

2019 Adaptive Management Report for the Fish Habitat
Management System for Yukon Placer Mining

Appendix B: 2019 Aquatic Health Monitoring Report





Aquatic Health Monitoring Program 2019 Report

Fish Habitat Management System for Yukon Placer Mining

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Acronyms

AHM	Aquatic Health Monitoring Program
ANOVA	Analysis of Variance
BEAST	Benthic Assessment of Sediment
C	Chironomidae
CABIN	Canadian Aquatic Biomonitoring Network
CRI	Canadian Rivers Institute
CSAS	Canadian Science Advisory Secretariat
DFO	Fisheries and Oceans Canada
E	Ephemeroptera
ECCE	Environment and Climate Change Canada
FHMS	Fish Habitat Management System
IMG	Intergovernmental Management Group
P	Plecoptera
PERMANOVA	Permutational multivariate analysis of variance
RCA	Reference Condition Approach
SDI	Simpson's Diversity Index
SEI	Simpson's Evenness Index
T	Trichoptera
UNB	University of New Brunswick
YG	Yukon Government

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Executive Summary

2019 Aquatic Health Monitoring and Results

The Aquatic Health Monitoring (AHM) Program is intended to assess how effective the Fish Habitat Management System (FHMS) is in maintaining aquatic health for fish and fish habitat in placer mining watersheds. Information from aquatic health monitoring is then used to make changes to the FHMS, if necessary, through adaptive management.

In 2018, the Canadian Science Advisory Secretariat (CSAS) undertook an evaluation of the suitability of the Yukon Regional Reference Model and provided guidance regarding the adequacy of the reference condition approach (RCA) for informing regulatory decisions for placer mining in the Yukon. Recommendations from this review were used to inform the Intergovernmental Management Group (IMG) in planning a study redesign and as a result Fisheries and Oceans Canada and Yukon government carried out targeted studies in 2019 to begin to answer several key questions that will be used to inform a revised approach to aquatic health monitoring.

Consistent with the 2018 AHM report, results from the 2019 monitoring program were not compared to the 2013 Yukon Regional Reference Model. Instead, the interim assessment approach used in 2018 has been used for the 2019 samples, which relies on characterization of physical habitat, degree of placer mining development, evaluation of several invertebrate community metrics and a qualitative description of the invertebrate community in comparison to local reference sites. Detailed results and an overall site assessment for each site are provided in this report.

Watersheds sampled in 2019 included: Alsek River, Big Creek, Indian River, Klondike River, Mayo River, and White River. Site visits were carried out from July 18 to August 11, 2019. A total of 39 sites were sampled among the 6 watersheds. Sampling was carried out at 9 reference sites and 30 test sites. For sites that were sampled in 2019, all available years of data were included in the analysis to evaluate trends over time.

Several targeted studies were carried out as part of the 2019 AHM program to answer key questions to inform the study redesign. The targeted studies for 2019 were as follows:

- Replicate study to better characterize within site variability in benthic invertebrate community composition to evaluate the need to incorporate site replication into the study design.
- Analysis of substrate composition to evaluate the potential effects of sample size on variability of mean substrate diameter.
- In-situ sediment sampling to explore benthic invertebrate community response to selected sediment parameters.

Joint sampling with the Yukon Government Water Quality Objectives Monitoring Program to answer some key questions related to placer mining activity in Hunker Creek. Further analysis is planned for several of the targeted studies during the 2020/2021 Adaptive Management Cycle. Additional field data to support the targeted studies may also be required to answer key questions that were identified.

1 Introduction

The Fish Habitat Management System for Yukon Placer Mining (FHMS) is intended to balance the objectives of a sustainable Yukon placer mining industry with the conservation and protection of fish and fish habitat supporting fisheries. Within the FHMS there are three effects-monitoring programs and associated protocols including Aquatic Health, Water Quality Objectives and Economic Health. All three programs help to verify the effectiveness of the FHMS in meeting its objectives.

The Aquatic Health Monitoring (AHM) Program is intended to assess how effective the Fish Habitat Management System is in maintaining aquatic health for fish and fish habitat in placer mining watersheds. Information is then used to make changes to the FHMS, if necessary, through adaptive management. The annual AHM program is jointly delivered by Fisheries and Oceans Canada (DFO) and the Yukon Government (YG).

An implementation status review of the FHMS was carried out in 2015, which identified the need for additional methodology and data to enable monitors to determine relationships between the level of placer development and the condition of the watercourse. As a follow-up from these recommendations, the Canadian Science Advisory Secretariat (CSAS) undertook an evaluation of the suitability of the Yukon Regional Reference Model and provided guidance regarding the adequacy of RCA for informing regulatory decisions for placer mining in the Yukon. CSAS is a Secretariat within DFO that addresses scientific questions related to the conservation of marine and freshwater resources.

The CSAS Report identified some significant challenges with the current monitoring approach for evaluating the effects of placer activity on the aquatic health of fish and fish habitat. The report provided several recommendations for consideration to support the long term goal of developing a statistically defensible approach that meets the needs of the monitoring protocol within the adaptive management framework. As such, the Intergovernmental Management Group (IMG) is currently in the planning phase of a study redesign.

DFO and Yukon Government carried out targeted studies in 2019 to answer several key questions that will be used to inform a revised approach to aquatic health monitoring. An interim approach to evaluating aquatic health will continue to be used until such time as the new program is developed.

The 2019 Aquatic Health Monitoring report presents the results of the 2019 monitoring; however, as with the 2018 AHM reporting, this report does not provide the detailed analysis and comparisons to the regional reference model using RCA that was done in years prior to 2018.

2 Methods

2.1 Aquatic Health Monitoring Protocol

The Aquatic Health Monitoring (AHM) program is governed by the Aquatic Health Monitoring Protocol. The AHM Protocol describes the objectives and key questions to be addressed in monitoring, and guides sampling design (locations, timing, frequency, and methods employed). The 2019 field sampling program was carried out according to the AHM Protocol. Due to challenges identified with using the regional reference model comparisons, an interim approach to data analysis was used for the 2019 sampling results. A revised Aquatic Health Monitoring Protocol will be developed during the study redesign phase.

2.2 CABIN Sampling

Data gathered under the AHM program is housed, managed, and analyzed online through the [Canadian Aquatic Biomonitoring Network \(CABIN\)](#), a website administered and maintained by Environment and Climate Change Canada (ECCC) to support the collection, assessment, reporting and distribution of biological monitoring information across Canada. CABIN is an aquatic biomonitoring network for assessing the health of freshwater ecosystems in Canada. CABIN is based on the network of networks approach that promotes inter-agency collaboration and data-sharing to achieve consistent and comparable reporting on freshwater quality and aquatic ecosystem conditions in Canada. CABIN allows for a formalized scientific assessment using nationally comparable standards overseen by a National Science Team.

A training program for the application of CABIN protocols is provided by ECCC in partnership with the Canadian Rivers Institute (CRI) at the University of New Brunswick (UNB). Training ensures that practitioners of CABIN fieldwork, laboratory analysis, and data entry and interpretation are operating under a nationally standardized methodology. Certified personnel can then reduce the work required in building their own biomonitoring program, benefit from the collective research efforts by practitioners across Canada, and contribute consistent data to the national

database. In turn, this data can be shared for building more accurate and up-to-date assessment models.

2.3 Reference Condition Approach and Model Review

Given the inherent challenges identified in previous years with the reliability of the Yukon reference model, the Canadian Science Advisory Secretariat (CSAS) was asked to evaluate the suitability of the Reference Condition Approach (RCA) for informing regulatory decisions for placer mining in the Yukon.

The CSAS evaluation included analysis of spatial and temporal variation of invertebrate community data collected from 2004 to 2017. The following trends in variability were noted:

- Temporal variability was high and shifts among years were observed in total abundance and relative abundance of taxonomic groups
- Sample variability was observed to be more variable using abundance-based metrics compared to taxa-presence metrics
- Site variability was generally low
- Stream variability indicated that sites within streams are more similar based on family level richness and total abundance
- High degree of variability was observed at the regional scale and abundance appeared to be the primary driver in determining model groups in the Yukon reference model

Several potential areas that could introduce sampling error and bias were noted:

- Variation among sampler
- Lack of replication
- Appropriateness of sampling habitat
- Range of variability of habitat conditions

The full science report is published on the CSAS website and can be accessed at the link below:

- DFO. 2019. Evaluation of the reference condition approach for Yukon placer mining monitoring. DFO Can. Sci. Advis. Sec. Sci. Resp. 2018/053. (http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-RS/2018/2018_053-eng.html).

Several targeted studies were carried out during the 2019 field program to address some of the questions identified during the CSAS review. Findings from the targeted studies will be used to inform the study redesign process to develop a practical and statistically defensible approach that meets the needs of the aquatic health monitoring protocol within the adaptive management framework.

2.4 Annual Aquatic Health Monitoring

Study Area

The Aquatic Health Monitoring Protocol applies to 18 watersheds in Yukon where placer mining activities have historically occurred or are currently taking place including: Alsek River, Big Creek, Big Salmon River, Fortymile River, Indian River, Klondike River, Liard River, Mayo River, McQuesten River, Nisutlin River, Nordenskiold River, Pelly River, Sixty Mile River, Southern Lakes, Stewart River, White River, Yukon River North and Yukon River South. Placer mining occurs at different intensities among these watersheds and as such sampling is not carried out equally in each watershed.

Site Selection

Approximately 40 sites are sampled each year by Fisheries and Oceans Canada and Yukon Government. The selection of priority reference and test sites for sampling/re-sampling is based on several factors outlined in the Aquatic Health Monitoring Protocol and the Adaptive Management Framework. Due to challenges identified with using the regional reference model comparisons, a modified approach to site selection was used for 2019. A revised Aquatic Health Monitoring Protocol will be developed during the study redesign phase and may include updated site selection criteria.

Several of these factors are summarized in Table 1 below.

Table 1. Summary of Site Selection Criteria and Conditions that were Used to Select Sampling Sites for Annual Monitoring in 2019

Site Selection Criteria	Condition
Watershed Sensitivity Category	Equal representation of A and B.
Habitat Suitability	Equal representation of habitat suitability types.
New placer operations on reference/un-impacted streams	If new operations are active on previously un-impacted streams, these sites are considered a high priority for sampling.
Chronic compliance issues	These sites may not be sampled until issues are addressed because the sample results may not reflect the FHMS.
Known natural disturbance with influence on site (forest fire, landslide etc.)	If significant and can be tied to site/watershed may not re-sample. It may not be possible to differentiate natural impacts from placer impacts.
Long term trend sites	Some sites are sampled each year regardless of previous site assessment results in order to monitor long term trends and maintain continuity of sample years.
Reference sites	1 in 5 annual site visits are done on repeat reference sites to monitor natural variation.
Points of Interest	Sites of interest to Indigenous groups, industry, government agencies, non-governmental organizations may be a priority.

Field Sampling

Annual sampling is carried out over a three-week period beginning no earlier than the second week of July and extending no later than the start of the second week of August of each year. Repeat site visits are sampled at the same location each visit while new site locations are chosen based on ease of access as well as representation of the sample stream. Data collected during site visits includes basic water chemistry (YSI Probe: pH, temperature, conductivity, dissolved oxygen), detailed water chemistry (laboratory analysis: nutrients, physical and chemical properties and metals), environmental variables (stream width, depth, slope and velocity, riparian vegetation and site characteristics), stream substrate characterisation (100 pebble count) and invertebrate community samples using a kicknet. All information is recorded on a standard field form and several standardized photos are taken of each site while on the ground and from the air, when possible. More information regarding field sampling procedures can be found in the CABIN field sampling protocol



(<http://www.ec.gc.ca/rcba-cabin/default.asp?lang=en&n=74876ADD-1>) as well as in the AHM Protocol.

Invertebrate Classification

All benthic invertebrate samples are classified by a certified taxonomist. Each organization and laboratory participating in the CABIN program is required to implement stringent quality assurance and quality control procedures. For more information regarding laboratory methods see documentation on the CABIN website (<http://www.ec.gc.ca/rcba-cabin/default.asp?lang=en&n=74876ADD-1>).

2.5 Targeted Studies

In order to explore concerns identified in the CSAS analysis, several targeted studies were carried out as part of the 2019 AHM program.

Replicate Study

A study to evaluate variability in replicates of benthic invertebrate community samples was carried out to answer the following key question:

- *Should AHM protocols incorporate replication into the study design?*

Field work included collection of three replicate invertebrate samples from consecutive riffles at 20 sites. Standard three minute travelling 500µm kick net samples were collected in successive riffle habitats moving in an upstream direction.

For each site, summary statistics (e.g., mean, minimum, maximum, standard deviation, coefficient of variation) were calculated for total abundance, richness, SDI, and SEI. Total abundance, richness, SDI, and SEI values for each replicate sample were also shown on dot plots, grouped by watershed.

Benthic invertebrate community structure data were summarized using non-multidimensional scaling (nMDS). The nMDS procedure reduces the abundance data of the taxonomic samples to ideally two dimensions, allowing differences among sites and replicates to be identified. Prior to producing the nMDS, the family-level benthic invertebrate count data were square-root transformed and a Bray-Curtis resemblance

matrix was generated. The matrix data were plotted in a two-dimensional nMDS whereby the relative position of sites were determined in terms of taxa abundance. Goodness-of-fit of the data within the two-dimensional ordination was determined by the stress value, with lower stress values indicating a greater goodness-of-fit. A stress value of <0.20 was considered acceptable.

Analysis of substrate composition methods

An analysis of substrate composition methods was carried out to answer the following key questions:

- *How comparable are substrate composition values between sample sizes of 10 and 100 substrate measurements?*
- *What is the recommended sample size to provide an accurate representation of in-stream substrate composition?*

Historically, the AHM program used a modified substrate sampling method that relied on a basic characterization of stream substrate composition by measuring the intermediate axis of ten randomly selected rocks from the stream bed and one measurement of embeddedness. In 2019, standard CABIN protocols were followed to determine substrate composition using a 100-pebble count. Rocks were selected by conducting a random walk through the sampled area and stopping every couple of steps to select the closest rock. The intermediate axis of 100 rocks were measured using a ruler. Estimates of embeddedness were provided for every ten rocks measured.

Given the variability in substrate composition within and among sites monitored by the AHM program, the value of increasing substrate sample sizes to 100 measurements was assessed. Incorporating 100 measurements into assessment of substrate composition is a more standard sample number according to accepted sampling protocols (e.g, CABIN).

Data analyses were carried out to provide a comparison of the estimated mean substrate values between sample sizes of 10 and 100 substrate measurements. The study was used to better understand how variation in mean substrate diameter

changed with increasing sample size and to provide a recommendation for the AHM sampling protocols moving forward.

In-situ sediment sampling

Collection of in-situ sediment samples was carried out to answer the following key questions:

- *How does the benthic invertebrate community respond to varying sediment parameters?*

To further characterize substrate conditions at each site, in-stream sediment samples were collected in 2019 to provide supporting information for the invertebrate community analysis and to evaluate potential invertebrate community responses to varying sediment conditions.

Representative sediment samples were collected from three locations within the sample area using a metal spoon. Samples were homogenized and approximately 300-550g was transferred to a sediment bag for storage in a cool dark environment until submission to the analytical laboratory. Additional data was recorded including depth of easily penetrable sediments, depth of sediment sampled, sediment texture and colour, as well as other descriptive sample characteristics. Samples were submitted to ALS Environmental Laboratories for analysis of particle size, total organic carbon, total nitrogen, and moisture.

Sediment parameters analyzed in the laboratory were used to support the interpretation of the invertebrate community results. Total abundance, richness, % EPT, and % C were plotted against the sediment parameters to visually explore potential relationships.

Hunker Creek Joint Sampling

Intensive sampling in Hunker Creek was done to accommodate a joint sampling initiative undertaken with the Yukon Government Water Quality Objectives Monitoring Program to answer some key questions related to placer mining activity in Hunker Creek. Sampling was carried out at ten locations along the length of Hunker Creek. Sites were selected to capture a range of sediment conditions and varying degrees of placer mining activity. Where possible, sites were located immediately downstream from areas of known sediment inputs (e.g., Gold Bottom Creek, Last Chance Creek). By sampling a range of sediment conditions, the data can be used to explore the relationship between sediment inputs and benthic invertebrate communities and to evaluate the potential for developing a sediment sensitivity index specific to placer mining activity. Exploratory studies such as these are recommended.

Ten sites were sampled along the length of Hunker Creek to further characterize sediment related impacts in this watershed. Standard CABIN sampling and sediment sampling was carried out at each location. Extensive water quality sampling was also carried out in Hunker Creek in 2019 and reported on in the 2019 Water Quality Objective monitoring program report.

2.6 Data Analysis

Several challenges have been identified with using the applicable regional reference model developed by CABIN for the Yukon region (CSAS 2019). Previous comparisons of benthic invertebrate community using the BEAST (Benthic Assessment of Sediment) assessment provided by CABIN yielded inconsistent site assessment results and an inability to link divergence from the reference condition to anthropogenic stresses from placer mining activity.

For this reason, results from the 2019 monitoring program were not compared to the regional reference model. An interim assessment approach has been used for the 2019 samples, which relies on characterization of physical habitat, degree of placer mining development, evaluation of several invertebrate community metrics and a qualitative description of the invertebrate community in comparison to multiple local reference sites.

All data collected in 2019 were entered into the Canadian Aquatic Biomonitoring Network (CABIN) online database.

Reference Site Characterization

To support the 2019 assessment, habitat and community data from nine reference sites were provided for comparison. Habitat characteristics measured as part of the CABIN sampling protocols are presented to provide an indication of the habitat similarities between reference and test sites. Using multiple reference locations in comparable stream habitats serves to bound the variability inherent in the streams. Summary statistics, including mean, standard deviation, minimum, and maximum, were calculated for metrics at selected reference sites.

The use of multiple reference locations for comparison will be further explored and expanded during the study redesign phase.

Habitat Characterization

Environmental variables can provide explanatory information for data interpretation. Stream habitat characteristics were measured during field sampling and are used to inform potential differences observed in the stream invertebrate communities that could be due to environmental factors rather than anthropogenic influences.

A habitat assessment was conducted at each site following CABIN field sampling protocols. In addition to the field habitat assessment, several environmental variables were determined from site maps, including altitude and stream order.

Placer Mining Development Assessment

The degree of placer mining at each site was estimated using the following approach. When possible during 2016 to 2019 field sampling, streams were flown upstream of sampling locations and photographs were taken along with notes about placer activity. Based on the information collected, the proximity of recent (<2 years) placer mining development as well as older (>2 years) placer mining development was assessed.

The intensity of placer mining development (low, moderate, high) was estimated from aerial photographs taken during field sampling, as well as from aerial photographs available on the Yukon Placer Watershed Atlas. The intensity of placer mining presented in this report is based on a visual estimate of placer mining development within the watershed upstream of each sample location and may not reflect actual placer mining activities that would be expected to affect aquatic health. In the future, additional sources of information will be incorporated from Yukon Government databases, mining inspection reports, and GIS mapping exercises.

To support the evaluation of placer mining development, a pilot study was carried out by DFO's Science branch in collaboration with Wilfred Laurier University to characterize and quantify placer disturbances using image processing techniques and modelling with high resolution satellite image data. The goal of the study was to develop a computer based model that could be used to detect placer mining activity using satellite imagery. High resolution imagery from the Alsek Watershed was used to create training and reference datasets for model development and validation. Two modelling approaches were compared to evaluate the accuracy of the different approaches and to gain insight into the feasibility of using these tools to support the aquatic health monitoring program. Based on the results of the pilot study, placer mining activity in the Alsek Watershed could be detected with reasonable accuracy using both modelling approaches. Further investigation is required to evaluate whether this approach could be applied to a broader spatial scale across all Yukon watersheds and whether this method would have the ability to detect smaller scale changes that may be relevant to analysis of aquatic health monitoring data.

Benthic Invertebrate Community Composition

The following variables were calculated to characterize benthic invertebrate communities:

- Community metrics including total abundance, family level taxonomic richness, Simpson's Evenness Index (SEI), Simpson's Diversity Index (SDI), % Chironomidae (C), % Ephemeroptera (E), % Plecoptera (P), % EPT (Ephemeroptera, Plecoptera, Trichoptera) individuals

- Relative abundance of major taxonomic groups (e.g., Ephemeroptera, Plecoptera, Trichoptera, Diptera)

Invertebrate community metrics were calculated using the on-line CABIN tools based on family-level taxonomic identification.

The metrics are described as follows:

- Total abundance – absolute number of individuals standardized for each kick per CABIN sampling protocols
- Family level taxonomic richness – total number of taxonomic families identified at a site
- Simpson's Diversity Index – measures the proportional distribution of organisms in the community, which takes into account the number of species present and how evenly the abundance is distributed among these taxa. Values range from 0 to 1; values closer to 1 indicate that a higher diversity of taxa compared to sites with values closer to 0.
- Simpson's Evenness Index – is a measure of how evenly the abundance is distributed among the taxa present at a site. Values range from 0 to 1; values closer to 1 indicate equal numbers of all taxa present in a sample and values closer to zero indicate a high degree of dominance by one or a few organisms.

Total abundance at each site was presented graphically to provide a visual comparison of trends in abundance over time. Replicates collected at sites in 2019 were presented as mean values (\pm standard deviation [SD]). Relative abundances of major taxonomic groups were also summarized and presented graphically to provide a visual representation of broad level taxonomic composition and total invertebrate abundance at each site.

3 Results – 2019 Aquatic Health

Health

3.1 Study Area

Watersheds sampled in 2019 included: Alsek River, Big Creek, Indian River, Klondike River, Mayo River, and White River (Figure 1). Maps showing sampling sites in each watershed are provided in Appendix B1.

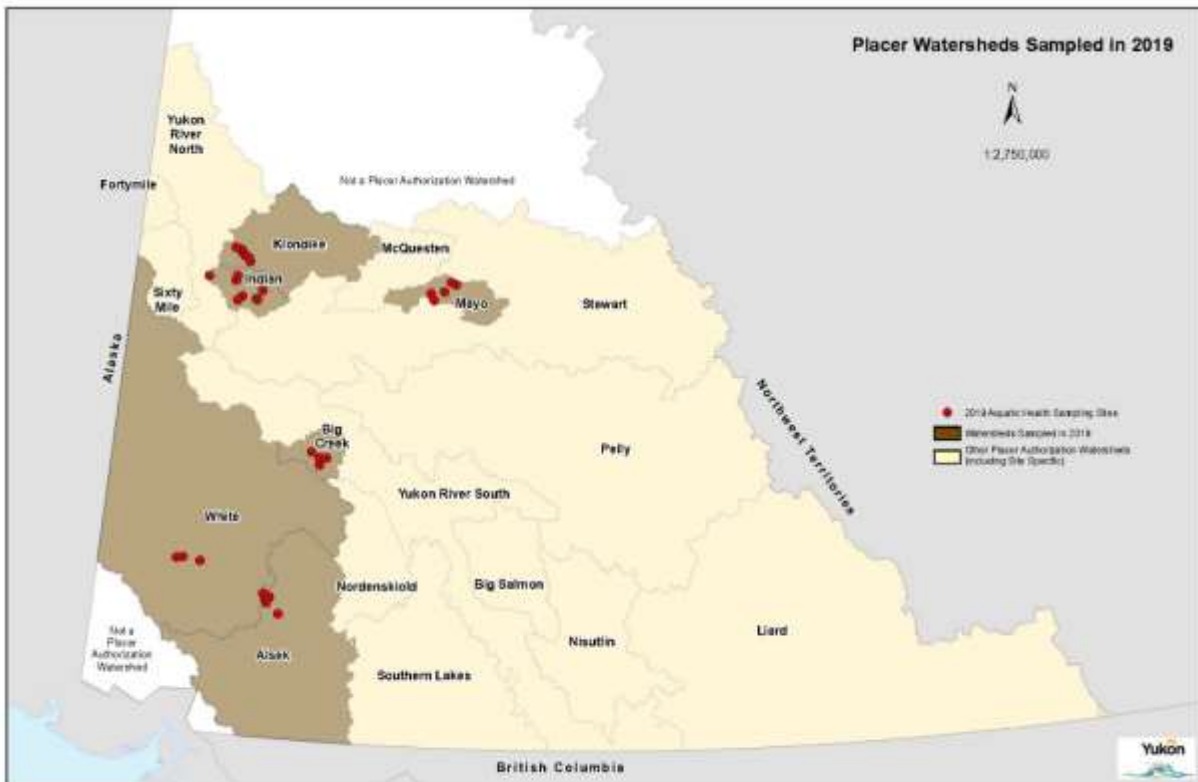


Figure 1. Placer Watersheds and the 2019 Aquatic Health Monitoring Sampling Sites

3.2 Sample Sites

Site visits were carried out from July 18 to August 11, 2019. A total of 39 sites were sampled among 6 watersheds (Table 2). Sampling was carried out at 9 reference sites

and 30 test sites. For sites that were sampled in 2019, all available years of data were included in the analysis (Table 3).

