini Sept -Takhini Jan	-85.6	n/a	n/a	n/a
% of MP count in the >6.5≤10µm size category								
All Blanks	N	N	Wilcoxon-Mann-Whitney	None	n/a	n/a	n/a	n/a
September 2021	Y	Y	ANOVA	Dawson-Carmacks	125.4	0.86	7	6

Comparison	Distributions normal?	Variances equal?	Statistical test	Significant differences	% difference	Power (ANOVA only)	Minimum sample size for 0.95 power	Minimum sample size for 0.95 power
				Dawson-MarshLake	125.9			
				Dawson-Tagish	158.3			
				Dawson-Takhini	124.2			
January 2022	Y	N	Wilcoxon-Mann-Whitney	Tagish-Blank	-91.5	n/a	n/a	n/a
Temporal	Y	Y	ANOVA	Dawson Sept - Dawson Jan	97.8	0.99	5	4
				Tagish Sept - Tagish Jan	428.4	0.99	3	3