Table 2. Number of Sites Sampled in 2019 by Watershed

Watershed	Reference	Test	Grand Total
Alsek River	3	4	7
Big Creek	1	4	5
Indian River	2	7	9
Klondike River	0	10	10
Mayo River	2	3	5
White River	1	2	3
Total	9	30	39

Table 3. Summary of Annual Aquatic Health Monitoring Conducted at Sites Sampled in 2019

Watershed	Site	Watercourse Name	Sample Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alesk River	YPS-441	4th of July Creek	Reference						X								X	X
	YPS-618	Larose Creek	Reference															X
	YPS-445	McKinley Creek	Reference						X						X	X	X	X
	YPS-585	Larose Creek	Test												X	X		X
	YPS-617	4th of July Creek	Test															X
	YPS-442	4th of July Creek (lower)	Test						X						X	X	X	X
	YPS-597	Jarvis River	Test													X	X	X
Big Creek	YPS-410	Bow Creek	Reference					X							X			X
	YPS-577	Big Creek	Test											X	X	X		X
	YPS-411	Mechanic Creek	Test					X					X	X				X
	YPS-412	Big Creek	Test					X					X	X		X		X
	YPS-414	Seymour Creek	Test					X					X	X				X
Indian River	YPS-482	Wounded Moose Creek	Reference							X		X			X		X	X
	YPS-480	Montana Creek	Reference							X		X					X	X
	YPS-103	Gold Run Creek	Test		X											X		X
	YPS-481	Australia Creek	Test							X		X	X		X			X
	YPS-610	Wounded Moose Creek	Test															X
	YPS-606	Montana Creek	Test														X	X
	YPS-615	Quartz Creek	Test															X
	YPS-546	Quartz Creek	Test										X			X	X	X
YPS-090	Indian Rive at Water Resources Station	Test		X			X					X	X		X	X	X	X
Klondike River	YPS-078	Hunker Creek upstream of Ontario Creek	Test		X		X		X		X	X			X		X	X
	YPS-611	Hunker Creek	Test															X
	YPS-079	Hunker Creek upstream of Gold Bottom Creek	Test		X													X
	YPS-080	Hunker Creek downstream of Gold Bottom Creek	Test		X													X



	YPS-614	Hunker Creek	Test																X
	YPS-051	Hunker Creek downstream of Hester Creek inflow	Test	X	X														X
	YPS-621	Hunker Creek	Test																X
	YPS-613	Hunker Creek	Test																X
	YPS-612	Hunker Creek	Test																X
	YPS-544 ^a	Hunker Creek	Test		X							X	X	X	X	X	X	X	X
Mayo River	YPS-619	Granite Creek	Reference																X
	YPS-620	Davidson Creek	Reference																X
	YPS-574	Granite Creek	Test										X	X	X	X	X	X	X
	YPS-053	Keystone Creek inflow to Mayo Lake	Test	X														X	X
	YPS-573	Davidson Creek	Test										X					X	X
White River	YPS-591	Unnamed Tributary to Wade Creek	Reference											X					X
	YPS-507	Wade Creek	Test						X										X
	YPS-506	Burwash Creek	Test						X				X						X

Notes:

a. formerly YPS-077 – moved upstream and renamed in 2013 due to dry channel at original site location.



3.3 2019 Results by Watershed

The results of the reference site characterization, test site habitat characteristics, degree of placer mining development by watershed, and invertebrate community composition are provided below. Information for the current year as well as previous years were analysed to provide an indication of inter-annual variability within a test site. Comparison to reference sites are also provided where appropriate.

Site description, map location, site photos, and metrics are provided for each site in Appendix B2 – CABIN Summary Reports for 2019 Sampling Sites. Raw data for all aquatic monitoring sites can be found through the CABIN open data portal (<https://open.canada.ca/data/en/dataset/13564ca4-e330-40a5-9521-bfb1be767147>).

Reference Sites

Habitat and invertebrate community data for reference sites sampled in each watershed are provided below. Direct comparisons of reference sites to test sites are not possible at this time but the local reference site data can be used to characterize the natural variability in invertebrate community composition under reference conditions. Data for reference sites that were sampled in 2019 and historical data for these locations are provided. A total of 25 sampling events from nine reference sites were included to support the 2019 analysis. This information can be used to provide useful context to support the evaluation of potential effects of placer mining at the test sites.

Habitat Characterization

Habitat characteristics measured at reference sites are provided in Appendix B3, Table 3-1. Stream orders vary among the reference sites; however, no reference sites in large river systems were sampled. Five of the reference sites sampled in 2019 are in more mature reaches (i.e., third and fourth order), located below 1,000 m altitude with stream slopes generally less than 0.25%. Four of the reference sites are in less mature reaches (i.e., first and second order), located above 1,000 m altitude with stream slopes generally greater than 0.3%.

Associated with the variability in stream order, other habitat characteristics such as stream width, depth, and velocity were likewise variable among reference sites (Table 3-1). Dominant substrate type was generally dominated by pebble or cobble substrate. Embeddedness of coarse substrate at the sites ranged from unembedded to 50% embedded.

Periphyton coverage varied among sites and occasionally among years for a given site, but generally ranged from <0.5 to 5 mm (Table 3-1). Periphyton coverage was 5-20 mm thick at YPS-620 (Davidson Creek) in 2019. Canopy coverage was generally 1–50%, with the exception of YPS-480 (Montana Creek) and YPS-619 (Granite Creek) which exhibited greater than 50% canopy coverage.

Habitat characteristics at reference sites generally encompassed the same type of habitat variability observed at test sites with the exception of large river systems where a comparable reference site was not sampled.

Benthic Invertebrate Community Composition

Invertebrate community metrics measured at reference sites are provided in Table 4. Total abundance at reference sites is shown on Figure 2 and relative abundance of major taxonomic groups are shown on Figure 3.

Abundance and richness were variable at reference sites (Table 4). Abundance ranged from 45 to 10,047 individuals with a mean value of 3,262. Compared to other reference sites and years, total abundance was notably lower at YPS-445 (McKinley Creek) in 2016 and greater at YPS-619 (Granite Creek) in 2019 (Figure 2). More analysis is needed to determine why total abundance was relatively high at all 2019 reference sites. Family-level richness ranged from 8 to 18.

The average SDI of 0.69 suggests that reference site communities are reasonably diverse, and the average SEI of 0.30 indicates generally low evenness among sites (Table 4).

Invertebrate communities at reference sites were generally dominated by the Orders Ephemeroptera (mayflies) and Plecoptera (stoneflies) and the family Chironomidae (non-biting midges) (Table 4, Figure 3). In 2019, the relative abundance of chironomids

was notably high (i.e., greater than approximately 50%) at YPS-410 (Bow Creek), YPS-480 (Montana Creek), YPS-619 (Granite Creek), and YPS-620 (Davidson Creek). A large relative abundance of the family Simuliidae (black flies, Order Diptera) was identified at YPS-482 (Wounded Moose Creek) in 2011 and 2019, and at YPS-480 (Montana Creek) in 2011, 2013, and 2018, which are both located in the Indian River Watershed.



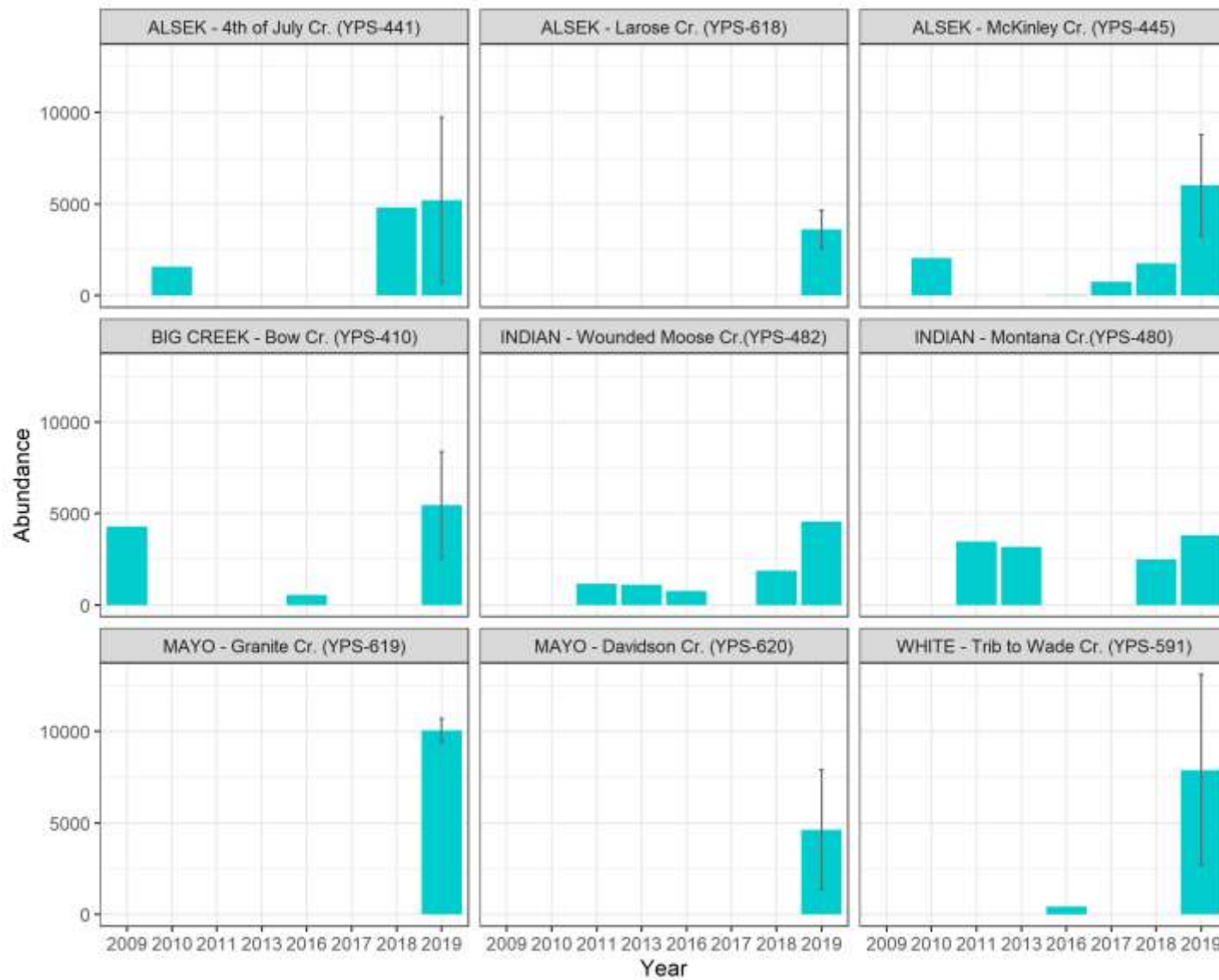
Table 4. Benthic Invertebrate Community Metrics at Reference Sites

Watershed	Creek Name	Site	Year	Total Abund.	Family Rich.	SDI	SEI	% C	% E	% P	% T	% EPT
Alek River	4th of July Creek	YPS-441	2010	1,562	15	0.84	0.41	31	24	26	1	50
			2018	4,814	12	0.81	0.43	28	40	7	1	48
			2019 ^a	5,206	13	0.74	0.30	36	44	11	1	56
	Larose Creek	YPS-618	2019 ^a	3,608	8	0.77	0.54	29	17	40	0	57
	McKinley Creek	YPS-445	2010	2,060	18	0.80	0.27	33	52	3	2	56
			2016	45	11	0.79	0.42	7	67	4	13	84
			2017	746	17	0.82	0.33	9	63	2	2	68
			2018	1,745	13	0.79	0.36	17	57	4	3	64
			2019 ^a	6,022	13	0.60	0.20	5	59	1	1	61
Big Creek	Bow Creek	YPS-410	2009	4,300	13	0.79	0.36	31	37	6	0	43
			2016	559	13	0.73	0.28	5	57	8	27	92
			2019 ^a	5,464	13	0.64	0.21	51	8	11	0	19
Indian River	Wounded Moose Creek	YPS-482	2011	1,166	12	0.71	0.29	8	27	5	1	33
			2013	1,118	15	0.72	0.24	21	49	5	1	56
			2016	771	14	0.69	0.23	3	76	1	2	80
			2018	1,878	9	0.40	0.18	10	77	2	2	80
			2019	4,543	12	0.74	0.32	36	20	3	0	23
	Montana Creek	YPS-480	2011	3,478	9	0.64	0.31	16	10	14	0	24
			2013	3,180	10	0.46	0.19	7	3	16	1	20
			2018	2,487	8	0.67	0.38	13	42	6	0	49
2019			3,817	12	0.70	0.27	47	12	22	0	34	
Mayo River	Granite Creek	YPS-619	2019 ^a	10,047	15	0.61	0.17	60	17	13	1	31
	Davidson Creek	YPS-620	2019 ^a	4,628	11	0.46	0.17	70	4	1	1	6
White River	Unnamed Tributary to Wade Creek	YPS-591	2016	428	13	0.77	0.34	15	60	16	1	77
			2019 ^a	7,888	9	0.57	0.25	13	70	5	0	75
Summary Statistics	Arithmetic Mean			3,262	12	0.69	0.30	24	40	9	2	51
	Standard Deviation			2,479	3	0.12	0.09	18	24	9	6	23
	Minimum			45	8	0.40	0.17	3	3	1	0	6
	Maximum			10,047	18	0.84	0.54	70	77	40	27	92

Notes: Abund. = Abundance; Rich. = Richness; SDI = Simpson's Diversity Index; SEI = Simpson's Evenness Index; C = Chironomidae (non-biting midges); E = Ephemeroptera (mayflies); P = Plecoptera (stoneflies); T = Trichoptera (caddisflies)

a. 2019 metric values for sites in Alek River, Big Creek, Mayo River, and White River watersheds are based on the average of three replicate samples.





Note: error bars show standard deviation from triplicate samples collected in 2019

Figure 2. Total Abundance at Reference Sites Sampled from 2009 to 2019

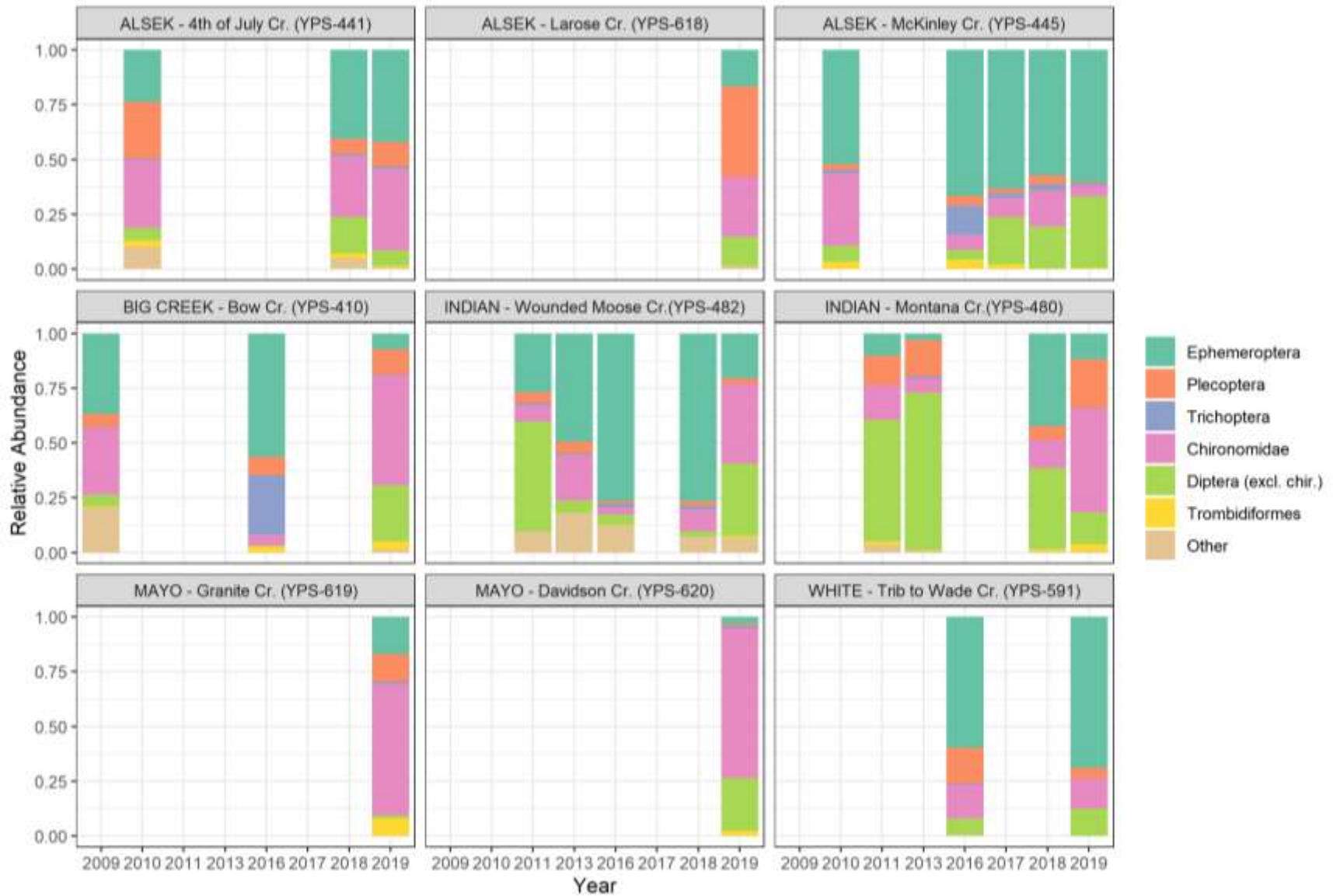


Figure 3. Relative Abundance of Major Taxonomic Groups Identified at Reference Sites Sampled from 2009 to 2019

Alsek River Watershed Test Sites

The following section presents the site assessment results for the four sites sampled in the Alsek River Watershed. The number of annual sampling events per site ranged from one year of data (i.e., 2019) at YPS-617 (4th of July Creek) to five years of data at YPS-442 (4th of July Creek [lower]). The test site evaluation was focused on the 2019 sampling results.

Habitat Characterization

Habitat characteristics measured at the four sites in the Alsek River Watershed are provided in Appendix B3, Table 3-2. One site, YPS-585 (Larose Creek), is located in a third order reach at higher altitude and steeper slope than the other three sites, which are located in fourth order reaches. Wetted width ranged from 4 to 9.5 m and average velocity ranged from 0.3 to 1.18 m/s, with no consistent trends observed among sites and years. Average depth ranged from 11.8 to 46 cm and were generally lower in more recent years (i.e., 2018 and 2019) compared to past years. Stream substrate was generally dominated by small and large pebbles, with embeddedness ranging from 0% to 50%.

Degree of Placer Mining

Placer mining development upstream of sites sampled in the Alsek Watershed in 2019 was estimated as ranging from no development to moderate (

Table 5).



Table 5. Degree of Placer Mining Development at Sites Sampled in the Alsek River Watershed

Name	Site	Degree of Placer Mining (low, mod, high)	Upstream Distance to Active (within 2 years) Mining Development (km)	Upstream Distance to old (older than 2 years) Mining Development (km)	Comments
Larose Creek	YPS-585	Mod-Low	0.3	0.3	Most of the mining in this watershed has occurred within the last five years.
4th of July Creek	YPS-617	Moderate	2.5	0.3	Fords 200 m upstream
4th of July Creek (lower)	YPS-442	Mod-Low	4.0	7.5	Active fords 200 m to 5 km upstream.
Jarvis River	YPS-597	Mod-Low	10.0	6.5	Ford 2 km upstream

Benthic Invertebrate Community Composition

Benthic invertebrate community metrics for the Alsek River Watershed sites are provided in Table 6. Total abundance is shown Figure 4 and relative abundance of major taxonomic groups is shown on Figure 5.

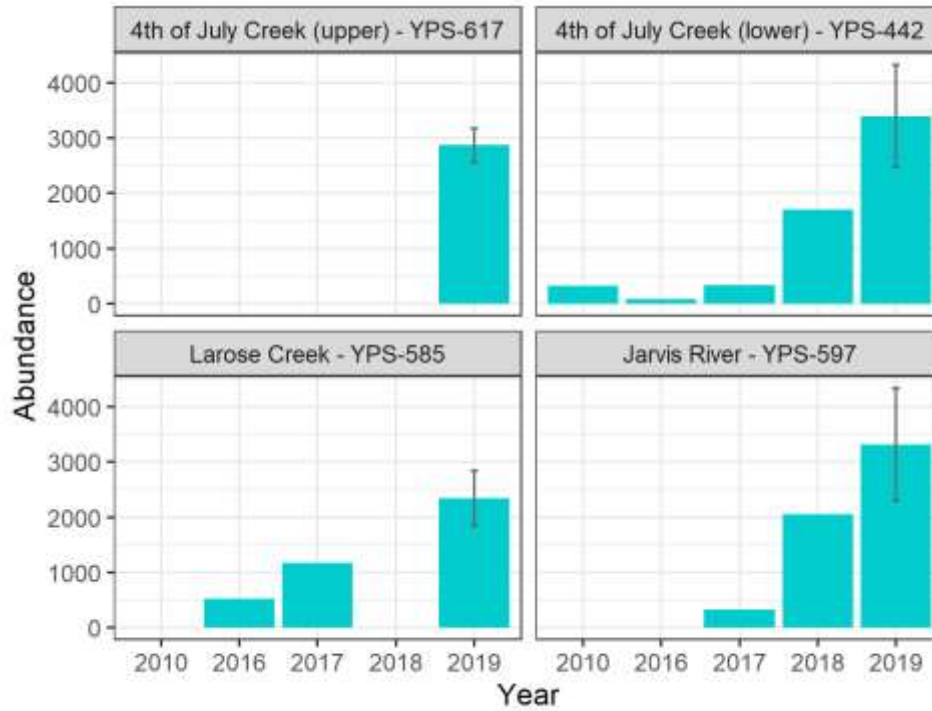
Table 6. Benthic Invertebrate Community Metrics in the Alsek River Watershed

Watercourse Name	Site	Year	Total Abundance	Family Richness	SDI	SEI	% C	% E	% P	% T	% EPT
Larose Creek	YPS-585	2016	521	15	0.86	0.48	14	37	18	1	56
		2017	1170	13	0.73	0.28	14	71	5	0	76
		2019 ^a	2342	10	0.68	0.32	43	15	4	0	19
4th of July Creek	YPS-617	2019 ^a	2870	14	0.78	0.33	15	67	13	1	81
4th of July Creek (lower)	YPS-442	2010	327	17	0.83	0.34	24	46	15	1	62
		2016	82	10	0.80	0.51	9	48	32	4	83
		2017	338	17	0.87	0.45	9	45	25	1	71
		2018	1705	11	0.73	0.33	25	53	6	0	60
		2019 ^a	3395	11	0.76	0.38	11	75	5	0	80
Jarvis River	YPS-597	2017	326	17	0.77	0.26	10	67	10	1	79
		2018	2056	13	0.74	0.29	31	51	10	0	61
		2019 ^a	3315	14	0.80	0.36	11	69	4	1	73

Notes: SDI = Simpson’s Diversity Index; SEI = Simpson’s Evenness Index; C = Chironomidae (non-biting midges); E = Ephemeroptera (mayflies); P = Plecoptera (stoneflies); T = Trichoptera (caddisflies)

a. 2019 metric values for the sites are based on the average of three replicate samples.





Note: error bars show standard deviation from triplicate samples collected in 2019

Figure 4. Total Abundance of Benthic Invertebrates at Test Sites in the Alsek Watershed

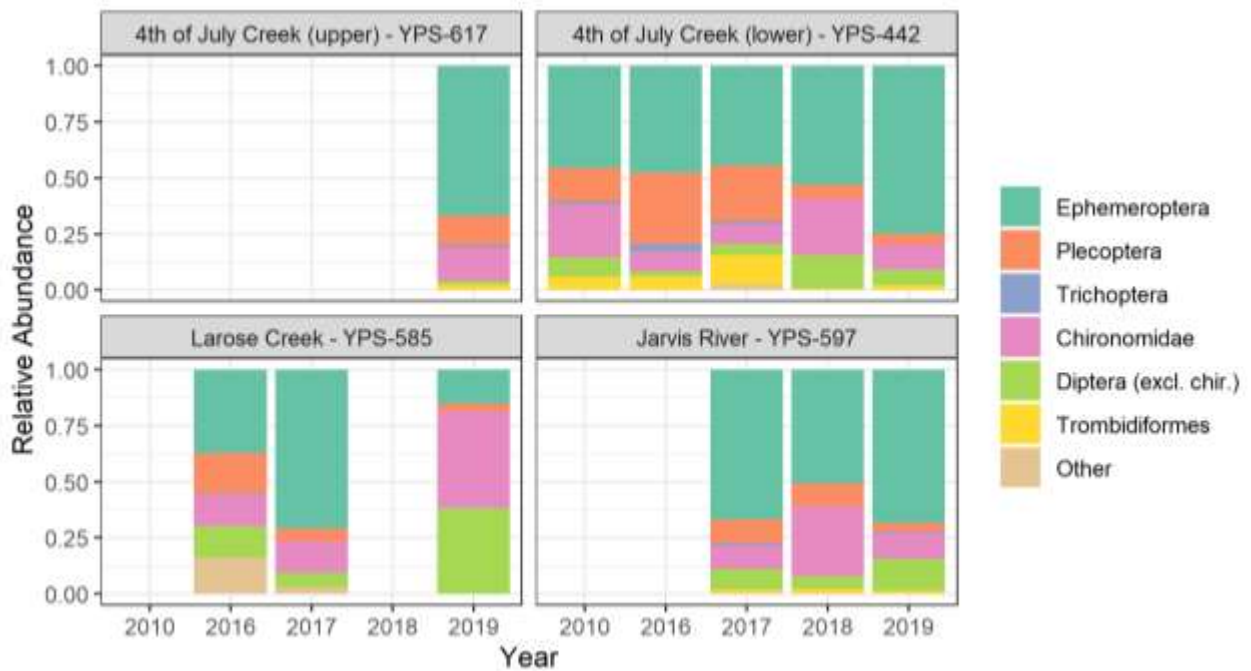


Figure 5. Relative Abundance of Major Taxonomic Groups at Test Sites in the Alsek Watershed



Total abundance in 2019 was similar among each of the Alsek River Watershed test sites, which were greater than abundances observed in previous years (Figure 4). At a given site, family-level richness in 2019 was typically within the range of values observed in previous years and within the range of normal variability observed at reference sites (Table 6). The SDI and SEI values at the Alsek River Watershed sites were similar or greater than the average values observed at the reference sites.

Invertebrate communities at the test sites were generally dominated by Ephemeroptera, Plecoptera, and Chironomidae (Table 6, Figure 5), which was similar to observations at reference sites. The invertebrate community at YPS-585 (Larose Creek) in 2019 was dominated by Diptera, with greater relative abundance of Chironomidae and Simuliidae and lower relative abundance of Ephemeroptera than observed at other test sites. The reference site on Larose Creek (YPS-618) also exhibited a low relative abundance of Ephemeroptera in 2019 but there was a greater relative abundance of Plecoptera rather than Diptera (Table 4). However, communities composed of greater relative abundance of Diptera have been observed during several years at reference sites.

Big Creek Watershed Test Sites

The following section presents the site assessment results for the four sites sampled in the Big Creek Watershed. Four years of data were available for YPS-577 (Big Creek), YPS-412 (Mechanic Creek), and YPS-414 (Seymour Creek), and five years of data were available for YPS-412 (Big Creek). The test site evaluation was focused on the 2019 sampling results.

Habitat Characterization

Habitat characteristics measured at the four sites in the Big Creek Watershed are provided in Appendix B3, Table 3-3. One site, YPS-411 (Mechanic Creek), is located in a second order reach and exhibited a steeper slope than the other three sites, which are located in fourth and fifth order reaches. Associated with the difference in stream order, YPS-411 was smaller in terms of wetted width, average depth, and average velocity compared to the other sites. Wetted width ranged from 1.2 to 24.5 m and average velocity ranged from 0.07 to 1.15 m/s, with no consistent trends observed among

years. Average depth ranged from 4.8 to 82.8 cm and was generally lower in 2019 compared to previous years. Stream substrate was generally dominated by large pebbles and small cobbles, with embeddedness ranging from 0% to 50%.

Degree of Placer Mining

Placer mining development upstream of sites sampled in the Big Creek Watershed in 2019 was estimated as ranging from no development to high (Table 7).

Table 7. Degree of Placer Mining Development at Sites Sampled in the Big Creek Watershed

Name	Site	Degree of Placer Mining (low, mod, high)	Upstream Distance to Active (within 2 years) Mining Development (km)	Upstream Distance to old (older than 2 years) Mining Development (km)	Comments
Big Creek	YPS-577	None	None	None	Road runs along left bank of Big Creek upstream of site.
Mechanic Creek	YPS-411	High	0.9	0.1	Entire drainage heavily impacted by historic and current mining.
Big Creek	YPS-412	Mod-low	2.5	3.5	Located 2.5 km downstream of Mechanic Creek.
Seymour Creek	YPS-414	Moderate	5.0	2.0	Small older tailings pile at 2.0 km.

Benthic Invertebrate Community Composition

Benthic invertebrate community metrics for the Big Creek Watershed sites are provided in Table 8. Total abundance is shown on Figure 6 and relative abundance of major taxonomic groups is shown on Figure 7.

Table 8. Benthic Invertebrate Community Metrics in the Big Creek Watershed

Watercourse Name	Site	Year	Total Abundance	Family Richness	SDI	SEI	% C	% E	% P	% T	% EPT
Big Creek	YPS-577	2015	1,574	14	0.76	0.30	26	53	6	5	65
		2016	281	16	0.83	0.37	6	63	3	19	85
		2017	514	17	0.78	0.27	37	40	4	3	47
		2019 ^a	3,685	16	0.74	0.25	24	58	5	1	64
Mechanic Creek	YPS-411	2009	867	14	0.51	0.15	68	10	13	1	24
		2014	254	12	0.70	0.28	37	2	1	1	4
		2015	281	14	0.62	0.19	59	7	2	2	11
		2019 ^a	392	13	0.72	0.30	44	13	14	0	28
Big Creek	YPS-412	2009	4,988	11	0.75	0.36	19	65	3	1	69

		2014	47	11	0.84	0.58	21	21	28	4	53
		2015	1,260	12	0.73	0.31	6	77	10	4	90
		2017	1,512	14	0.82	0.41	25	45	1	8	54
		2019 ^a	3,529	13	0.71	0.27	35	44	5	1	50
Seymour Creek	YPS-414	2009	2,438	19	0.83	0.32	21	50	6	1	57
		2014	476	15	0.66	0.19	8	71	12	2	85
		2015	1,580	17	0.83	0.34	13	66	7	6	79
		2019 ^a	3,265	13	0.72	0.28	36	54	5	1	59

Notes: SDI = Simpson's Diversity Index; SEI = Simpson's Evenness Index; C = Chironomidae (non-biting midges); E = Ephemeroptera (mayflies); P = Plecoptera (stoneflies); T = Trichoptera (caddisflies)

a. 2019 metric values for the sites are based on the average of three replicate samples.

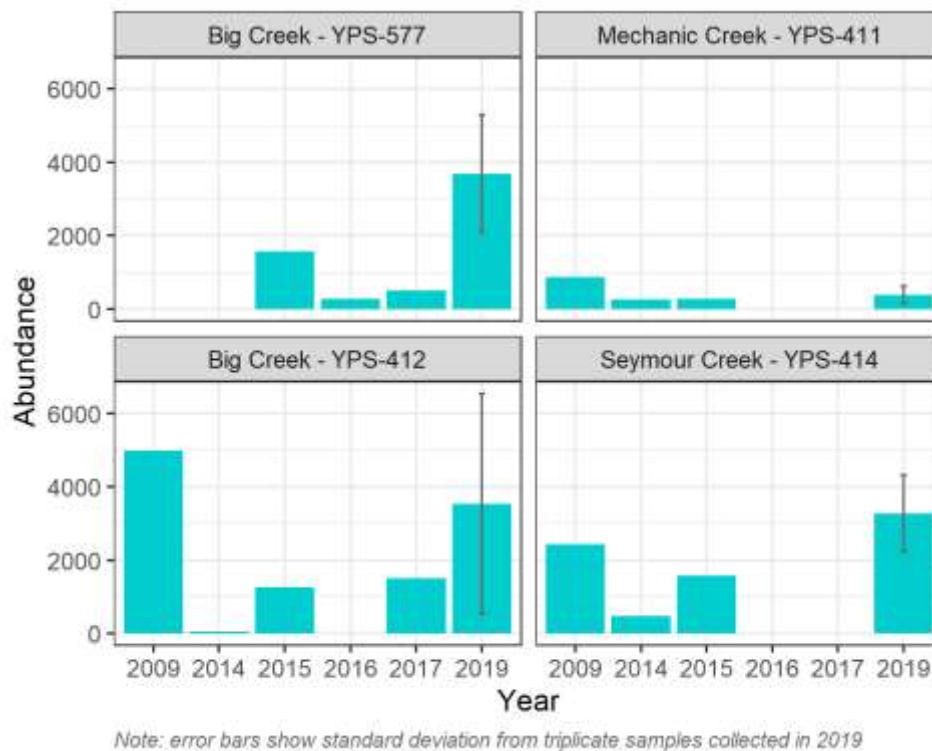


Figure 6. Total Abundance of Benthic Invertebrates at Test Sites in the Big Creek Watershed

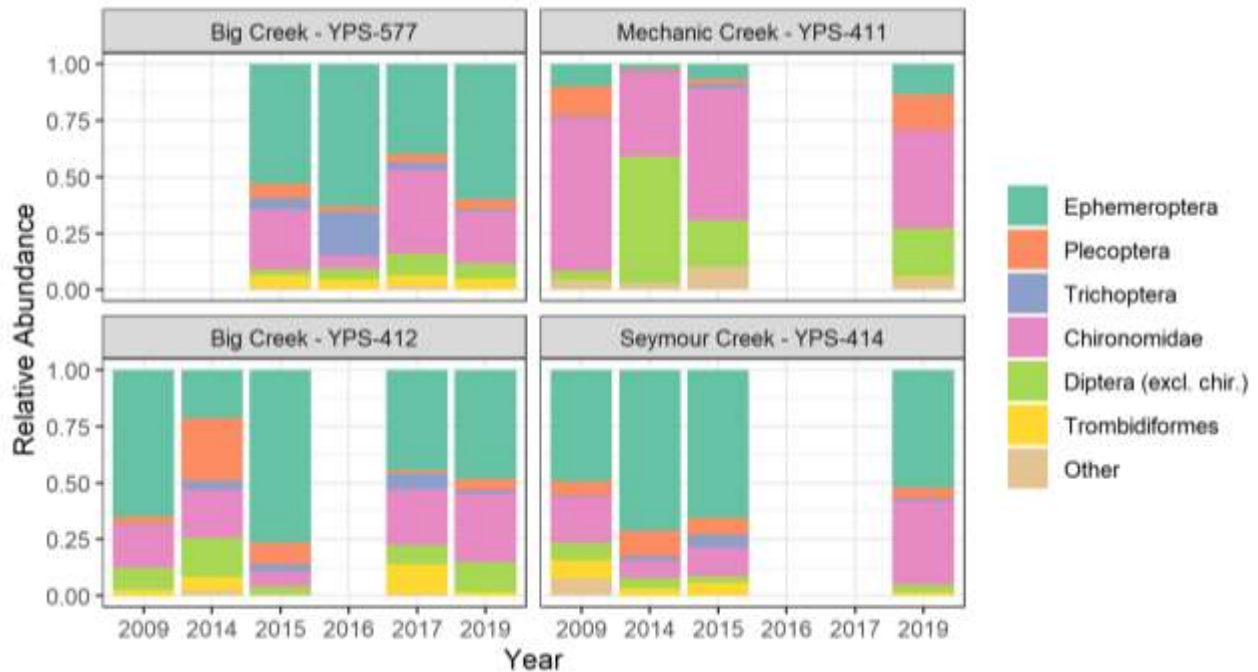


Figure 7. Relative Abundance of Major Taxonomic Groups at Test Sites in the Big Creek Watershed

Total abundance was low at YPS-411 (Mechanic Creek) in 2019 compared to other Big Creek Watershed test sites (Figure 6). While other sites have previously exhibited low abundance numbers during some sampling events, the total abundance at YPS-411 has been consistently below 1,000 individuals. At a given site, family-level richness has been similar over time and generally within the range of normal variability observed at reference sites (Table 8). The ranges of SDI and SEI values at the Big Creek Watershed sites were similar to ranges observed at the reference sites.

With the exception of YPS-411 (Mechanic Creek), invertebrate communities at the test sites were generally dominated by Ephemeroptera, Plecoptera, and Chironomidae (Table 8, Figure 7). The invertebrate community at YPS-411 was dominated by Diptera, with greater relative abundance of Chironomidae than observed at other test sites. A similar community composition was observed at the Big Creek Watershed reference site (YPS-410; Bow Creek) in 2019 (Table 4).

Indian River Watershed Test Sites

The following section presents the site assessment results for seven sites sampled in the Indian River Watershed. The number of annual sampling events per site ranged

from one year of data (i.e., 2019) at YPS-610 (Wounded Moose Creek) and YPS-615 (Quartz Creek) to eight years of data at YPS-090 (Indian River at the Water Resources Station). The test site evaluation focused on the 2019 sampling results.

Habitat Characteristics

Habitat characteristics measured at the seven sites in the Indian River Watershed are provided in Appendix B3, Table 3-4. Habitat characteristics at YPS-090 (Indian River at Water Resources Station), located in a sixth order reach, are notably different compared to the other sites located in third and fourth order reaches. The Indian River at YPS-090 is a larger stream compared to the streams at other sample sites, in terms of wetted width, average depth, and average velocity. Stream substrates among the sites were generally dominated by large pebbles and cobbles, and embeddedness generally ranged from 0% to 50%.

Degree of Placer Mining

Placer mining development upstream of sites sampled in the Indian River Watershed in 2019 was estimated as either low or high (Table 9).

Table 9. Degree of Placer Mining Development at Sites Sampled in the Indian River Watershed

Name	Site	Degree of Placer Mining (low, mod, high)	Upstream Distance to Active (within 2 years) Mining Development (km)	Upstream Distance to old (older than 2 years) Mining Development (km)	Comments
Gold Run Creek	YPS-103	High	2.5	0.0	Large active mine upstream
Australia Creek	YPS-481	Low	4.0	7.0	
Wounded Moose Creek	YPS-610	Low	0.0	0.0	Site on diverted channel
Montana Creek	YPS-606	Low	1.0	0.5	
Quartz Creek	YPS-615	High	6.0	0.0	
Quartz Creek	YPS-546	High	0.2	0.0	
Indian River at Water Resources Station	YPS-090	High	9.0	10.0	



Benthic Invertebrate Community Composition

Benthic invertebrate community metrics for the Indian River Watershed sites are provided in Table 10. Total abundance is shown on and Figure 9 and relative abundance of major taxonomic groups is shown on Figure 10 and Figure 11.



Table 10. Benthic Invertebrate Community Metrics in the Indian River Watershed

Watercourse Name	Site	Year	Total Abundance	Family Richness	SDI	SEI	% C	% E	% P	% T	% EPT
Gold Run Creek	YPS-103	2006	528	15	0.75	0.27	28	33	2	2	37
		2017	572	17	0.61	0.15	14	61	0	3	64
		2019	1,933	17	0.49	0.11	70	1	3	17	20
Australia Creek	YPS-481	2011	2,546	16	0.64	0.17	57	7	2	5	13
		2013	632	18	0.67	0.17	54	15	7	1	23
		2014	2,364	15	0.76	0.28	36	46	2	7	54
		2016	757	18	0.74	0.22	24	12	6	4	22
		2019	2,871	17	0.82	0.33	30	35	7	5	46
Wounded Moose Creek	YPS-610	2019	3,400	13	0.71	0.26	51	17	16	0	33
Montana Creek	YPS-606	2018	71	9	0.77	0.49	36	27	7	12	46
		2019	3,350	12	0.75	0.34	29	20	10	0	31
Quartz Creek	YPS-615	2019	8,120	13	0.51	0.16	68	1	0	3	4
Quartz Creek	YPS-546	2013	2	2	0.50	1.00	50	0	50	0	50
		2017	1,091	11	0.64	0.25	33	49	5	1	56
		2018	1,779	9	0.64	0.31	22	53	1	4	58
		2019	11,680	9	0.38	0.18	78	5	5	2	12
Indian River at Water Resources Station	YPS-090	2006	513	16	0.57	0.15	62	25	0	4	29
		2009	1,423	21	0.59	0.12	63	6	1	9	16
		2013	433	22	0.86	0.32	15	44	4	21	69
		2014	130	8	0.71	0.43	5	60	2	25	88
		2016	760	26	0.78	0.18	37	39	3	6	49
		2017	1,332	15	0.78	0.31	20	54	5	9	68
		2018	1,016	15	0.76	0.28	35	10	1	16	27
		2019	1,994	19	0.74	0.20	18	12	2	48	62

Notes: SDI = Simpson's Diversity Index; SEI = Simpson's Evenness Index; C = Chironomidae (non-biting midges); E = Ephemeroptera (mayflies); P = Plecoptera (stoneflies); T = Trichoptera (caddisflies)



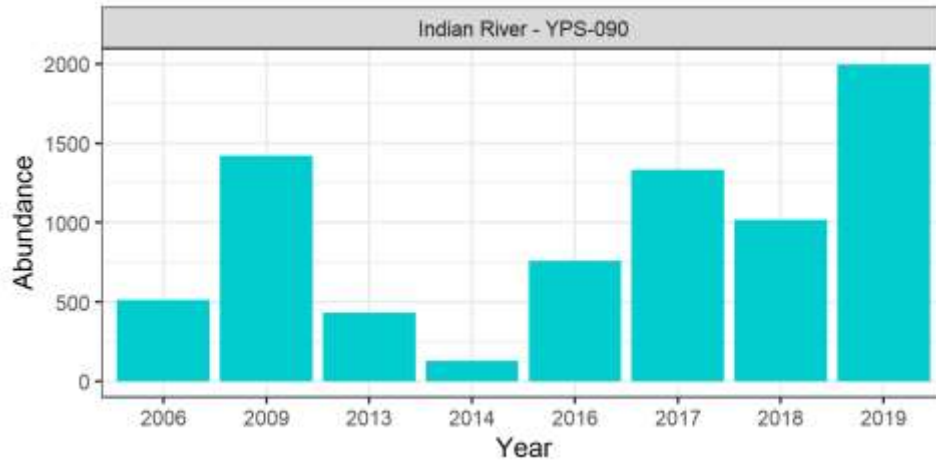


Figure 8. Total Abundance of Benthic Invertebrates at Test Sites in the Indian River Long Term Monitoring Station

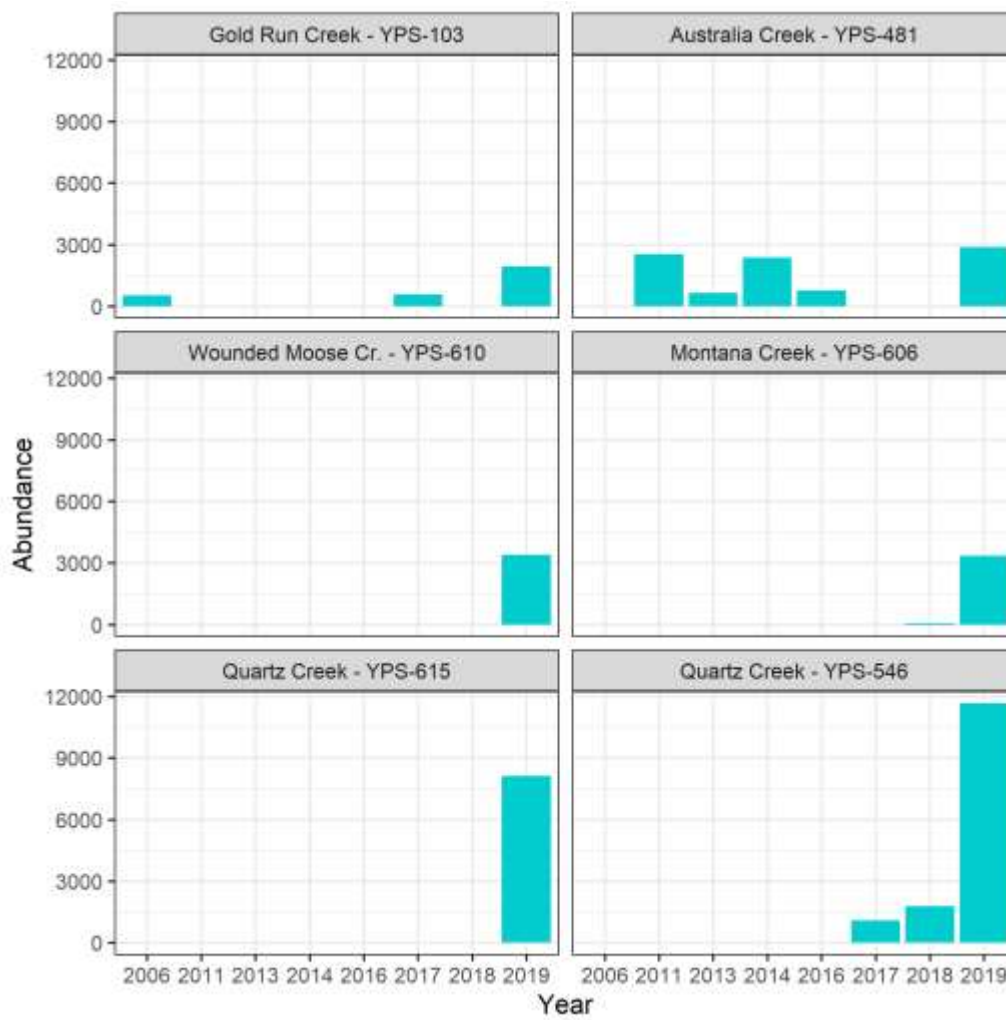


Figure 9. Total Abundance of Benthic Invertebrates at Test Sites in Small Tributaries in the Indian River Watershed

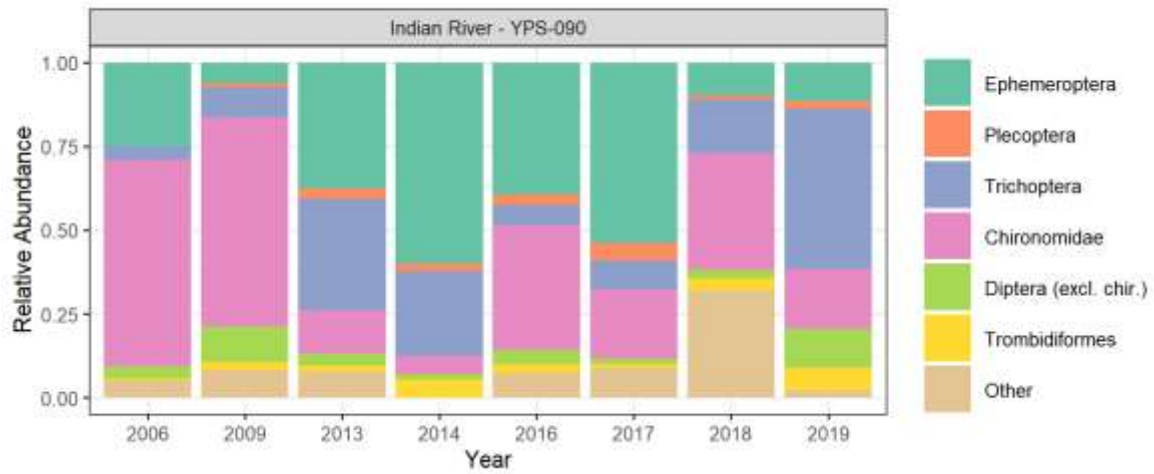


Figure 10. Relative Abundance of Major Taxonomic Group at the Indian River Long Term Monitoring Station

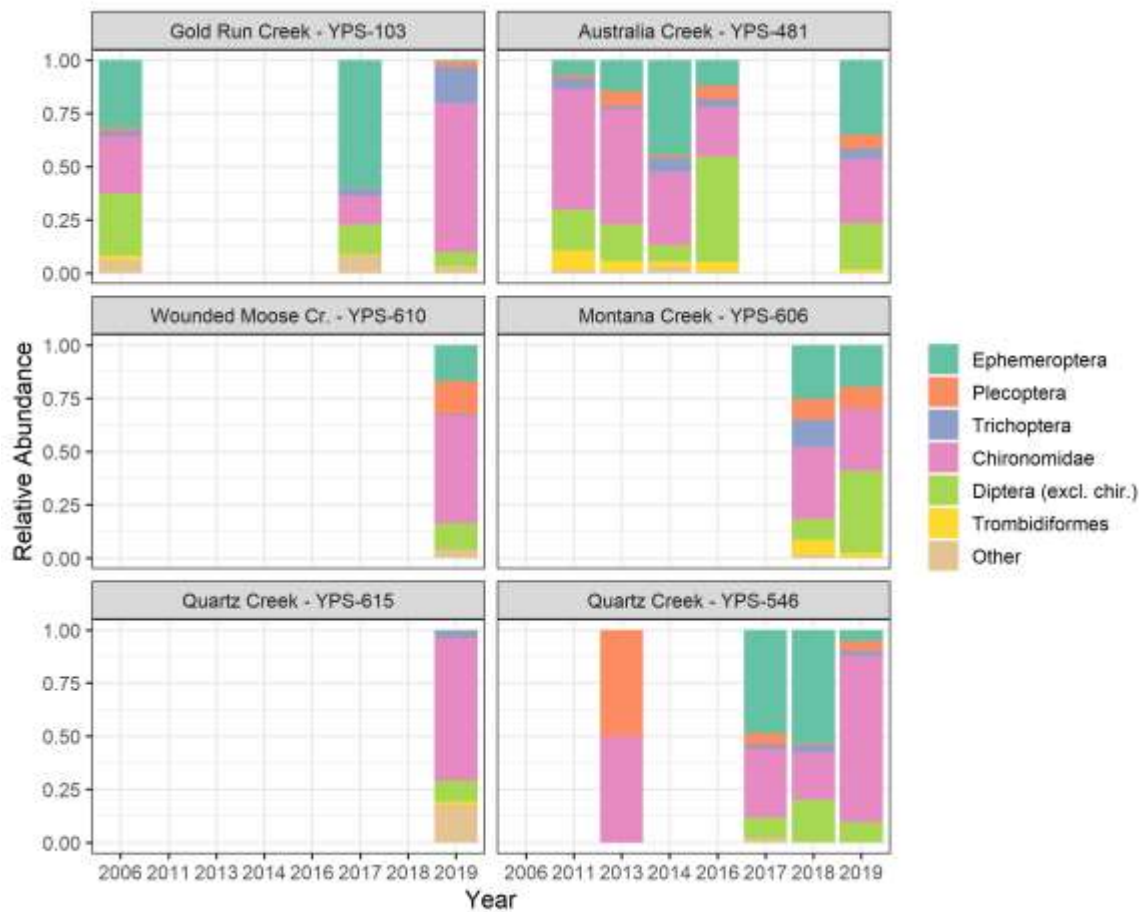


Figure 11. Relative Abundance of Major Taxonomic Groups at Test Sites in the Indian River Watershed

For sites with multiple years of data, total abundance was greater in 2019 compared to previous years (and Figure 9). Total abundance at both sites on Quartz Creek (YPS-615 and YPS-546) in 2019 was considerably greater than values observed at other sites and other years. At most sites, family-level richness has been similar over time and generally within the range of normal variability observed at reference sites (Table 10). Low richness was observed at YPS-546 in 2013, associated with an anomalously low total abundance. Family-level richness at YPS-090 (Indian River at Water Resources Station) has been variable over time, with four sampling years above the range of richness observed at reference sites; however, habitat characteristics in the Indian River are different compared to selected reference sites. The ranges of SDI and SEI values at the Indian River Watershed sites were similar to ranges observed at the reference sites.

Invertebrate communities at the test sites were generally dominated by Ephemeroptera, Plecoptera, and Chironomidae (Table 10, Figure 10 and Figure 11). Community composition varied over time at YPS-090 (Indian River at Water Resources Station), with the most dominant taxon shifting among Chironimdae, Trichoptera, and Ephemeroptera (Figure 10). Chironomidae were the most dominant taxon at several Indian River Watershed sites during some years, most notably at four sites in 2019 (Figure 11); however, a greater relative abundance of Chironomidae was also observed at reference sites in 2019 (Table 4). Similar to observations at Indian River Watershed reference sites, a large number of individuals from the family Simuliidae (black flies) were identified at YPS-481 (Australia Creek) in 2016 and YPS-606 (Montana Creek) in 2019.

Klondike River Watershed Test Sites

The following section presents the site assessment results for ten sites sampled on Hunker Creek in the Klondike River Watershed. The number of annual sampling events per site ranged from one year of data (i.e., 2019) at five sites (YPS-611; YPS-612; YPS-613; YPS-614; YPS-621) to eight years of data at YPS-078 (Hunker Creek upstream of Ontario Creek) and YPS-544. The test site evaluation focused on the 2019 sampling results.

Habitat Characteristics

Habitat characteristics measured at the ten sites in the Klondike River Watershed are provided in Appendix B3, Table 3-5. All the sites are located along Hunker Creek in third and fourth order reaches of the creek. Stream slopes were low gradient, ranging from 0.05% to 0.3%. Wetted width ranged from 1.6 to 8.2 m. Average velocity ranged from 0.16 to 0.67 m/s and average depth ranged from 6 to 47 cm. Stream substrate generally ranged from gravel to cobble, although some years of sampling indicated the dominant substrate was predominantly fines (sand/silt/clay). Embeddedness typically ranged from 0% to 50%.

Degree of Placer Mining

Placer mining development upstream of sites sampled in the Klondike River Watershed in 2019 was estimated as high, with the exception of YPS-078 (Hunker Creek upstream of Ontario Creek) which was estimated as moderate-low (Table 11).

Table 11. Degree of Placer Mining Development at Sites Sampled in the Klondike River Watershed

Name	Site	Degree of Placer Mining (low, mod, high)	Upstream Distance to Active (within 2 years) Mining Development (km)	Upstream Distance to old (older than 2 years) Mining Development (km)	Comments
Hunker Creek downstream of Hester Creek inflow	YPS-051	High	0.0	0.0	Active placer near site. Ford upstream of site.
Hunker Creek upstream of Ontario Creek	YPS-078	Mod-low	0.2	0.0	Site very close to Hunker Creek Rd.
Hunker Creek upstream of Gold Bottom Creek	YPS-079	High	0.0	0.0	Active placer upstream of site.
Hunker Creek downstream of Gold Bottom Creek	YPS-080	High	0.5	0.0	
Hunker Creek	YPS-544	High	0.2	0.2	Water pipe and foot bridge near site
Hunker Creek	YPS-611	High	0.6	0.0	
Hunker Creek	YPS-612	High	1.0	0.0	Old bridge upstream of site.
Hunker Creek	YPS-613	High	0.5	0.0	
Hunker Creek	YPS-614	High	1.0	0.0	
Hunker Creek	YPS-621	High	3.0	0.0	

Benthic Invertebrate Community Composition

Benthic invertebrate community metrics for the Klondike River Watershed sites are provided in



Table 12. Total abundance is shown on Figure 12 and Figure 13 and relative abundance of major taxonomic groups is shown on Figure 14 and Figure 15.



Table 12. Benthic Invertebrate Community Metrics in the Klondike River Watershed

Watercourse Name	Site	Year	Total Abundance	Family Richness	SDI	SEI	% C	% E	% P	% T	% EPT
Hunker Creek upstream of Ontario Cr.	YPS-078	2006	596	12	0.53	0.18	19	69	4	1	74
		2008	555	15	0.35	0.10	80	10	5	0	15
		2010	943	16	0.69	0.20	51	17	2	1	20
		2012	665	19	0.75	0.21	4	55	7	0	63
		2013	234	14	0.79	0.33	37	30	10	1	41
		2016	294	19	0.85	0.35	21	34	3	2	38
		2018	443	16	0.61	0.16	13	74	3	1	78
		2019	833	18	0.81	0.30	25	32	6	1	40
Hunker Creek	YPS-611	2019	2,371	19	0.84	0.33	21	7	18	28	54
Hunker Creek upstream of Gold Bottom Cr.	YPS-079	2006	1,276	10	0.49	0.20	67	23	1	1	25
		2019	889	10	0.41	0.17	76	13	2	8	23
Hunker Creek downstream of Gold Bottom Cr.	YPS-080	2006	852	12	0.47	0.16	15	72	4	1	76
		2019	3,655	19	0.57	0.12	6	64	15	11	91
Hunker Creek	YPS-614	2019	3,027	13	0.62	0.20	7	60	20	4	84
Hunker Creek downstream of Hester Creek inflow	YPS-051	2005	189	11	0.26	0.12	8	87	1	0	88
		2006	445	13	0.60	0.19	20	60	1	1	62
		2019	462	20	0.68	0.16	11	52	3	10	66
Hunker Creek	YPS-621	2019	1,267	19	0.73	0.20	13	48	4	14	66
Hunker Creek	YPS-613	2019	1,068	21	0.77	0.20	6	38	22	24	84
Hunker Creek	YPS-612	2019	2,239	20	0.68	0.16	5	50	13	27	90
Hunker Creek	YPS-544	2006	340	15	0.77	0.29	36	11	0	2	12
		2013	40	6	0.67	0.51	31	49	0	10	59
		2014	45	4	0.64	0.70	0	49	0	0	49
		2015	143	12	0.73	0.31	32	37	3	4	43
		2016	270	15	0.58	0.16	59	28	1	3	32
		2017	242	15	0.67	0.20	48	30	2	6	38
		2018	332	13	0.62	0.20	54	30	2	1	33
		2019	730	19	0.75	0.21	35	34	4	10	47

Notes: SDI = Simpson's Diversity Index; SEI = Simpson's Evenness Index; C = Chironomidae (non-biting midges); E = Ephemeroptera (mayflies); P = Plecoptera (stoneflies); T = Trichoptera (caddisflies)



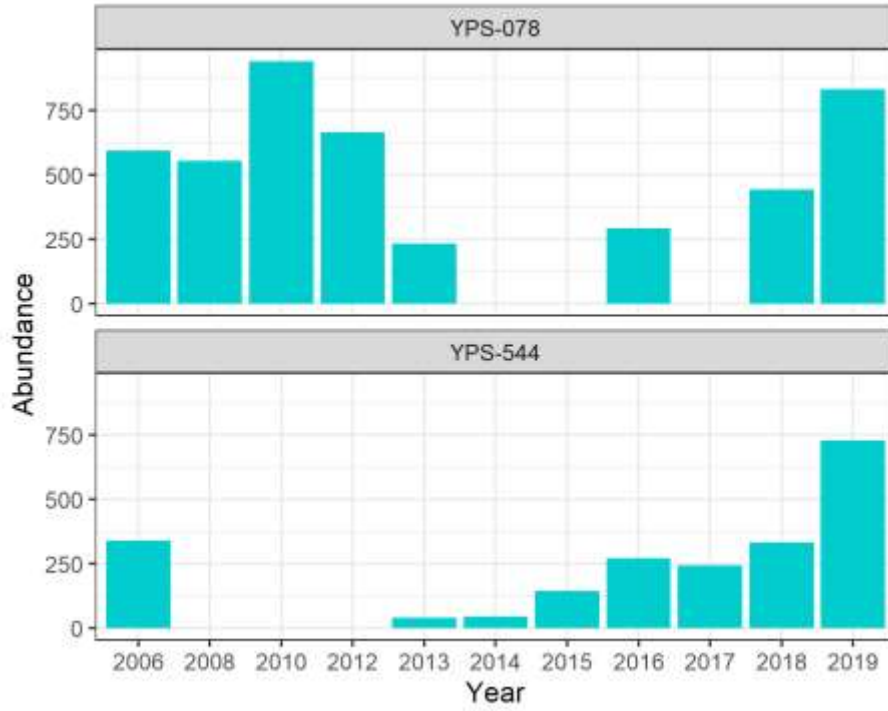


Figure 12. Total Abundance of Benthic Invertebrates in Hunker Creek Long Term Monitoring Sites

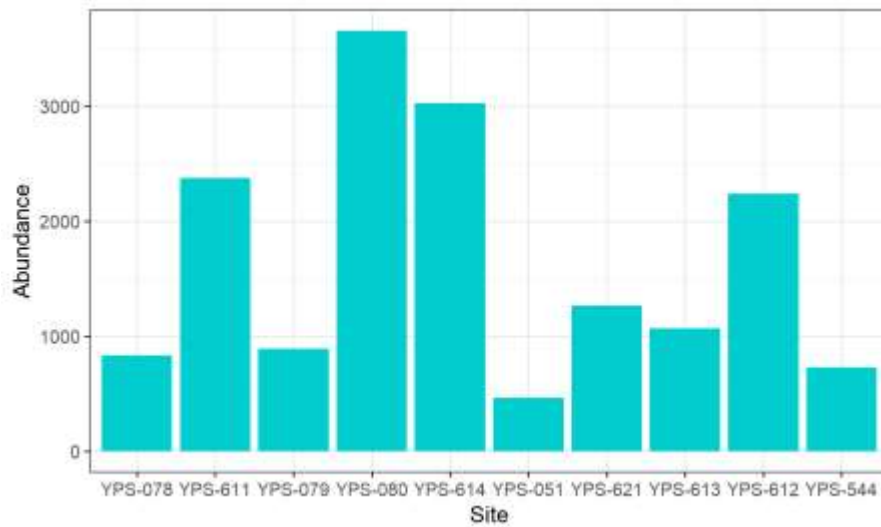


Figure 13. Total Abundance of Benthic Invertebrates at Sites in Hunker Creek in 2019



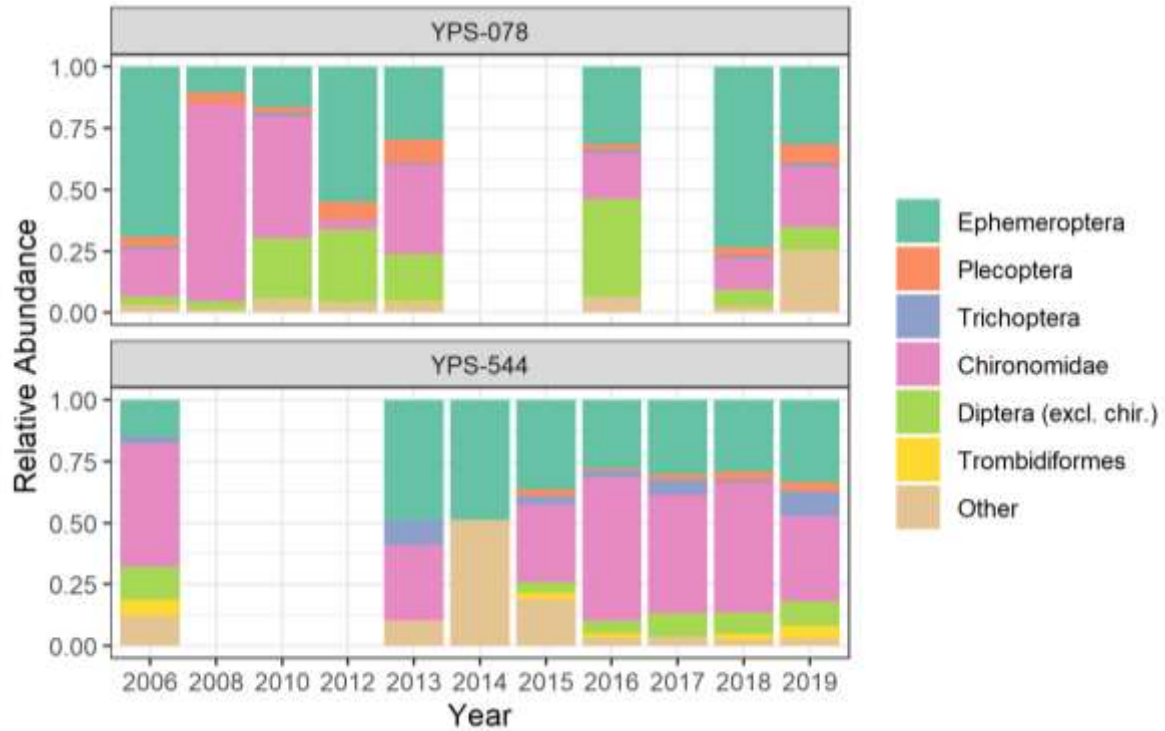


Figure 14. Relative Abundance of Major Taxonomic Groups at Hunker Creek Long Term Monitoring Sites

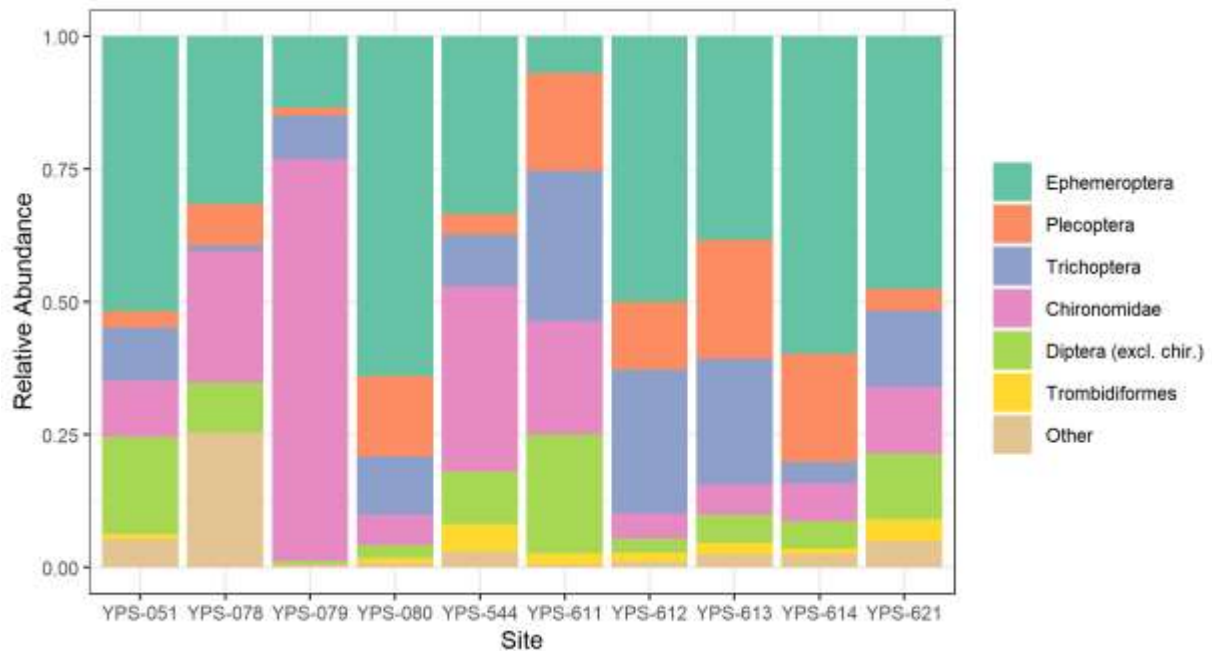


Figure 15. Relative Abundance of Major Taxonomic Groups at Sites in Hunker Creek in 2019



At the two Hunker Creek long-term monitoring sites total abundance has been low over time relative to reference sites, with counts consistently below 1,000 individuals (Figure 12). In 2019, six of the ten Hunker Creek sites had relatively low total abundances with the other four sites exhibiting counts above 2,000 individuals (Figure 13). Family-level richness was generally within the range of normal variability observed at reference sites, with the exception of two low values observed at YPS-544 in 2013 and 2014, associated with anomalously low total abundance counts (



Table 12). The ranges of SDI and SEI values at the Klondike River Watershed sites were similar to ranges observed at the reference sites.

The invertebrate community at YPS-078 (Hunker Creek upstream of Ontario Creek) has varied over time, with the dominant taxon shifting among Ephemeroptera, Chironomidae, and other Diptera (



Table 12, Figure 14). A large relative abundance of oligochaete worms from the family Lumbriculidae was identified at YPS-078 in 2019. The invertebrate community at the other Hunker Creek long-term monitoring site (YPS-544) was generally dominated by Ephemeroptera and Chironomidae and has remained relatively stable from 2015 to 2019 (



Table 12, Figure 14). Community composition varied among the Hunker Creek sites in 2019, with the most dominant taxon shifting among Ephemeroptera, Chironimdae, and Trichoptera (Figure 15).

Mayo River Watershed Test Sites

The following section presents the site assessment results for three sites sampled in the Mayo River Watershed. Three years of data were available for YPS-053 (Keystone Creek) and YPS-573 (Davidson Creek) and five years of data were available for YPS-574 (Granite Creek). The test site evaluation focused on the 2019 sampling results.

Habitat Characteristics

Habitat characteristics measured at the three sites in the Mayo River Watershed are provided in Appendix B3, Table 3-6. Two of the sites are located in third order reaches and the other site is located in a fourth order reach. The sites were similar in physical habitat characteristics. Stream slopes were low gradient, ranging from 0.1% to 0.25%. Wetted width ranged from 3.6 to 7 m. Average velocity ranged from 0.2 to 0.78 m/s and average depth ranged from 7.8 to 37 cm. At a given site, the average velocity and depth were generally lower in 2019 compared to previous years. Stream substrate was generally dominated by small and large cobbles, and embeddedness generally ranged from 0% to 50%.

Degree of Placer Mining

Placer mining development upstream of sites sampled in the Mayo River Watershed in 2019 was estimated as ranging from no development to high (Table 13).

Table 13. Degree of Placer Mining Development at Sites Sampled in the Mayo River Watershed

Name	Site	Degree of Placer Mining (low, mod, high)	Upstream Distance to Active (within 2 years) Mining Development (km)	Upstream Distance to old (older than 2 years) Mining Development (km)	Comments
Granite Creek	YPS-574	Low	4.0	None	Placer development is increasing upstream
Keystone Creek inflow to Mayo Lake	YPS-053	None	None	None	New road near channel starts 1km upstream. Development proposed.
Davidson Creek	YPS-573	High	3.0	3.0	

Benthic Invertebrate Community Composition

Benthic invertebrate community metrics for the Mayo River Watershed sites are provided in Table 14. Total abundance is shown on Figure 16 and relative abundance of major taxonomic groups is shown on Figure 17.

Table 14. Benthic Invertebrate Community Metrics in the Mayo River Watershed

Watercourse Name	Site	Year	Total Abundance	Family Richness	SDI	SEI	% C	% E	% P	% T	% EPT
Granite Creek	YPS-574	2015	2,147	16	0.80	0.31	30	32	22	2	57
		2016	2,717	14	0.76	0.29	16	42	18	1	61
		2017	1,883	14	0.77	0.30	16	40	32	4	75
		2018	5,186	16	0.78	0.29	35	34	19	3	56
		2019 ^a	4,401	15	0.73	0.24	43	26	22	3	50
Keystone Creek inflow to Mayo Lake	YPS-053	2005	255	12	0.83	0.49	18	27	21	1	49
		2018	3,130	15	0.81	0.36	14	23	35	2	59
		2019 ^a	1,859	16	0.77	0.29	24	20	38	4	61
Davidson Creek	YPS-573	2015	150	19	0.82	0.29	35	31	13	1	45
		2018	54	9	0.66	0.32	54	2	6	0	7
		2019 ^a	1,456	18	0.74	0.22	27	50	9	1	60

Notes: SDI = Simpson's Diversity Index; SEI = Simpson's Evenness Index; C = Chironomidae (non-biting midges); E = Ephemeroptera (mayflies); P = Plecoptera (stoneflies); T = Trichoptera (caddisflies)

a. 2019 metric values for the sites are based on the average of three replicate samples.



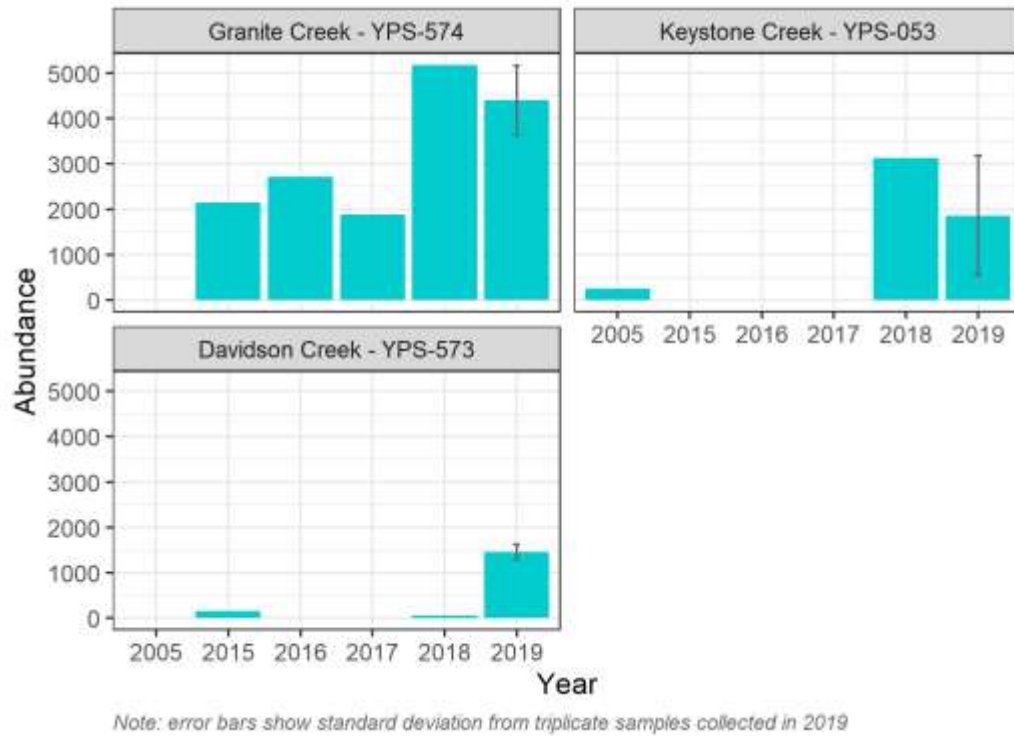


Figure 16. Total Abundance of Benthic Invertebrates at Test Sites in the Mayo River Watershed

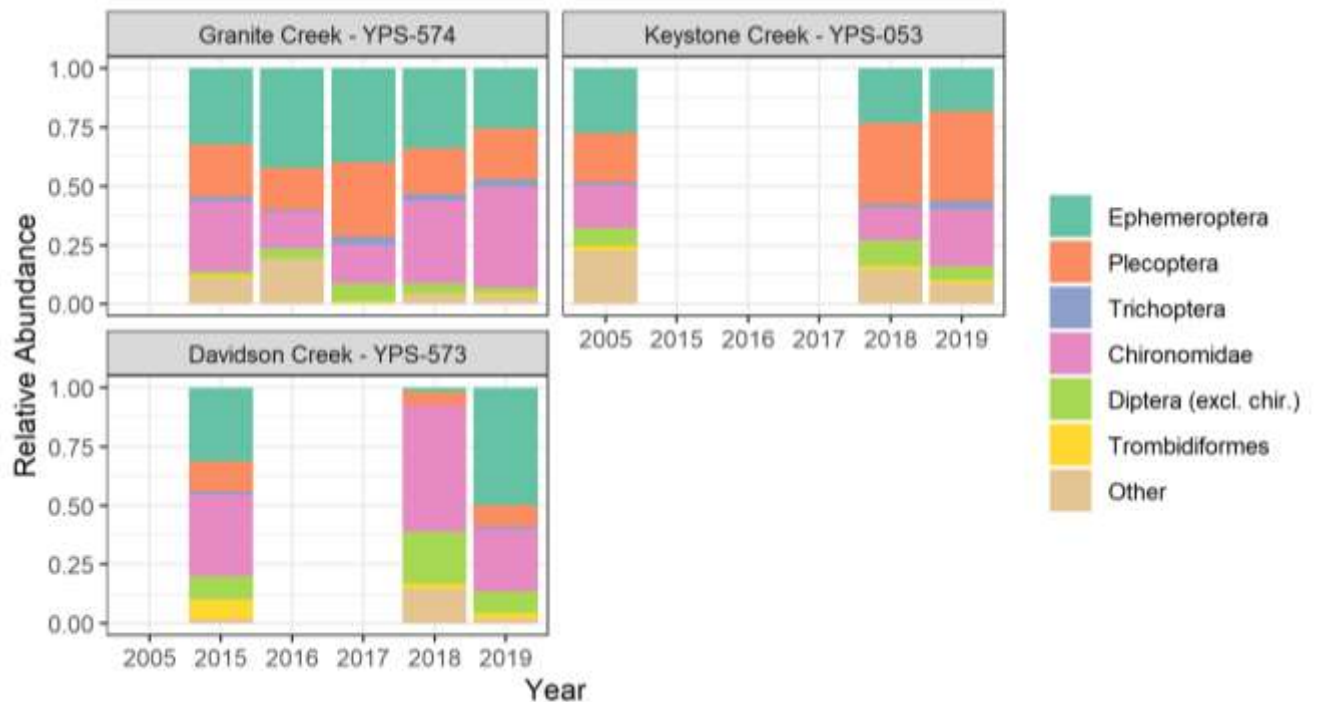


Figure 17. Relative Abundance of Major Taxonomic Groups at Test Sites in the Mayo River Watershed

Total abundance was variable among the Mayo River Watershed test sites (Figure 16), although counts were within the range of normal variability observed at reference sites. At YPS-574 (Granite Creek) and YPS-053 (Keystone Creek), abundance was higher in 2018 and 2019 compared to previous years. Abundance was anomalously low at YPS-573 (Davidson Creek) in 2015 and 2018, but an increase above 1,000 individuals was observed in 2019. Apart from a lower richness value at YPS-573 in 2018 associated with low abundance, family-level richness at the sites were at or above the average richness observed at reference sites (Table 14). The SDI values at the Mayo River Watershed sites were generally above the average observed at reference sites, and the SEI values were similar.

Invertebrate communities at the test sites were generally dominated by Ephemeroptera, Plecoptera, and Chironomidae (non-biting midges) (Table 14, Figure 17). In 2019, relative abundance of Ephemeroptera and Plecoptera was greater at YPS-574 (Granite Creek) and YPS-573 (Davidson Creek) than at reference sites on the same creeks. At the Granite Creek (YPS-619) and Davidson Creek (YPS-620) reference sites, the dominant taxon was Chironomidae with a respective relative abundance of 60% and 70%.

White River Watershed Test Sites

The following section presents the site assessment results for two sites sampled in the White River Watershed. Two years of data were available for YPS-507 (Wade Creek) and three years of data were available for YPS-506 (Burwash Creek). The test site evaluation focused on the 2019 sampling results.

Habitat Characteristics

Habitat characteristics measured at the two sites in the White River Watershed are provided in Appendix B3, Table 3-7. The two sites are located in fourth order reaches. Stream slopes ranged from 0.1 to 0.35%, with YPS-507 (Wade Creek) having a steeper gradient than YPS-506 (Burwash Creek). Wetted width ranged from 4.9 to 16.5 m, average depth ranged from 17.6 to 55 cm, and average velocity ranged from 0.5 to 2 m/s. The two streams appeared to be smaller in 2019 compared to previous years, in terms of wetted width, average depth, and average velocity. Stream substrate

was generally dominated by large pebbles or cobbles, with embeddedness ranging from 0% to 25%.

Degree of Placer Mining

Placer mining development in the White River Watershed in 2019 was estimated as low upstream of YPS-507 (Wade Creek) and high upstream of YPS-506 (Burwash Creek) (Table 15).

Table 15. Degree of Placer Mining Development at Sites Sampled in the White River Watershed

Name	Site	Degree of Placer Mining (low, mod, high)	Upstream Distance to Active (within 2 years) Mining Development (km)	Upstream Distance to old (older than 2 years) Mining Development (km)	Comments
Wade Creek	YPS-507	Low	3.0	3.0	Naturally high bedload with highly braided channel.
Burwash Creek	YPS-506	High	0.0	0.0	High energy stream with a naturally braided channel.

Benthic Invertebrate Community Composition

Benthic invertebrate community metrics for the White River Watershed sites are provided in Table 16. Total abundance is shown on Figure 18 and relative abundance of major taxonomic groups is shown on Figure 19.

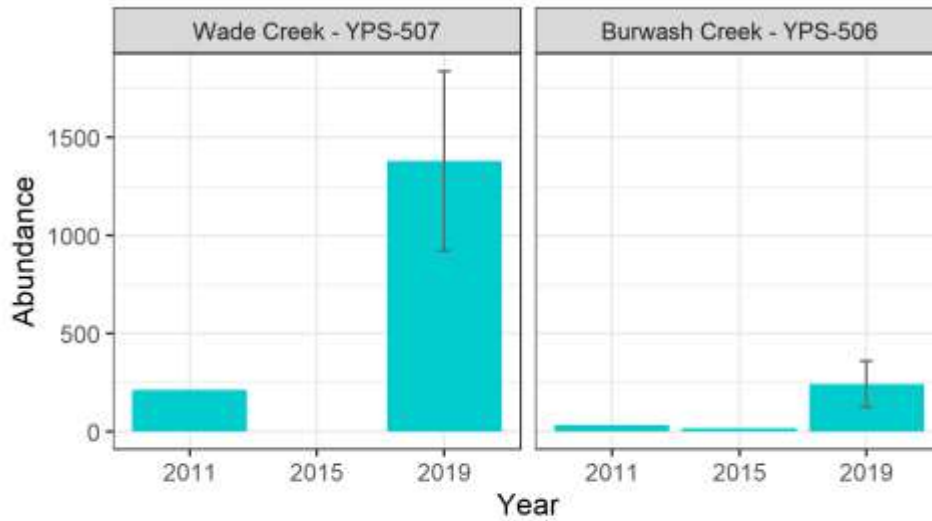
Table 16. Benthic Invertebrate Community Metrics in the White River Watershed

Watercourse Name	Site	Year	Total Abundance	Family Richness	SDI	SEI	% C	% E	% P	% T	% EPT
Wade Creek	YPS-507	2011	212	14	0.75	0.28	44	30	13	0	44
		2019 ^a	1,380	9	0.38	0.18	77	16	2	0	18
Burwash Creek	YPS-506	2011	32	6	0.68	0.53	33	7	47	0	53
		2015	16	6	0.72	0.59	44	31	13	0	44
		2019 ^a	241	10	0.73	0.37	35	37	13	0	51

Notes: SDI = Simpson’s Diversity Index; SEI = Simpson’s Evenness Index; C = Chironomidae (non-biting midges); E = Ephemeroptera (mayflies); P = Plecoptera (stoneflies); T = Trichoptera (caddisflies)

a. 2019 metric values for the sites are based on the average of three replicate samples.





Note: error bars show standard deviation from triplicate samples collected in 2019

Figure 18. Total Abundance of Benthic Invertebrates at Test Sites in the White River Watershed

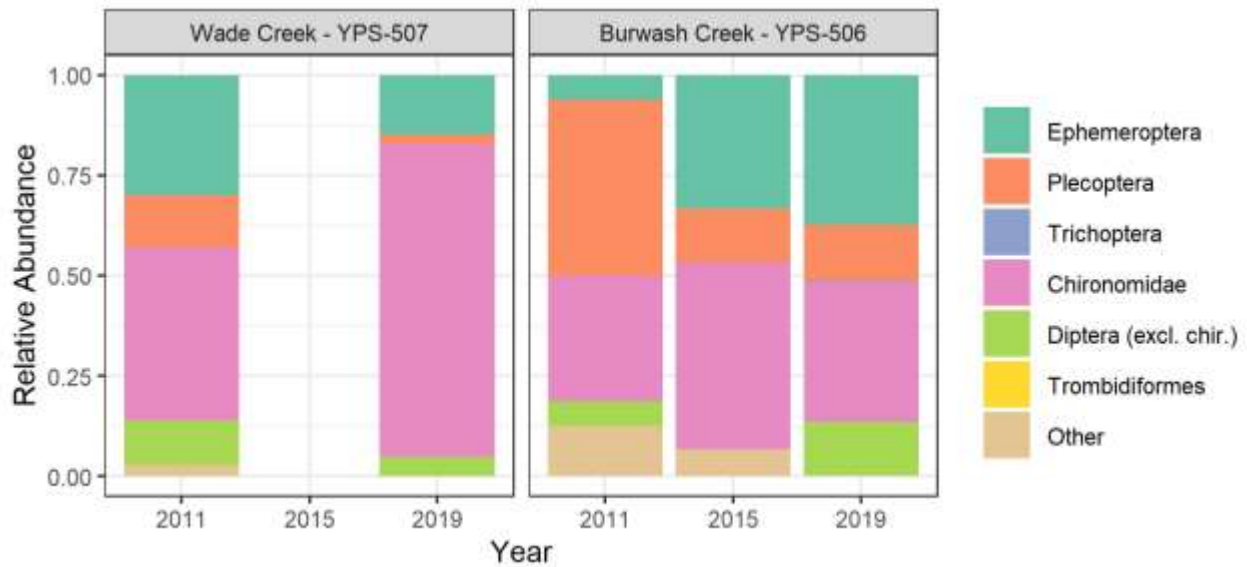


Figure 19. Relative Abundance of Major Taxonomic Groups at Test Sites in the White River Watershed

Total abundance was low at YPS-506 (Burwash Creek) in 2019 and in previous years, with total counts consistently below 1,000 individuals (Figure 18). Total abundance at YPS-507 (Wade Creek) in 2019 was above 1,000 in 2019, but had been low in 2011. Family-level richness at both sites in 2019 were similar to the richness observed at the White River Watershed reference site (YPS-591) in 2019. The ranges of SDI and SEI values at the White River Watershed sites were similar to ranges observed at the reference sites.

Invertebrate communities at the test sites were generally dominated by Ephemeroptera, Plecoptera, and Chironomidae (Table 16, Figure 19). At both sites, there was a greater relative abundance of Chironomidae than observed at the White River Watershed reference site (YPS-591), where Ephemeroptera was the dominant taxon in both years sampled.

3.4 Targeted Studies

Several targeted studies were carried out to answer key questions to inform a revised study design for aquatic health monitoring. A brief summary of the results from the 2019 studies is provided below. A more detailed analysis of the results from these studies is planned for the 2020/2021 Adaptive Management Cycle.

Replicate Study

Summary statistics of total abundance, richness, SDI, and SEI for triplicate samples are tabulated in Appendix B4. For each watershed, within-site variability of the benthic metrics is shown on the dot plots in Figures 20 to 23.

Of the four benthic metrics (i.e., total abundance, richness, SDI, and SEI), abundance exhibited the greatest within-site variability based on comparison of the coefficients of variation (CV) (Appendix B4, Table 4-1; Figure 24). The CV for abundance ranged from 3.9% to 53.4% with only three sites exhibiting a CV below 10%. By contrast, SDI had the least within-site variability with all but two sites exhibiting a CV below 10%. Within-site variability for richness and SEI was intermediate relative to abundance and SDI, but generally richness was less variable than SEI with more sites exhibiting a CV below 10%.

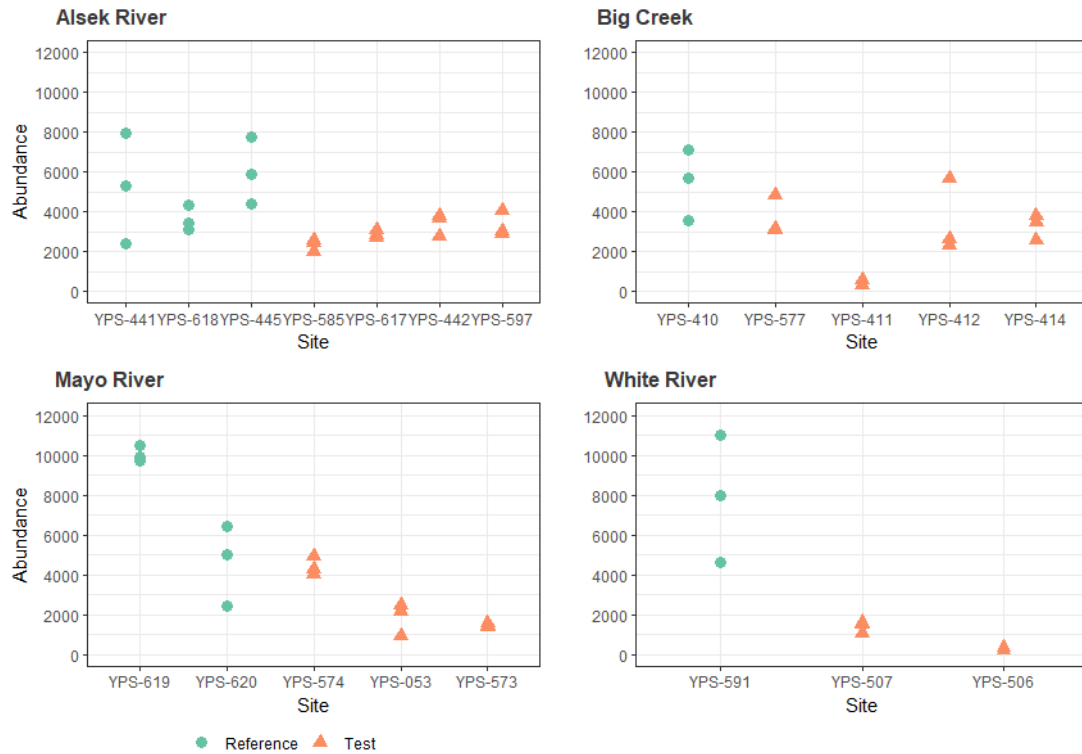


Figure 20. Total Abundance of Benthic Invertebrates in Triplicate Samples

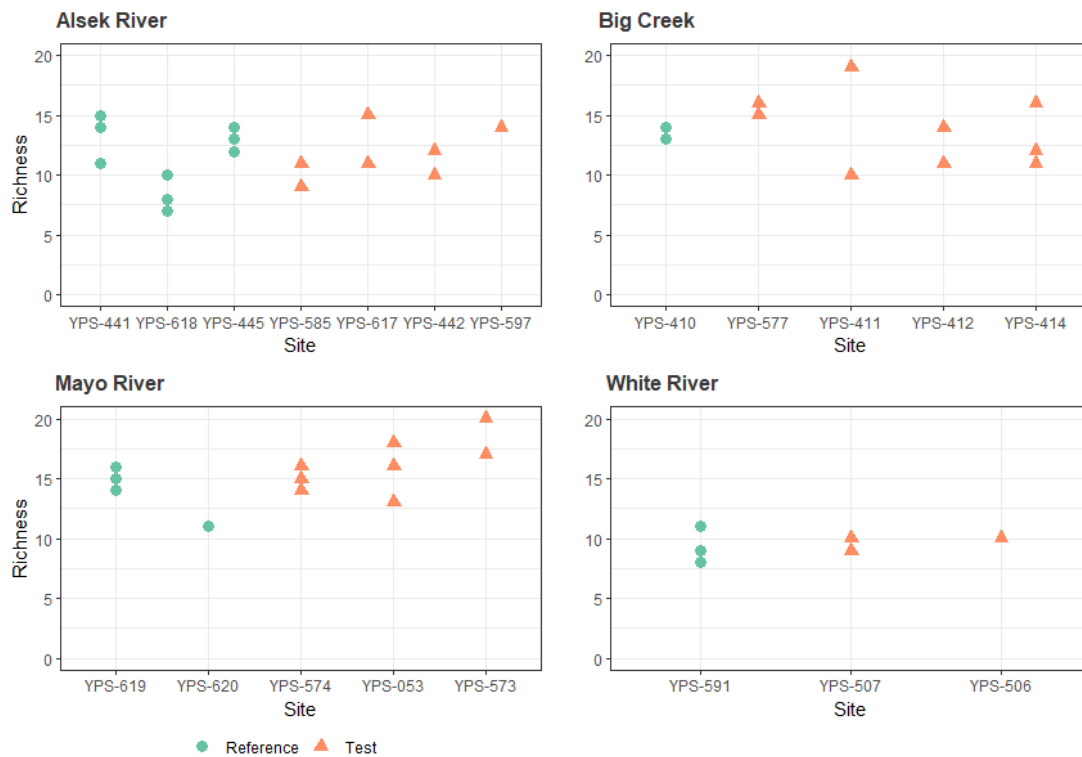


Figure 21. Family-Level Richness of Benthic Invertebrates in Triplicate Samples

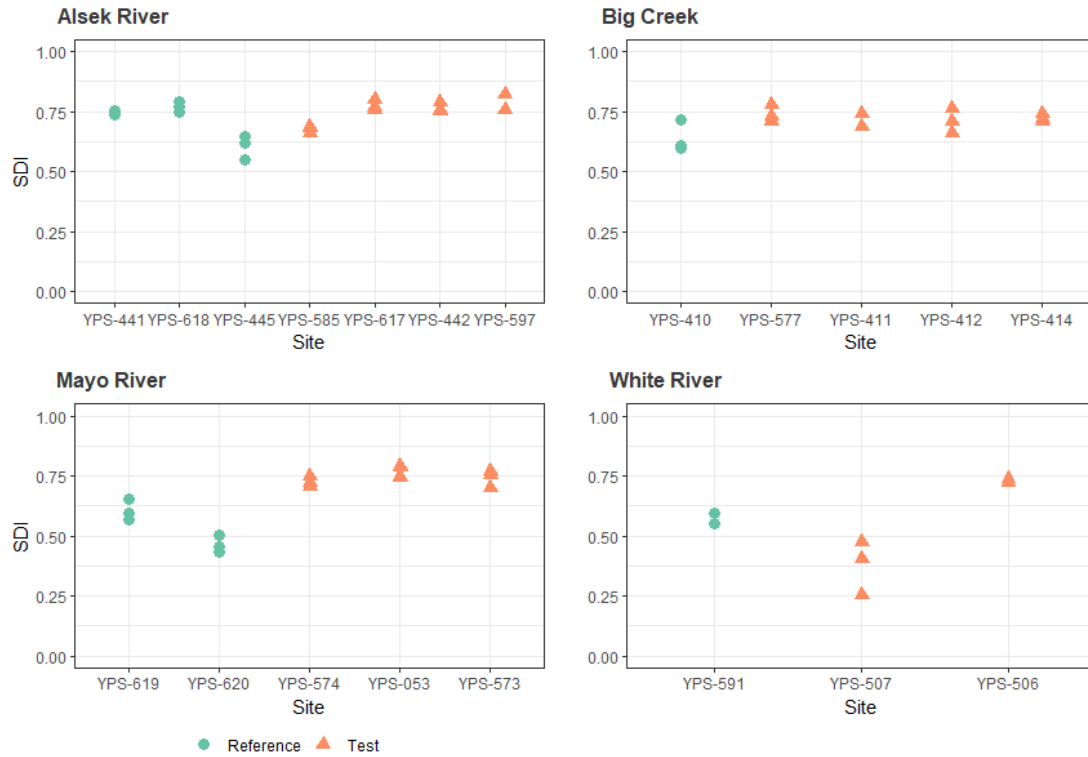


Figure 22. Simpson's Diversity Index (SDI) of Benthic Invertebrate Communities in Triplicate Samples

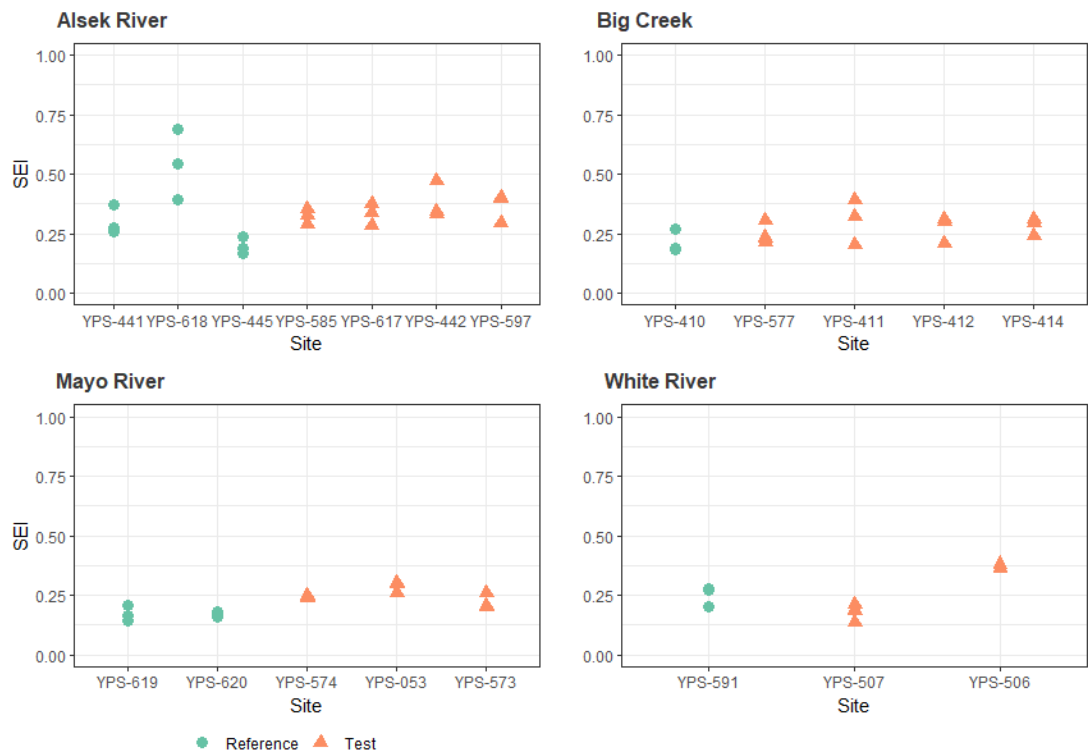


Figure 23. Simpson's Evenness Index (SEI) of Benthic Invertebrate Communities in Triplicate Samples

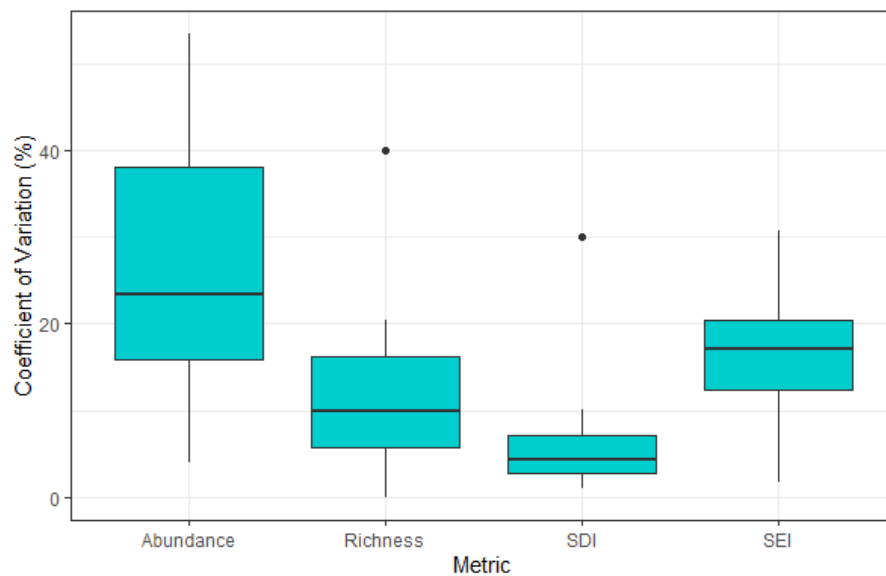


Figure 24. Coefficient of Variation Measured in Invertebrate Metrics from 20 Sites

The two-dimensional nMDS is presented in Figure 25. The stress value for the nMDS was 0.18, indicating an acceptable fit to the original count data. The ordination identified separation among sites in terms of community structure, with some sites (e.g., YPS-411 and YPS-506) more separated from the rest of the sites. There is a cluster of sites in the top right quadrant of the nMDS indicating that those sites have a relatively similar family-level community structure. For some sites (e.g., YPS-411, YPS-412, YPS-620) the replicate samples are not as closely positioned to each other as others indicating greater separation in community structure among the replicates. However, for a given watershed the individual replicate samples of a site tend to be more similar to each other than to samples from other sites.

Another year of data with replicate samples would be useful to further evaluate how within site variability compares to variability among years and to gain a better understanding of our ability to detect trends over time with the current monitoring design.

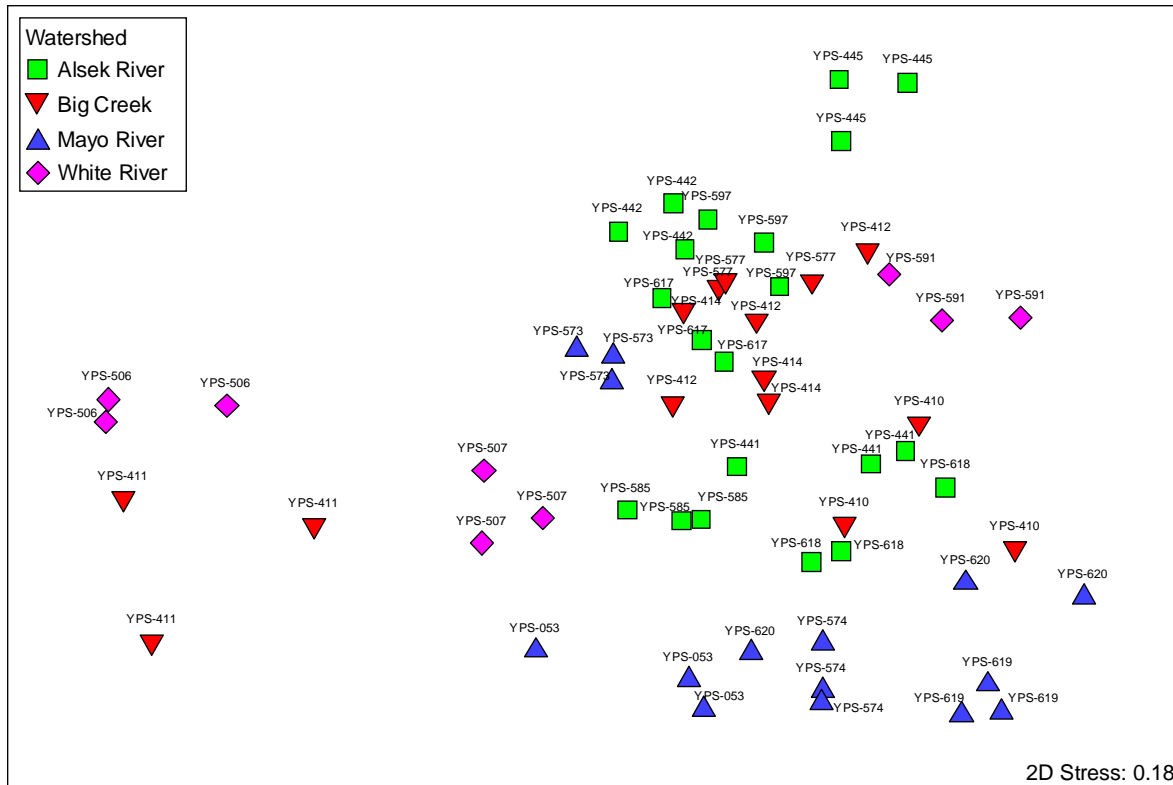


Figure 25. Non-metric Multidimensional Scaling of Family-Level Benthic Invertebrate Community Structure at 20 Sites

Analysis of substrate composition methods

Results from the analysis of substrate composition methods are provided in Appendix B5.

The analysis showed that substantial variation in calculated geometric mean substrate size can occur when sample sizes are <75. Therefore, a sample size of 100 substrate measurements is recommended to characterize substrate composition at aquatic health monitoring sites.

In-situ sediment sampling

Results from the laboratory analysis of in-situ sediment sampling are provided in Appendix B6.

Based on visual examination of scatter plots, there are no distinct relationships between selected invertebrate community metrics (total abundance, richness, % EPT,

and % C) and the laboratory-analyzed sediment parameters (Figures 26 to 29). There was less variability in total abundance at greater concentrations of total nitrogen, total organic carbon, silt, and clay (Figure 26). For example, at sites with substrate composed of greater than 30%, total abundance is at or below approximately 4,000. However, there are fewer sites with higher concentrations of those sediment parameters and therefore the potential relationship is uncertain. More data would be useful in exploring potential relationships of invertebrate community metrics and sediment parameters. Evaluation of other invertebrate community metrics and taxa-specific relationships (including abundance of sediment sensitive invertebrate species) may also be useful to explore hypotheses related to invertebrate community response to variation in sediment parameters.

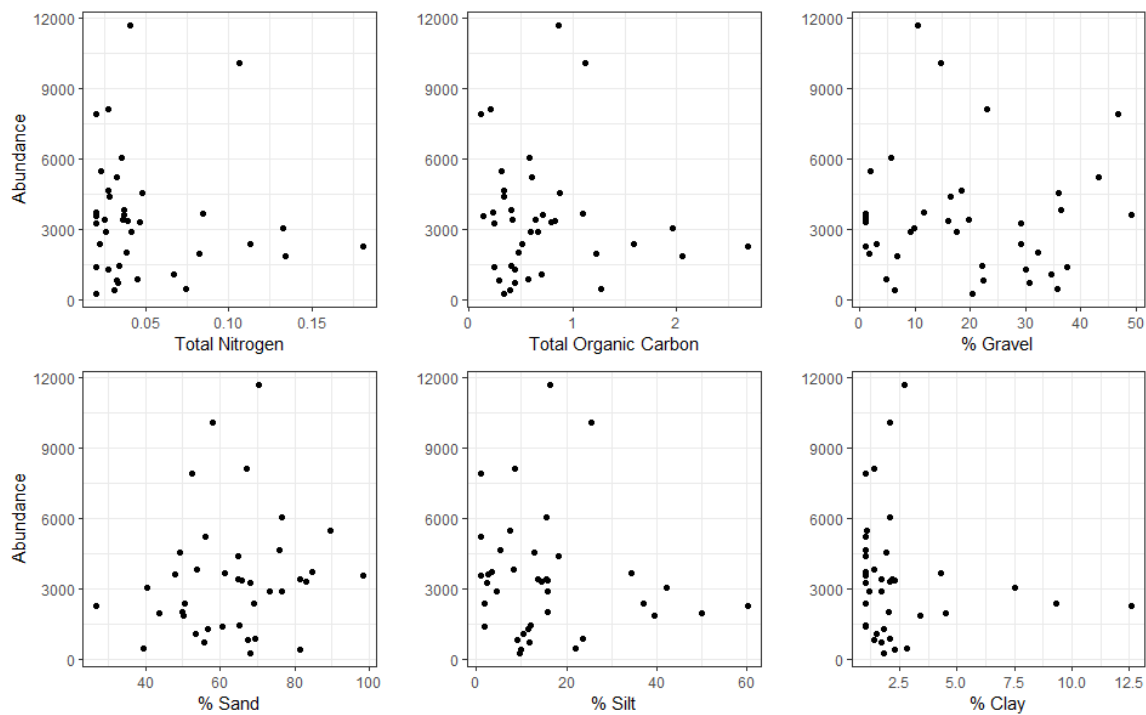


Figure 26. Total Abundance Versus Percent Particle Size, Total Nitrogen, and Total Organic Carbon



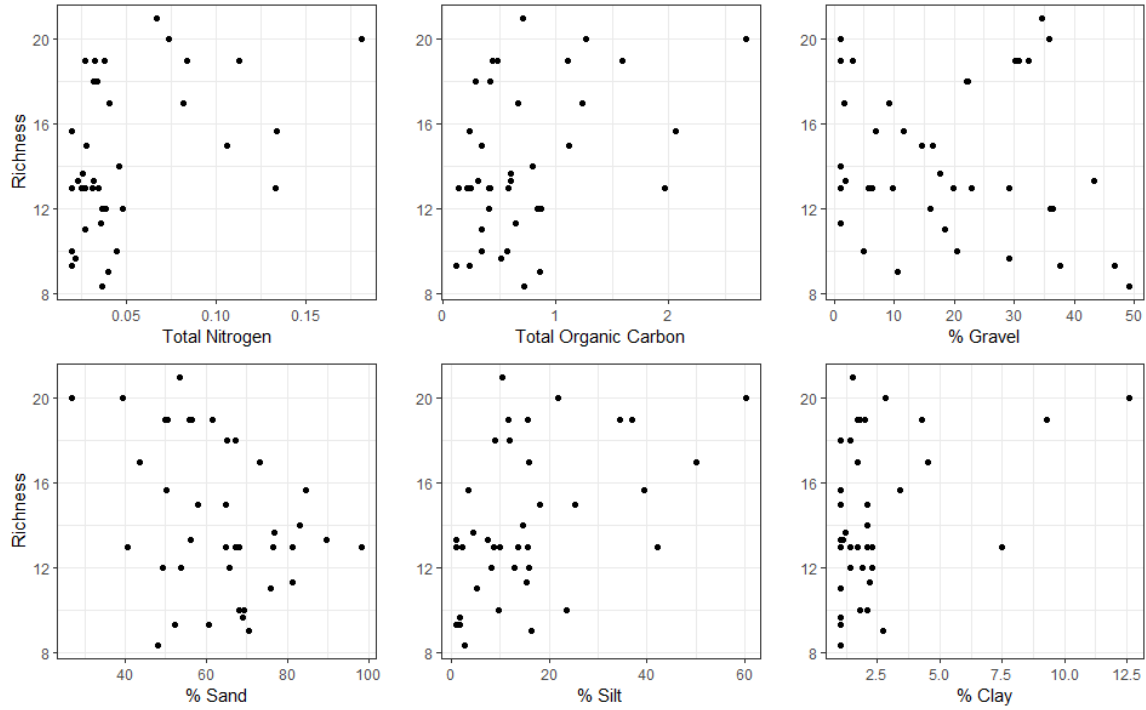


Figure 27. Richness Versus Percent Particle Size, Total Nitrogen, and Total Organic Carbon

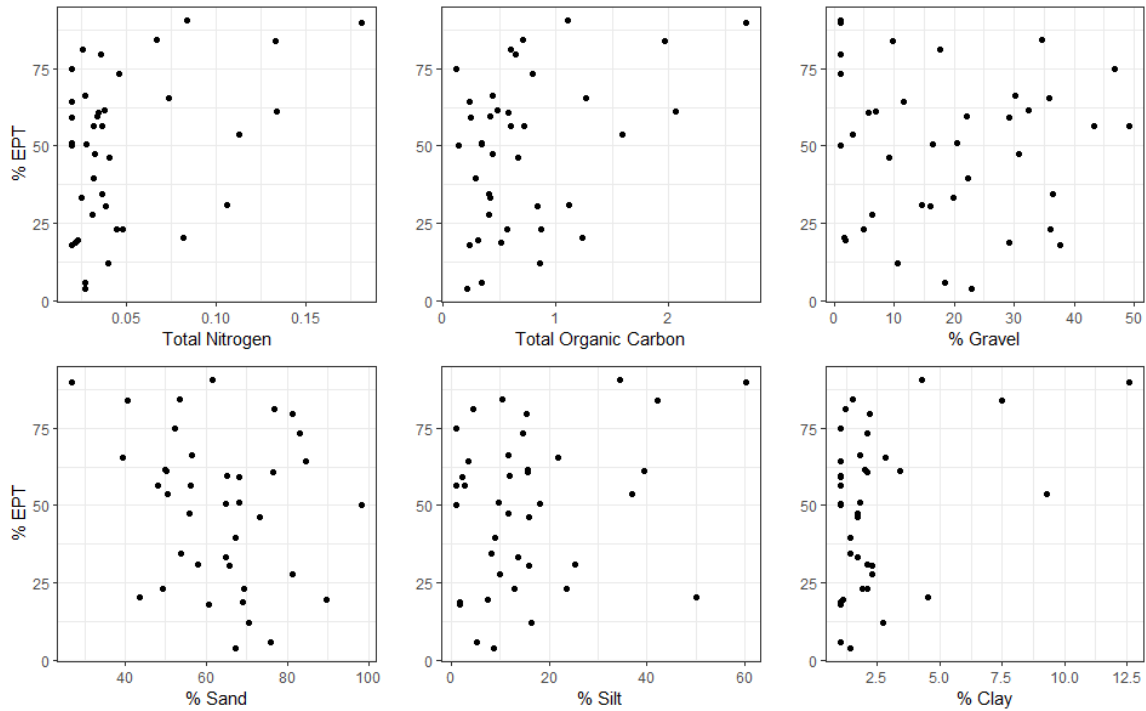


Figure 28. Percent Ephemeroptera, Plecoptera, and Trichoptera (EPT) Versus Percent Particle Size, Total Nitrogen, and Total Organic Carbon



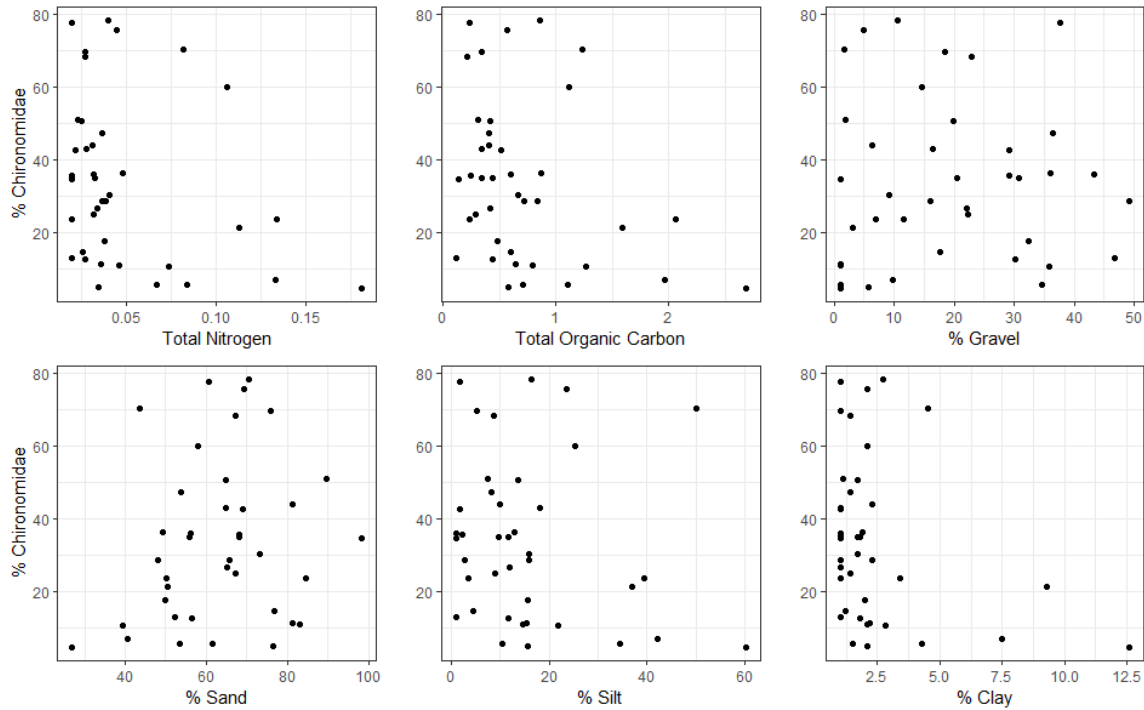


Figure 29. Percent Chironomidae Versus Percent Particle Size, Total Nitrogen, and Total Organic Carbon

Hunker Creek Joint Sampling

Yukon Government Water Quality Objectives Monitoring Program monitoring report for 2019 provides details and analyses regarding intensive monitoring in Hunker Creek.

Further exploratory studies related to sediment and invertebrate community composition is recommended. For example:

- How do sediment inputs from placer mining activity along the length of Hunker Creek affect the benthic invertebrate community composition?
- Do certain invertebrate taxa respond to sediment inputs from placer mining activity in predictable ways?



4 Next Steps

Aquatic health monitoring is being carried out to obtain data to evaluate aquatic health in streams affected by placer mining and to inform sound adaptive management decisions. IMG is currently in the planning phases of a revised aquatic health study design. An interim approach to monitoring will continue to be implemented for the 2020 field program until an updated study design is in place.

Targeted studies will be carried out to answer key questions to inform a revised study design. The following initiatives are planned:

- Additional replication to assess within site variability
- Additional in-situ sediment sampling to further explore relationships of sediment measurements and invertebrate community metrics,
- Explore hypotheses related to taxa specific invertebrate sensitivities to sedimentation
- Evaluation of comparability of reference sites based on community composition and physical habitat variables
- Further data analyses related to sediment and invertebrate community composition.

The long term goal will be to develop a statistically defensible approach to inform the adaptive management process.

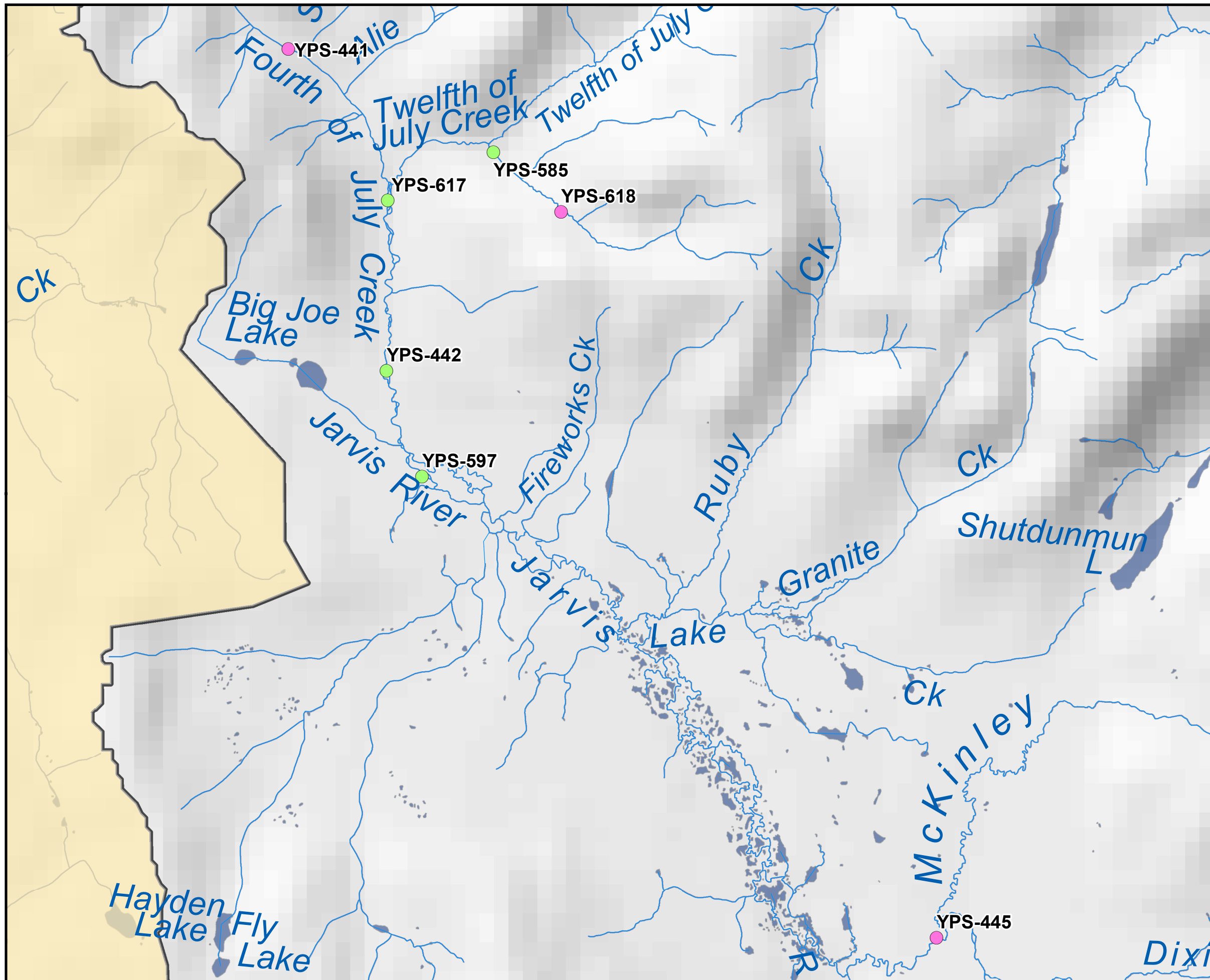
Fish Habitat Management System for Yukon Placer Mining
Aquatic Health Monitoring Program 2019 Report.

Appendix B1

Maps of Monitoring Locations by Watershed



Alesek River Watershed Aquatic Health Monitoring Sites 2019



Monitoring Sites

- Reference Site
- Test Site

Roads

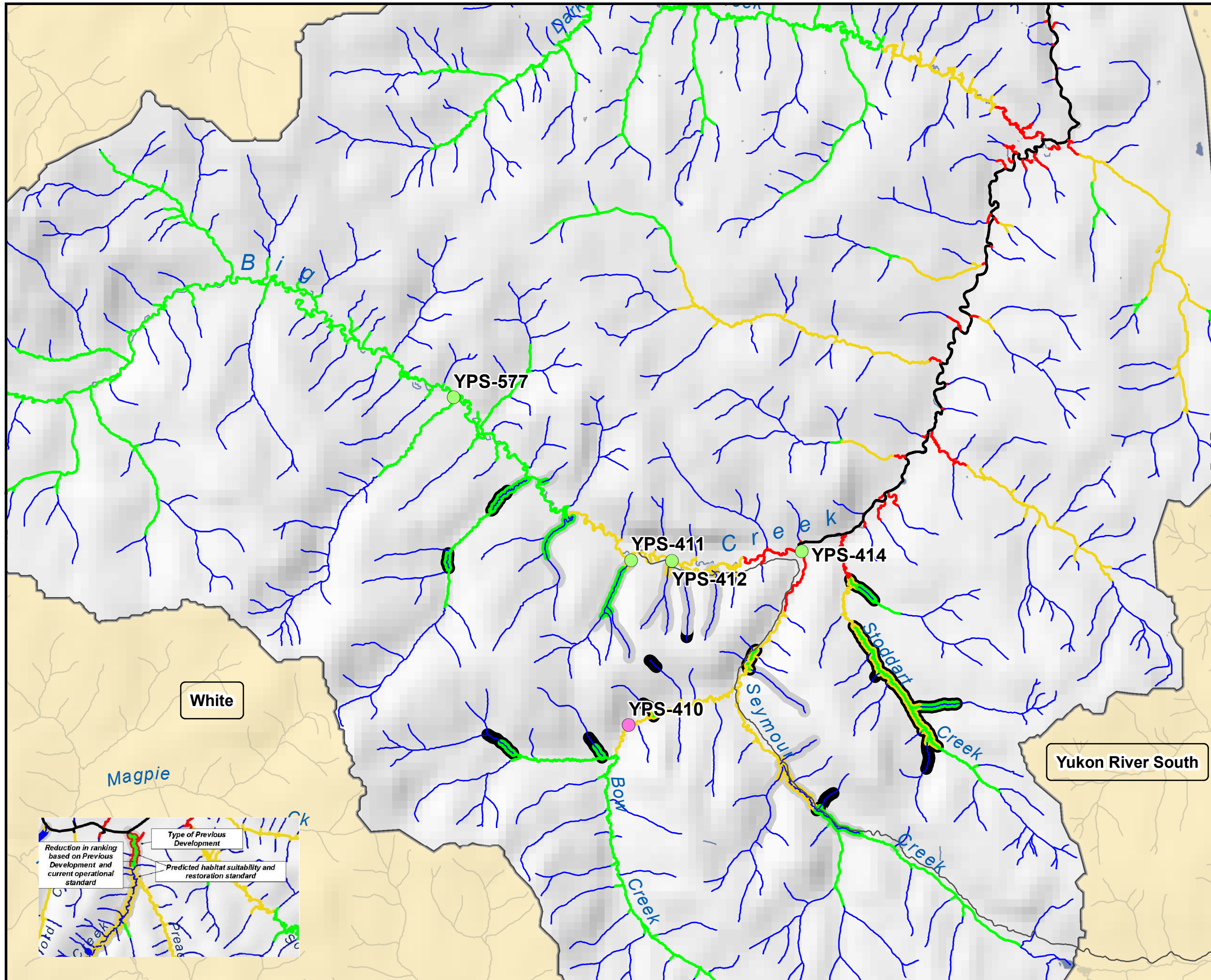
- Highway
- Primary Roads
- - - Local Roads
- . . . Resource / Recreation



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Big Creek Watershed Aquatic Health Monitoring Sites 2019



Monitoring Sites

- Reference Site
- Test Site

Stream Reach Classification

- Water Quality
- Low Suitability
- Moderate-Low Suitability
- Moderate-Moderate Suitability
- Moderate-High Suitability
- High Suitability
- Areas of Special Consideration (Ecological)
- Areas of Special Consideration (Cultural)



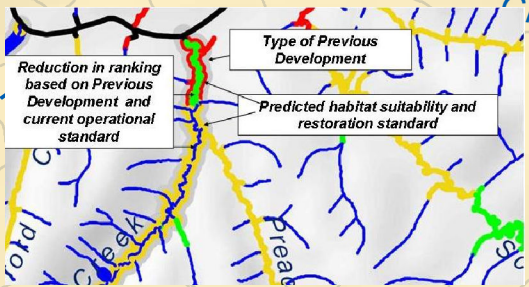
Development

- Current
- Historical
- Extensive

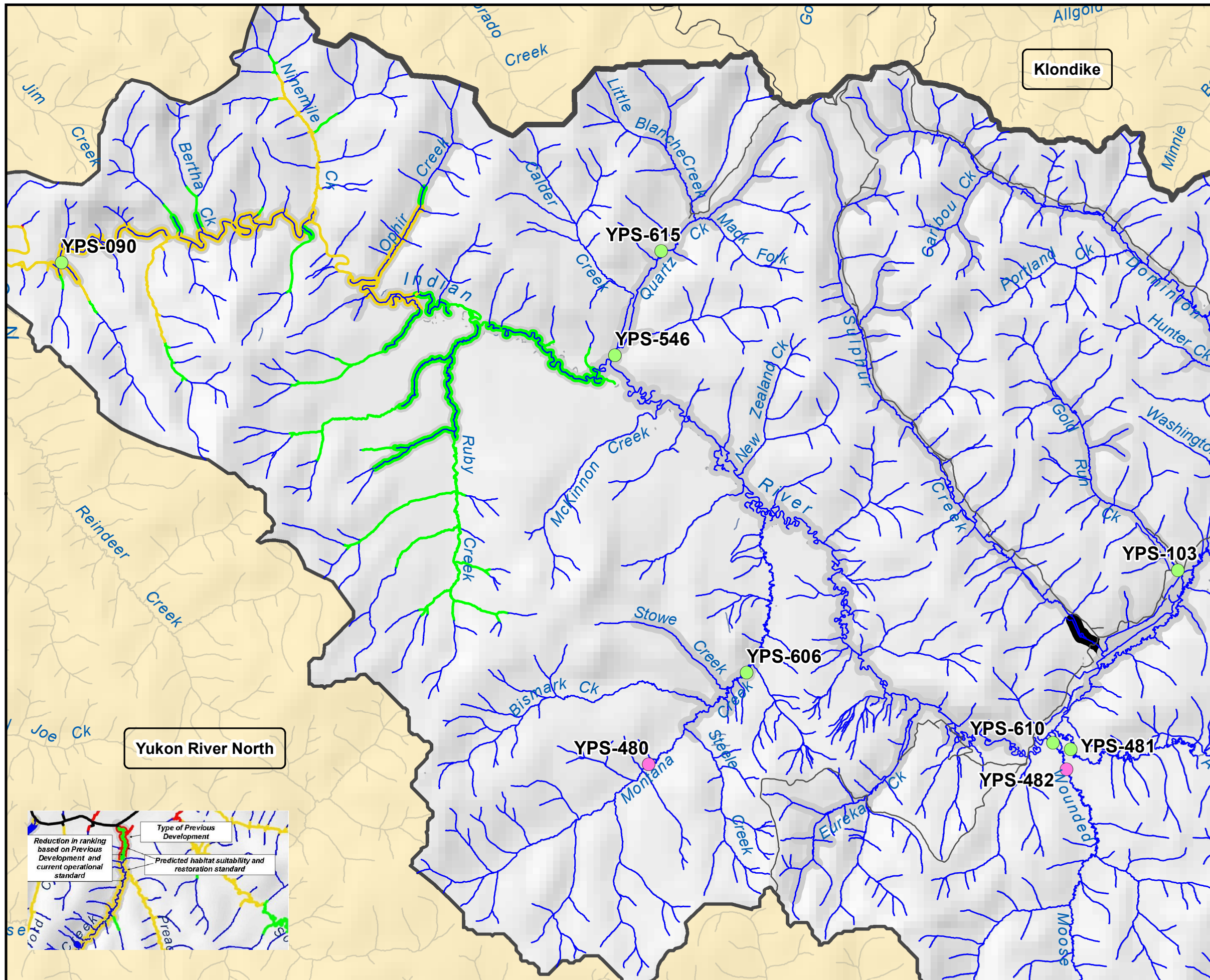
Roads

- Highway
- Primary Roads
- Local Roads
- - - Resource / Recreation

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Indian River Watershed Aquatic Health Monitoring Sites 2019



Monitoring Sites

- Reference Site
- Test Site

Stream Reach Classification

- Water Quality
- Low Suitability
- Moderate-Low Suitability
- Moderate-Moderate Suitability
- Moderate-High Suitability
- High Suitability
- Areas of Special Consideration (Ecological)
- Areas of Special Consideration (Cultural)

Development

- Current
- Historical
- Extensive

Roads

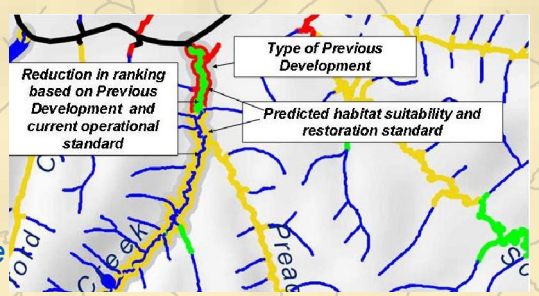
- Highway
- Primary Roads
- Local Roads
- Resource / Recreation



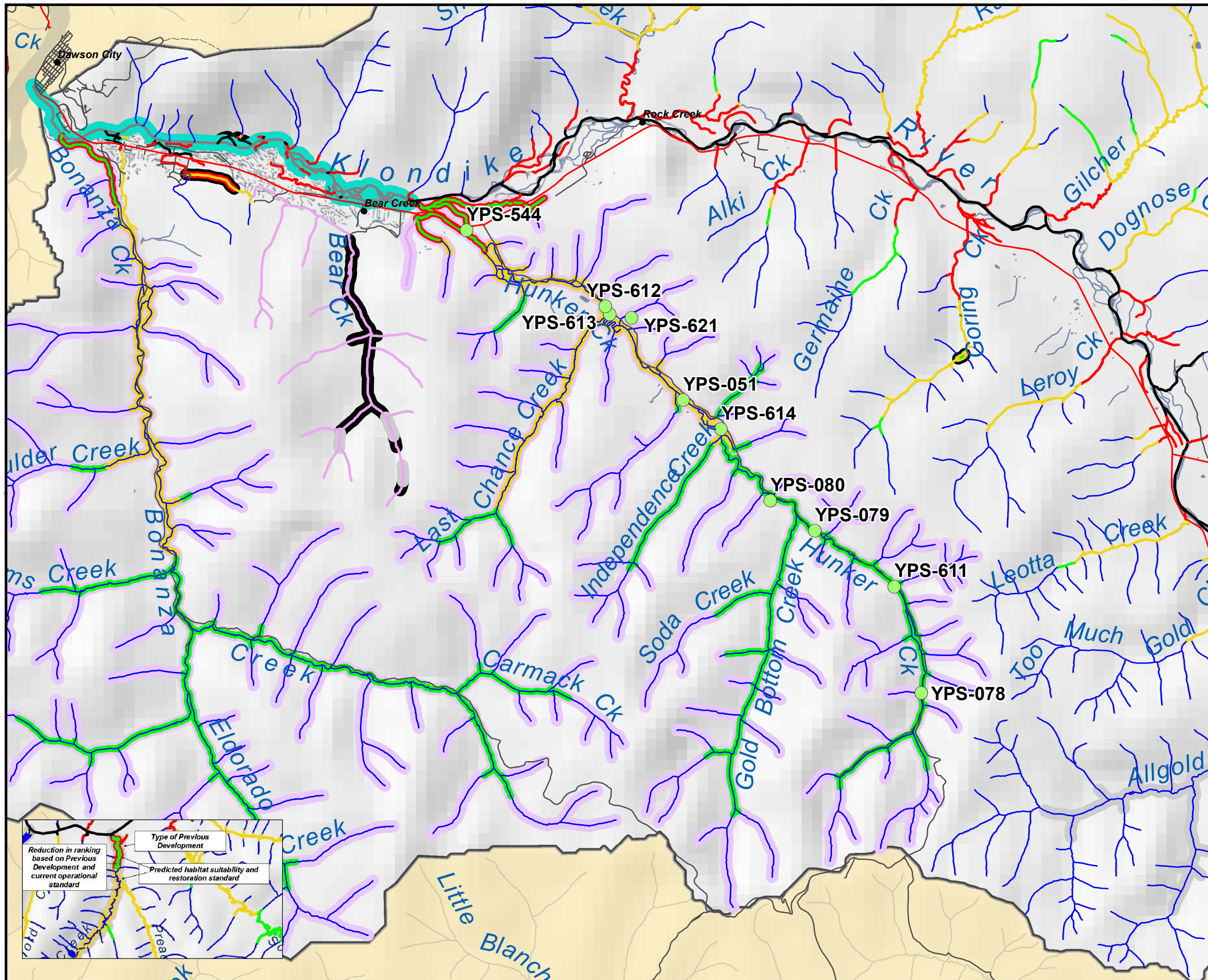
This map is provided to depict the location of water quality and weather monitoring sites in relation to streams classified using the Yukon Habitat Suitability Model, and is not intended for any other use. Under no circumstances will the Government of Canada, or Yukon Government be liable to any person or business entity for any direct, indirect, special, incidental, consequential, or other damages based on any use of information contained on this map, including, without limitation, any lost profits, business interruption, or loss of information.



Yukon River North



Klondike River Watershed Aquatic Health Monitoring Sites 2019



Monitoring Sites

- Reference Site
- Test Site

Stream Reach Classification

- Water Quality
- Low Suitability
- Moderate-Low Suitability
- Moderate-Moderate Suitability
- Moderate-High Suitability
- High Suitability
- Areas of Special Consideration (Ecological)
- Areas of Special Consideration (Cultural)



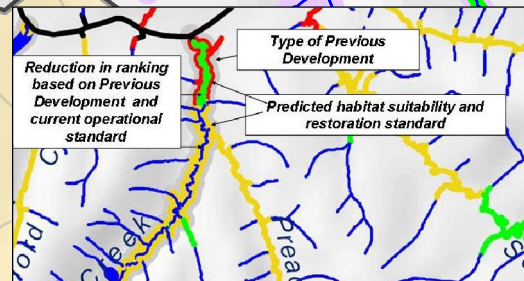
Development

- Current
- Historical
- Extensive

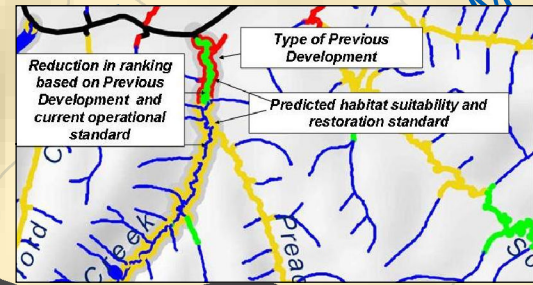
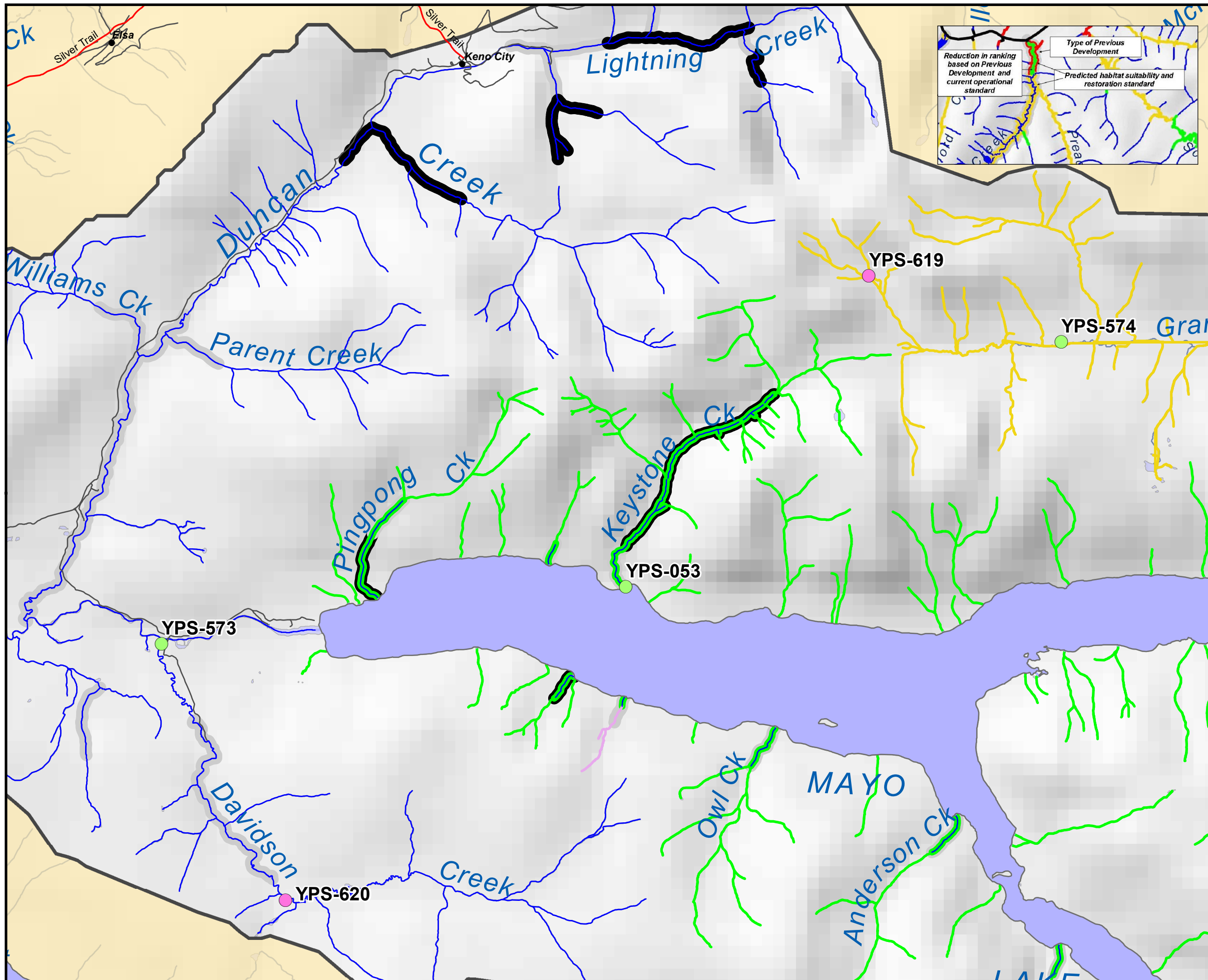
Roads

- Highway
- Primary Roads
- Local Roads
- Resource / Recreation

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Mayo Lake Watershed Aquatic Health Monitoring Sites 2019



Monitoring Sites

- Reference Site
- Test Site

Stream Reach Classification

- Water Quality
- Low Suitability
- Moderate-Low Suitability
- Moderate-Moderate Suitability
- Moderate-High Suitability
- High Suitability
- Areas of Special Consideration (Ecological)
- Areas of Special Consideration (Cultural)



Development

- Current
- Historical
- Extensive

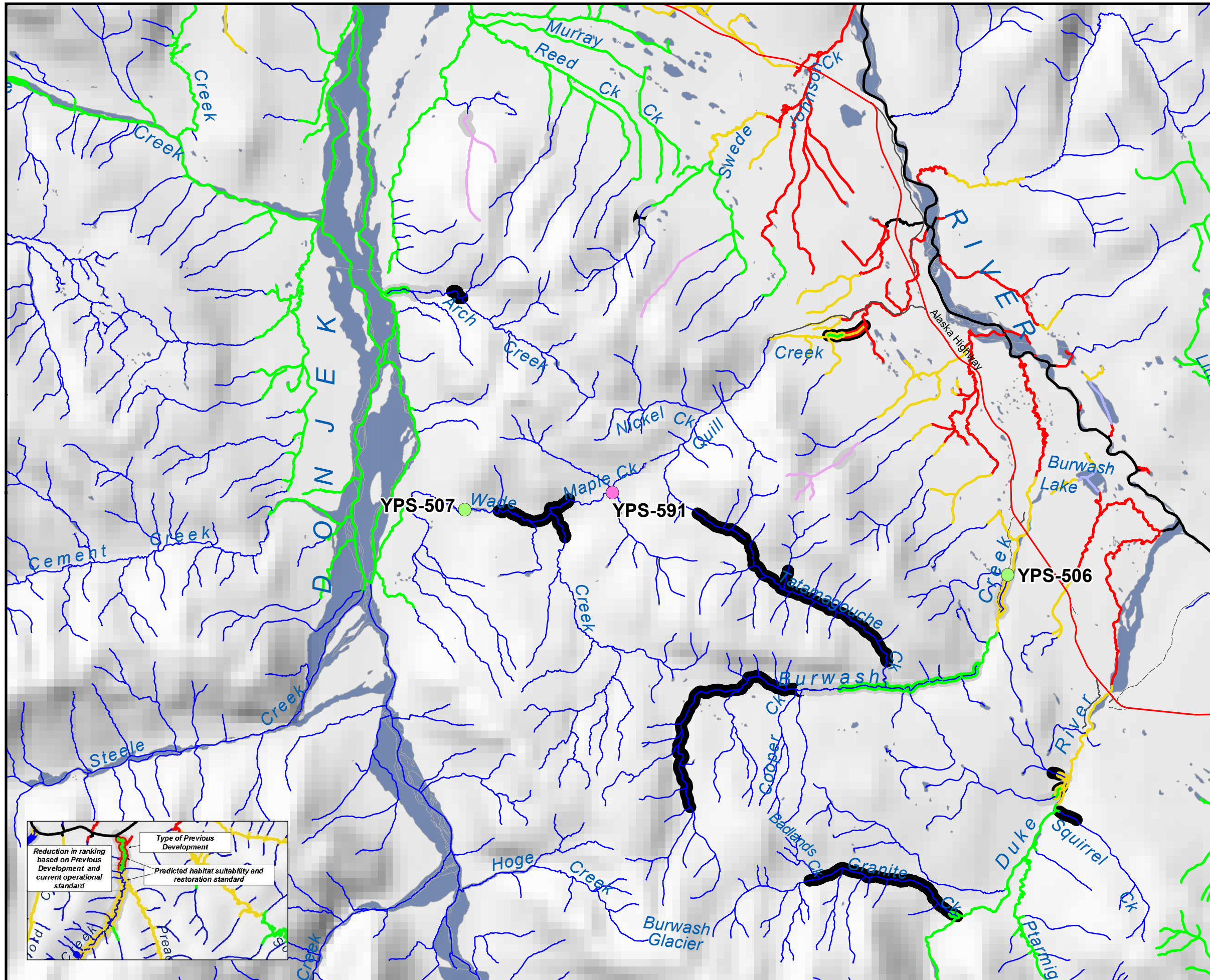
Roads

- Highway
- Primary Roads
- Local Roads
- Resource / Recreation

This map is provided to depict the location of water quality and weather monitoring sites in relation to streams classified using the Yukon Habitat Suitability Model, and is not intended for any other use. Under no circumstances will the Government of Canada, or Yukon Government be liable to any person or business entity for any direct, indirect, special, incidental, consequential, or other damages based on any use of information contained on this map, including, without limitation, any lost profits, business interruption, or loss of information.



White River Watershed Aquatic Health Monitoring Sites 2019



Monitoring Sites

- Reference Site
- Test Site

Stream Reach Classification

- Water Quality
- Low Suitability
- Moderate-Low Suitability
- Moderate-Moderate Suitability
- Moderate-High Suitability
- High Suitability
- Areas of Special Consideration (Ecological)
- Areas of Special Consideration (Cultural)



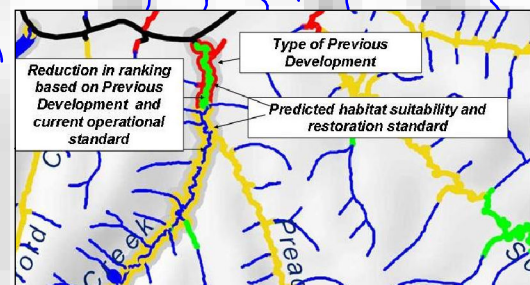
Development

- Current
- Historical
- Extensive

Roads

- Highway
- Primary Roads
- Local Roads
- Resource / Recreation

This map is provided to depict the location of water quality and weather monitoring sites in relation to streams classified using the Yukon Habitat Suitability Model, and is not intended for any other use. Under no circumstances will the Government of Canada, or Yukon Government be liable to any person or business entity for any direct, indirect, special, incidental, consequential, or other damages based on any use of information contained on this map, including, without limitation, any lost profits, business interruption, or loss of information.



Fish Habitat Management System for Yukon Placer Mining
Aquatic Heath Monitoring Program. 2019 Report.

Appendix B2

CABIN Reports for 2019 Sampling



Site Description

Study Name	Yukon Territory - AHM
Site	YPS-441
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.19205 N, 138.09311 W
Altitude	1161
Local Basin Name	4th of July Creek
	Alsek
Stream Order	2



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-441	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	40.3	
% Ephemeroptera	36.8	
% EPT Individuals	49.9	
% Plecoptera	11.6	
% Tricoptera	1.5	
Total Abundance	7940.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	15.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-441 [Q2]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.19205 N, 138.09311 W
Altitude	1161
Local Basin Name	4th of July Creek
	Alsek
Stream Order	2

Metrics

Name	YPS-441	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	35.5	
% Ephemeroptera	45.5	
% EPT Individuals	56.6	
% Plecoptera	11.1	
% Tricoptera	0.0	
Total Abundance	5300.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.8	
Simpson's Evenness	0.4	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-441 [Q3]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.19205 N, 138.09311 W
Altitude	1161
Local Basin Name	4th of July Creek
	Alsek
Stream Order	2

Metrics

Name	YPS-441	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	31.8	
% Ephemeroptera	50.8	
% EPT Individuals	62.8	
% Plecoptera	11.7	
% Tricoptera	0.3	
Total Abundance	2378.6	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-442
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.13369 N, 138.04436 W
Altitude	956
Local Basin Name	4th of July Creek (lower)
	Alsek
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-442	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	12.1	
% Ephemeroptera	72.5	
% EPT Individuals	79.9	
% Plecoptera	7.4	
% Tricoptera	0.0	
Total Abundance	3640.0	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.5	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-442 [Q2]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.13369 N, 138.04436 W
Altitude	956
Local Basin Name	4th of July Creek (lower)
	Alsek
Stream Order	4

Metrics

Name	YPS-442	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	12.9	
% Ephemeroptera	74.2	
% EPT Individuals	77.3	
% Plecoptera	3.1	
% Tricoptera	0.0	
Total Abundance	2746.2	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	12.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-442 [Q3]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.13369 N, 138.04436 W
Altitude	956
Local Basin Name	4th of July Creek (lower)
	Alsek
Stream Order	4

Metrics

Name	YPS-442	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	8.8	
% Ephemeroptera	77.8	
% EPT Individuals	81.3	
% Plecoptera	3.5	
% Tricoptera	0.0	
Total Abundance	3800.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	12.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-445
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.03664 N, 137.81393 W
Altitude	878
Local Basin Name	McKinley Creek
	Alsek
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-445	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	3.3	
% Ephemeroptera	68.1	
% EPT Individuals	70.2	
% Plecoptera	0.5	
% Tricoptera	1.5	
Total Abundance	7780.0	
Richness		
Shannon-Wiener Diversity	1.1	
Simpson's Diversity	0.5	
Simpson's Evenness	0.2	
Total No. of Taxa	13.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-445 [Q2]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.03664 N, 137.81393 W
Altitude	878
Local Basin Name	McKinley Creek
	Alsek
Stream Order	4

Metrics

Name	YPS-445	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	5.8	
% Ephemeroptera	53.3	
% EPT Individuals	54.7	
% Plecoptera	1.0	
% Tricoptera	0.5	
Total Abundance	5900.0	
Richness		
Shannon-Wiener Diversity	1.2	
Simpson's Diversity	0.6	
Simpson's Evenness	0.2	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-445 [Q3]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.03664 N, 137.81393 W
Altitude	878
Local Basin Name	McKinley Creek
	Alsek
Stream Order	4

Metrics

Name	YPS-445	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	6.3	
% Ephemeroptera	55.0	
% EPT Individuals	57.0	
% Plecoptera	0.6	
% Tricoptera	1.4	
Total Abundance	4387.5	
Richness		
Shannon-Wiener Diversity	1.3	
Simpson's Diversity	0.6	
Simpson's Evenness	0.2	
Total No. of Taxa	12.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-585
Sampling Date	Jul 19 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.17294 N, 138.00465 W
Altitude	1138
Local Basin Name	Larose Creek
	Alsek
Stream Order	3



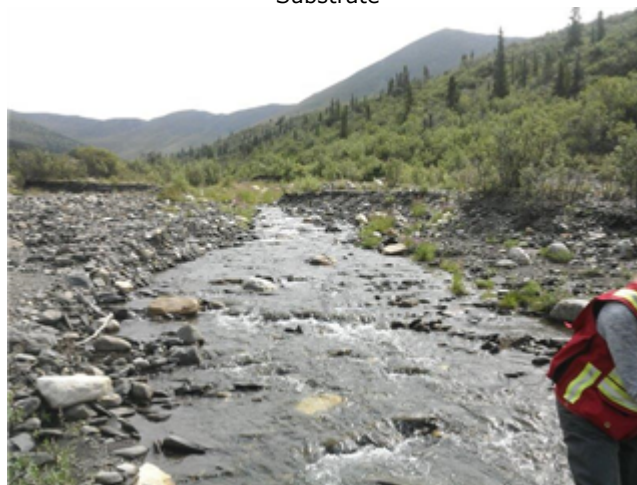
Across Reach



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-585	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	35.4	
% Ephemeroptera	16.0	
% EPT Individuals	19.4	
% Plecoptera	3.4	
% Tricoptera	0.0	
Total Abundance	1993.8	
Richness		
Shannon-Wiener Diversity	1.4	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-585 [Q2]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.17294 N, 138.00465 W
Altitude	1138
Local Basin Name	Larose Creek
	Alsek
Stream Order	3

Metrics

Name	YPS-585	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	44.5	
% Ephemeroptera	16.3	
% EPT Individuals	20.4	
% Plecoptera	4.1	
% Tricoptera	0.0	
Total Abundance	2453.8	
Richness		
Shannon-Wiener Diversity	1.4	
Simpson's Diversity	0.7	
Simpson's Evenness	0.4	
Total No. of Taxa	9.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-585 [Q3]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.17294 N, 138.00465 W
Altitude	1138
Local Basin Name	Larose Creek
	Alsek
Stream Order	3

Metrics

Name	YPS-585	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	47.9	
% Ephemeroptera	13.0	
% EPT Individuals	16.3	
% Plecoptera	3.3	
% Tricoptera	0.0	
Total Abundance	2578.6	
Richness		
Shannon-Wiener Diversity	1.3	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	9.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-597
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.11447 N, 138.02698 W
Altitude	931
Local Basin Name	Jarvis River
	Alsek
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-597	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	14.6	
% Ephemeroptera	62.5	
% EPT Individuals	66.7	
% Plecoptera	3.6	
% Tricoptera	0.6	
Total Abundance	4033.3	
Richness		
Shannon-Wiener Diversity	1.9	
Simpson's Diversity	0.8	
Simpson's Evenness	0.4	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-597 [Q2]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.11447 N, 138.02698 W
Altitude	931
Local Basin Name	Jarvis River
	Alsek
Stream Order	4

Metrics

Name	YPS-597	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	12.3	
% Ephemeroptera	62.5	
% EPT Individuals	68.5	
% Plecoptera	5.4	
% Tricoptera	0.6	
Total Abundance	2881.8	
Richness		
Shannon-Wiener Diversity	1.9	
Simpson's Diversity	0.8	
Simpson's Evenness	0.4	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-597 [Q3]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.11447 N, 138.02698 W
Altitude	931
Local Basin Name	Jarvis River
	Alsek
Stream Order	4

Metrics

Name	YPS-597	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	6.6	
% Ephemeroptera	81.8	
% EPT Individuals	84.8	
% Plecoptera	2.6	
% Tricoptera	0.3	
Total Abundance	3030.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-617
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.16550 N, 138.04955 W
Altitude	1025
Local Basin Name	4th of July Creek
	Alsek River
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-617	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	8.9	
% Ephemeroptera	73.5	
% EPT Individuals	86.9	
% Plecoptera	11.5	
% Tricoptera	1.8	
Total Abundance	2721.4	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	15.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-617 [Q2]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alesek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.16550 N, 138.04955 W
Altitude	1025
Local Basin Name	4th of July Creek
	Alesek River
Stream Order	4

Metrics

Name	YPS-617	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	17.6	
% Ephemeroptera	64.9	
% EPT Individuals	77.9	
% Plecoptera	12.5	
% Tricoptera	0.5	
Total Abundance	2807.1	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.8	
Simpson's Evenness	0.4	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-617 [Q3]
Sampling Date	Jul 18 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.16550 N, 138.04955 W
Altitude	1025
Local Basin Name	4th of July Creek
	Alsek River
Stream Order	4

Metrics

Name	YPS-617	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	17.5	
% Ephemeroptera	62.9	
% EPT Individuals	79.2	
% Plecoptera	15.4	
% Tricoptera	0.9	
Total Abundance	3081.8	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	15.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-618
Sampling Date	Jul 19 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.16612 N, 137.98233 W
Altitude	1216
Local Basin Name	Larose Creek
	Alsek River
Stream Order	2



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-618	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	21.4	
% Ephemeroptera	14.7	
% EPT Individuals	66.5	
% Plecoptera	51.7	
% Tricoptera	0.0	
Total Abundance	4325.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.8	
Simpson's Evenness	0.5	
Total No. of Taxa	8.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-618 [Q2]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.16612 N, 137.98233 W
Altitude	1216
Local Basin Name	Larose Creek
	Alsek River
Stream Order	2

Metrics

Name	YPS-618	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	23.6	
% Ephemeroptera	24.7	
% EPT Individuals	66.8	
% Plecoptera	42.1	
% Tricoptera	0.0	
Total Abundance	3400.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.8	
Simpson's Evenness	0.7	
Total No. of Taxa	7.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-618 [Q3]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	Alsek
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.16612 N, 137.98233 W
Altitude	1216
Local Basin Name	Larose Creek
	Alsek River
Stream Order	2

Metrics

Name	YPS-618	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	40.7	
% Ephemeroptera	10.1	
% EPT Individuals	36.5	
% Plecoptera	26.4	
% Tricoptera	0.0	
Total Abundance	3100.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.4	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-410
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.28972 N, 137.29472 W
Altitude	791
Local Basin Name	Bow Creek
	Big Creek
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-410	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	60.1	
% Ephemeroptera	7.9	
% EPT Individuals	20.2	
% Plecoptera	12.4	
% Tricoptera	0.0	
Total Abundance	3590.0	
Richness		
Shannon-Wiener Diversity	1.5	
Simpson's Diversity	0.6	
Simpson's Evenness	0.2	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-410 [Q2]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.28972 N, 137.29472 W
Altitude	791
Local Basin Name	Bow Creek
	Big Creek
Stream Order	4

Metrics

Name	YPS-410	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	60.0	
% Ephemeroptera	3.1	
% EPT Individuals	16.1	
% Plecoptera	12.7	
% Tricoptera	0.3	
Total Abundance	7120.0	
Richness		
Shannon-Wiener Diversity	1.4	
Simpson's Diversity	0.6	
Simpson's Evenness	0.2	
Total No. of Taxa	13.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-410 [Q3]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.28972 N, 137.29472 W
Altitude	791
Local Basin Name	Bow Creek
	Big Creek
Stream Order	4

Metrics

Name	YPS-410	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	32.7	
% Ephemeroptera	12.1	
% EPT Individuals	21.8	
% Plecoptera	9.4	
% Tricoptera	0.3	
Total Abundance	5683.3	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	13.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-411
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.34793 N, 137.30255 W
Altitude	690
Local Basin Name	Mechanic Creek
	Big Creek
Stream Order	2



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-411	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	41.7	
% Ephemeroptera	12.6	
% EPT Individuals	34.6	
% Plecoptera	21.5	
% Tricoptera	0.5	
Total Abundance	559.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	19.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-411 [Q2]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.34793 N, 137.30255 W
Altitude	690
Local Basin Name	Mechanic Creek
	Big Creek
Stream Order	2

Metrics

Name	YPS-411	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	51.6	
% Ephemeroptera	8.7	
% EPT Individuals	18.7	
% Plecoptera	10.0	
% Tricoptera	0.0	
Total Abundance	289.0	
Richness		
Shannon-Wiener Diversity	1.5	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-411 [Q3]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.34793 N, 137.30255 W
Altitude	690
Local Basin Name	Mechanic Creek
	Big Creek
Stream Order	2

Metrics

Name	YPS-411	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	39.0	
% Ephemeroptera	19.0	
% EPT Individuals	30.4	
% Plecoptera	11.0	
% Tricoptera	0.3	
Total Abundance	328.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.4	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-412
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.34889 N, 137.27139 W
Altitude	680
Local Basin Name	Big Creek
	Big Creek
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-412	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	20.9	
% Ephemeroptera	59.9	
% EPT Individuals	64.9	
% Plecoptera	4.4	
% Tricoptera	0.6	
Total Abundance	5650.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-412 [Q2]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.34889 N, 137.27139 W
Altitude	680
Local Basin Name	Big Creek
	Big Creek
Stream Order	4

Metrics

Name	YPS-412	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	49.2	
% Ephemeroptera	31.6	
% EPT Individuals	37.3	
% Plecoptera	3.9	
% Tricoptera	1.8	
Total Abundance	2606.7	
Richness		
Shannon-Wiener Diversity	1.5	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-412 [Q3]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.34889 N, 137.27139 W
Altitude	680
Local Basin Name	Big Creek
	Big Creek
Stream Order	4

Metrics

Name	YPS-412	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	33.3	
% Ephemeroptera	39.6	
% EPT Individuals	48.2	
% Plecoptera	6.6	
% Tricoptera	2.0	
Total Abundance	2330.8	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-414
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.35583 N, 137.17306 W
Altitude	632
Local Basin Name	Seymour Creek
	Big Creek
Stream Order	5



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-414	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	24.8	
% Ephemeroptera	65.9	
% EPT Individuals	71.0	
% Plecoptera	3.3	
% Tricoptera	1.8	
Total Abundance	2546.2	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	16.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-414 [Q2]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.35583 N, 137.17306 W
Altitude	632
Local Basin Name	Seymour Creek
	Big Creek
Stream Order	5

Metrics

Name	YPS-414	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	35.8	
% Ephemeroptera	51.7	
% EPT Individuals	56.4	
% Plecoptera	4.3	
% Tricoptera	0.3	
Total Abundance	3460.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	12.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-414 [Q3]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.35583 N, 137.17306 W
Altitude	632
Local Basin Name	Seymour Creek
	Big Creek
Stream Order	5

Metrics

Name	YPS-414	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	46.3	
% Ephemeroptera	43.1	
% EPT Individuals	50.7	
% Plecoptera	6.5	
% Tricoptera	1.2	
Total Abundance	3788.9	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-577
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.40106 N, 137.44690 W
Altitude	751
Local Basin Name	Big Creek
	Big Creek
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-577	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	31.8	
% Ephemeroptera	47.9	
% EPT Individuals	55.0	
% Plecoptera	5.7	
% Tricoptera	1.4	
Total Abundance	3172.7	
Richness		
Shannon-Wiener Diversity	1.9	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	15.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-577 [Q2]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.40106 N, 137.44690 W
Altitude	751
Local Basin Name	Big Creek
	Big Creek
Stream Order	4

Metrics

Name	YPS-577	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	23.1	
% Ephemeroptera	60.6	
% EPT Individuals	64.2	
% Plecoptera	3.3	
% Tricoptera	0.3	
Total Abundance	3070.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	16.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-577 [Q3]
Sampling Date	Jul 21 2019
Know Your Watershed Basin	Headwaters Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -Central EcoRegion
Coordinates (decimal degrees)	62.40106 N, 137.44690 W
Altitude	751
Local Basin Name	Big Creek
	Big Creek
Stream Order	4

Metrics

Name	YPS-577	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	16.6	
% Ephemeroptera	66.8	
% EPT Individuals	73.2	
% Plecoptera	4.9	
% Tricoptera	1.6	
Total Abundance	4812.5	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	16.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-090
Sampling Date	Aug 10 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.76944 N, 139.63000 W
Altitude	366
Local Basin Name	Indian Rive at Water Resources Station
	Indian River
Stream Order	6

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-090	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	17.7	
% Ephemeroptera	11.5	
% EPT Individuals	61.7	
% Plecoptera	2.4	
% Tricoptera	47.8	
Total Abundance	1994.1	
Richness		
Shannon-Wiener Diversity	1.9	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	19.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-103
Sampling Date	Aug 08 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	63.69139 N, 138.59778 W
Altitude	557
Local Basin Name	Gold Run Creek
	Indian River
Stream Order	3

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-103	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	70.2	
% Ephemeroptera	0.9	
% EPT Individuals	20.1	
% Plecoptera	2.6	
% Tricoptera	16.6	
Total Abundance	1933.3	
Richness		
Shannon-Wiener Diversity	1.2	
Simpson's Diversity	0.5	
Simpson's Evenness	0.1	
Total No. of Taxa	17.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-480
Sampling Date	Aug 09 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.59319 N, 139.05441 W
Altitude	568
Local Basin Name	Montana Creek
	Indian River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-480	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	47.4	
% Ephemeroptera	11.8	
% EPT Individuals	34.3	
% Plecoptera	22.3	
% Tricoptera	0.2	
Total Abundance	3816.7	
Richness		
Shannon-Wiener Diversity	1.5	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	12.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-481
Sampling Date	Aug 08 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.61597 N, 138.67836 W
Altitude	536
Local Basin Name	Australia Creek
	Indian River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-481	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	30.2	
% Ephemeroptera	35.1	
% EPT Individuals	46.4	
% Plecoptera	6.6	
% Tricoptera	4.7	
Total Abundance	2870.6	
Richness		
Shannon-Wiener Diversity	2.0	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	17.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-482
Sampling Date	Aug 08 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.60825 N, 138.68144 W
Altitude	521
Local Basin Name	Wounded Moose Creek
	Indian River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-482	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	36.5	
% Ephemeroptera	20.4	
% EPT Individuals	23.0	
% Plecoptera	2.5	
% Tricoptera	0.0	
Total Abundance	4542.9	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	12.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-546
Sampling Date	Aug 10 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.75424 N, 139.12285 W
Altitude	441
Local Basin Name	Quartz Creek
	Indian River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-546	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	78.3	
% Ephemeroptera	5.3	
% EPT Individuals	12.0	
% Plecoptera	4.6	
% Tricoptera	2.1	
Total Abundance	11680.0	
Richness		
Shannon-Wiener Diversity	0.9	
Simpson's Diversity	0.4	
Simpson's Evenness	0.2	
Total No. of Taxa	9.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-606
Sampling Date	Aug 09 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.63361 N, 138.97520 W
Altitude	499
Local Basin Name	Montana Creek
	Indian River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-606	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	28.7	
% Ephemeroptera	19.8	
% EPT Individuals	30.5	
% Plecoptera	10.5	
% Tricoptera	0.3	
Total Abundance	3350.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	12.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-610
Sampling Date	Aug 08 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.61792 N, 138.69458 W
Altitude	507
Local Basin Name	Wounded Moose Creek
	Indian River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-610	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	50.7	
% Ephemeroptera	16.9	
% EPT Individuals	33.1	
% Plecoptera	15.7	
% Tricoptera	0.5	
Total Abundance	3400.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	13.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-615
Sampling Date	Aug 09 2019
Know Your Watershed Basin	Central Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.79753 N, 139.09096 W
Altitude	501
Local Basin Name	Quartz Creek
	Indian River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-615	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	68.3	
% Ephemeroptera	0.5	
% EPT Individuals	3.8	
% Plecoptera	0.3	
% Tricoptera	3.0	
Total Abundance	8120.0	
Richness		
Shannon-Wiener Diversity	1.2	
Simpson's Diversity	0.5	
Simpson's Evenness	0.2	
Total No. of Taxa	13.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-051
Sampling Date	Aug 06 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.99167 N, 139.04111 W
Altitude	420
Local Basin Name	Hunker Creek downstream of Hester Creek inflow
	Klondike River
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-051	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	10.8	
% Ephemeroptera	52.4	
% EPT Individuals	65.6	
% Plecoptera	3.1	
% Tricoptera	10.1	
Total Abundance	462.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	20.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-078
Sampling Date	Aug 07 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.92250 N, 138.88389 W
Altitude	585
Local Basin Name	Hunker Creek upstream of Ontario Cr.
	Klondike River
Stream Order	3

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-078	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	25.0	
% Ephemeroptera	32.0	
% EPT Individuals	39.6	
% Plecoptera	6.4	
% Tricoptera	1.2	
Total Abundance	832.5	
Richness		
Shannon-Wiener Diversity	2.0	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	18.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-079
Sampling Date	Aug 07 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.96167 N, 138.95611 W
Altitude	492
Local Basin Name	Hunker Creek upstream of Gold Bottom Cr.
	Klondike River
Stream Order	3

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-079	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	75.7	
% Ephemeroptera	13.4	
% EPT Individuals	23.1	
% Plecoptera	1.5	
% Tricoptera	8.2	
Total Abundance	889.2	
Richness		
Shannon-Wiener Diversity	0.9	
Simpson's Diversity	0.4	
Simpson's Evenness	0.2	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-080
Sampling Date	Aug 07 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.96889 N, 138.98222 W
Altitude	460
Local Basin Name	Hunker Creek downstream of Gold Bottom Cr.
	Klondike River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-080	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	5.8	
% Ephemeroptera	64.5	
% EPT Individuals	90.7	
% Plecoptera	15.1	
% Tricoptera	11.1	
Total Abundance	3654.5	
Richness		
Shannon-Wiener Diversity	1.5	
Simpson's Diversity	0.6	
Simpson's Evenness	0.1	
Total No. of Taxa	19.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-544
Sampling Date	Aug 05 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	64.02940 N, 139.17841 W
Altitude	360
Local Basin Name	Hunker Creek
	Klondike River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-544	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	34.9	
% Ephemeroptera	33.5	
% EPT Individuals	47.3	
% Plecoptera	3.8	
% Tricoptera	9.9	
Total Abundance	730.0	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.2	
Total No. of Taxa	19.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-611
Sampling Date	Aug 11 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.94938 N, 138.90622 W
Altitude	519
Local Basin Name	Hunker Creek
	Klondike River
Stream Order	3

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-611	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	21.5	
% Ephemeroptera	6.9	
% EPT Individuals	53.8	
% Plecoptera	18.4	
% Tricoptera	28.4	
Total Abundance	2371.4	
Richness		
Shannon-Wiener Diversity	2.1	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	19.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-612
Sampling Date	Aug 06 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	64.01361 N, 139.09242 W
Altitude	389
Local Basin Name	Hunker Creek
	Klondike River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-612	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	4.7	
% Ephemeroptera	50.0	
% EPT Individuals	89.8	
% Plecoptera	12.7	
% Tricoptera	27.1	
Total Abundance	2238.9	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	20.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-613
Sampling Date	Aug 07 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	64.01166 N, 139.08920 W
Altitude	382
Local Basin Name	Hunker Creek
	Klondike River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-613	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	5.8	
% Ephemeroptera	38.3	
% EPT Individuals	84.3	
% Plecoptera	22.3	
% Tricoptera	23.7	
Total Abundance	1067.6	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.2	
Total No. of Taxa	21.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-614
Sampling Date	Aug 11 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.98524 N, 139.01706 W
Altitude	433
Local Basin Name	Hunker Creek
	Klondike River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-614	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	7.2	
% Ephemeroptera	59.8	
% EPT Individuals	84.1	
% Plecoptera	20.4	
% Tricoptera	3.9	
Total Abundance	3027.3	
Richness		
Shannon-Wiener Diversity	1.5	
Simpson's Diversity	0.6	
Simpson's Evenness	0.2	
Total No. of Taxa	13.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-621
Sampling Date	Aug 06 2019
Know Your Watershed Basin	Klondike
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	64.01131 N, 139.07620 W
Altitude	382
Local Basin Name	Hunker Creek
	Klondike River
Stream Order	4

Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Metrics

Name	YPS-621	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	12.7	
% Ephemeroptera	47.6	
% EPT Individuals	66.3	
% Plecoptera	4.1	
% Tricoptera	14.5	
Total Abundance	1266.7	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	19.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-053
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.78611 N, 135.20278 W
Altitude	671
Local Basin Name	Keystone Creek inflow to Mayo Lake
	Mayo Lake
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-053	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	22.7	
% Ephemeroptera	17.2	
% EPT Individuals	66.1	
% Plecoptera	45.7	
% Tricoptera	3.2	
Total Abundance	2175.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.3	
Total No. of Taxa	13.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-053 [Q2]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.78611 N, 135.20278 W
Altitude	671
Local Basin Name	Keystone Creek inflow to Mayo Lake
	Mayo Lake
Stream Order	4

Metrics

Name	YPS-053	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	21.3	
% Ephemeroptera	25.1	
% EPT Individuals	66.2	
% Plecoptera	36.2	
% Tricoptera	5.0	
Total Abundance	940.0	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	18.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-053 [Q3]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.78611 N, 135.20278 W
Altitude	671
Local Basin Name	Keystone Creek inflow to Mayo Lake
	Mayo Lake
Stream Order	4

Metrics

Name	YPS-053	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	26.7	
% Ephemeroptera	16.3	
% EPT Individuals	51.7	
% Plecoptera	32.3	
% Tricoptera	3.1	
Total Abundance	2462.5	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	16.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-573
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.76778 N, 135.45047 W
Altitude	659
Local Basin Name	Davidson Creek
	Mayo River
Stream Order	3



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-573	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	20.2	
% Ephemeroptera	50.3	
% EPT Individuals	61.4	
% Plecoptera	9.0	
% Tricoptera	2.1	
Total Abundance	1443.5	
Richness		
Shannon-Wiener Diversity	2.0	
Simpson's Diversity	0.8	
Simpson's Evenness	0.3	
Total No. of Taxa	17.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-573 [Q2]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.76778 N, 135.45047 W
Altitude	659
Local Basin Name	Davidson Creek
	Mayo River
Stream Order	3

Metrics

Name	YPS-573	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	26.2	
% Ephemeroptera	55.6	
% EPT Individuals	63.9	
% Plecoptera	8.0	
% Tricoptera	0.3	
Total Abundance	1565.0	
Richness		
Shannon-Wiener Diversity	1.7	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	17.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-573 [Q3]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.76778 N, 135.45047 W
Altitude	659
Local Basin Name	Davidson Creek
	Mayo River
Stream Order	3

Metrics

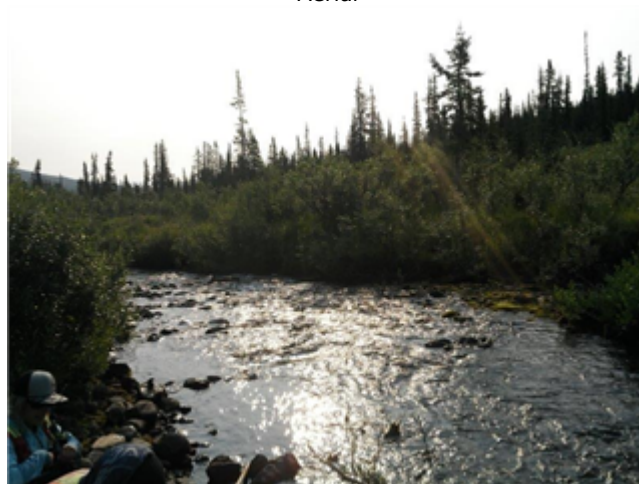
Name	YPS-573	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	34.1	
% Ephemeroptera	42.6	
% EPT Individuals	53.2	
% Plecoptera	9.7	
% Tricoptera	0.9	
Total Abundance	1360.0	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.8	
Simpson's Evenness	0.2	
Total No. of Taxa	20.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-574
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.84809 N, 134.97409 W
Altitude	1079
Local Basin Name	Granite Creek
	Mayo River
Stream Order	3



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-574	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	44.7	
% Ephemeroptera	25.1	
% EPT Individuals	51.4	
% Plecoptera	24.5	
% Tricoptera	1.8	
Total Abundance	4300.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-574 [Q2]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.84809 N, 134.97409 W
Altitude	1079
Local Basin Name	Granite Creek
	Mayo River
Stream Order	3

Metrics

Name	YPS-574	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	42.3	
% Ephemeroptera	27.9	
% EPT Individuals	52.1	
% Plecoptera	21.2	
% Tricoptera	3.1	
Total Abundance	3988.9	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	15.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-574 [Q3]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.84809 N, 134.97409 W
Altitude	1079
Local Basin Name	Granite Creek
	Mayo River
Stream Order	3

Metrics

Name	YPS-574	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	41.6	
% Ephemeroptera	23.8	
% EPT Individuals	48.0	
% Plecoptera	19.8	
% Tricoptera	4.4	
Total Abundance	4914.3	
Richness		
Shannon-Wiener Diversity	1.8	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	16.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-619
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.86203 N, 135.07918 W
Altitude	1287
Local Basin Name	Granite Creek
	Mayo River
Stream Order	2



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-619	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	63.6	
% Ephemeroptera	10.3	
% EPT Individuals	25.9	
% Plecoptera	14.2	
% Tricoptera	1.4	
Total Abundance	9720.0	
Richness		
Shannon-Wiener Diversity	1.4	
Simpson's Diversity	0.6	
Simpson's Evenness	0.1	
Total No. of Taxa	16.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-619 [Q2]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.86203 N, 135.07918 W
Altitude	1287
Local Basin Name	Granite Creek
	Mayo River
Stream Order	2

Metrics

Name	YPS-619	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	55.6	
% Ephemeroptera	19.2	
% EPT Individuals	34.3	
% Plecoptera	13.6	
% Tricoptera	1.5	
Total Abundance	10480.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.2	
Total No. of Taxa	14.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-619 [Q3]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.86203 N, 135.07918 W
Altitude	1287
Local Basin Name	Granite Creek
	Mayo River
Stream Order	2

Metrics

Name	YPS-619	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	60.8	
% Ephemeroptera	21.0	
% EPT Individuals	31.9	
% Plecoptera	10.3	
% Tricoptera	0.6	
Total Abundance	9940.0	
Richness		
Shannon-Wiener Diversity	1.4	
Simpson's Diversity	0.6	
Simpson's Evenness	0.2	
Total No. of Taxa	15.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-620
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.70848 N, 135.37745 W
Altitude	884
Local Basin Name	Davidson Creek
	Mayo River
Stream Order	3



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-620	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	65.0	
% Ephemeroptera	3.1	
% EPT Individuals	6.3	
% Plecoptera	1.7	
% Tricoptera	1.4	
Total Abundance	5014.3	
Richness		
Shannon-Wiener Diversity	1.0	
Simpson's Diversity	0.5	
Simpson's Evenness	0.2	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-620 [Q2]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.70848 N, 135.37745 W
Altitude	884
Local Basin Name	Davidson Creek
	Mayo River
Stream Order	3

Metrics

Name	YPS-620	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	74.2	
% Ephemeroptera	7.5	
% EPT Individuals	8.8	
% Plecoptera	0.6	
% Tricoptera	0.6	
Total Abundance	2453.8	
Richness		
Shannon-Wiener Diversity	1.0	
Simpson's Diversity	0.4	
Simpson's Evenness	0.2	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-620 [Q3]
Sampling Date	Jul 22 2019
Know Your Watershed Basin	Stewart
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Yukon Plateau -North EcoRegion
Coordinates (decimal degrees)	63.70848 N, 135.37745 W
Altitude	884
Local Basin Name	Davidson Creek
	Mayo River
Stream Order	3

Metrics

Name	YPS-620	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	69.4	
% Ephemeroptera	1.6	
% EPT Individuals	2.6	
% Plecoptera	0.5	
% Tricoptera	0.5	
Total Abundance	6416.7	
Richness		
Shannon-Wiener Diversity	0.9	
Simpson's Diversity	0.5	
Simpson's Evenness	0.2	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-506
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.41572 N, 139.22974 W
Altitude	870
Local Basin Name	Burwash Creek
	White
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-506	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	34.0	
% Ephemeroptera	37.3	
% EPT Individuals	54.0	
% Plecoptera	16.4	
% Tricoptera	0.3	
Total Abundance	324.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.4	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-506 [Q2]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.41572 N, 139.22974 W
Altitude	870
Local Basin Name	Burwash Creek
	White
Stream Order	4

Metrics

Name	YPS-506	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	34.5	
% Ephemeroptera	36.9	
% EPT Individuals	46.8	
% Plecoptera	9.4	
% Tricoptera	0.5	
Total Abundance	203.0	
Richness		
Shannon-Wiener Diversity	1.5	
Simpson's Diversity	0.7	
Simpson's Evenness	0.4	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-506 [Q3]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Ruby Ranges EcoRegion
Coordinates (decimal degrees)	61.41572 N, 139.22974 W
Altitude	870
Local Basin Name	Burwash Creek
	White
Stream Order	4

Metrics

Name	YPS-506	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	36.5	
% Ephemeroptera	37.6	
% EPT Individuals	52.3	
% Plecoptera	14.7	
% Tricoptera	0.0	
Total Abundance	197.0	
Richness		
Shannon-Wiener Diversity	1.6	
Simpson's Diversity	0.7	
Simpson's Evenness	0.4	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-507
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone St.Elias Mountains EcoRegion
Coordinates (decimal degrees)	61.41689 N, 139.64717 W
Altitude	897
Local Basin Name	Wade Creek
	White
Stream Order	4



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-507	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	70.1	
% Ephemeroptera	22.6	
% EPT Individuals	24.5	
% Plecoptera	1.9	
% Tricoptera	0.0	
Total Abundance	1063.3	
Richness		
Shannon-Wiener Diversity	1.0	
Simpson's Diversity	0.5	
Simpson's Evenness	0.2	
Total No. of Taxa	9.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-507 [Q2]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone St.Elias Mountains EcoRegion
Coordinates (decimal degrees)	61.41689 N, 139.64717 W
Altitude	897
Local Basin Name	Wade Creek
	White
Stream Order	4

Metrics

Name	YPS-507	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	86.0	
% Ephemeroptera	9.7	
% EPT Individuals	12.3	
% Plecoptera	2.6	
% Tricoptera	0.0	
Total Abundance	1595.5	
Richness		
Shannon-Wiener Diversity	0.6	
Simpson's Diversity	0.3	
Simpson's Evenness	0.1	
Total No. of Taxa	10.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-507 [Q3]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone St.Elias Mountains EcoRegion
Coordinates (decimal degrees)	61.41689 N, 139.64717 W
Altitude	897
Local Basin Name	Wade Creek
	White
Stream Order	4

Metrics

Name	YPS-507	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	76.0	
% Ephemeroptera	15.1	
% EPT Individuals	16.9	
% Plecoptera	1.8	
% Tricoptera	0.0	
Total Abundance	1481.8	
Richness		
Shannon-Wiener Diversity	0.9	
Simpson's Diversity	0.4	
Simpson's Evenness	0.2	
Total No. of Taxa	9.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-591
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone St.Elias Mountains EcoRegion
Coordinates (decimal degrees)	61.42923 N, 139.53664 W
Altitude	1136
Local Basin Name	Unnamed Tributary to Wade Creek
	White River
Stream Order	2



Aerial



Down Stream



Substrate



Up Stream

Metrics

Name	YPS-591	Predicted Group Reference Mean \pm SD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	9.8	
% Ephemeroptera	73.2	
% EPT Individuals	80.9	
% Plecoptera	7.7	
% Tricoptera	0.0	
Total Abundance	4642.9	
Richness		
Shannon-Wiener Diversity	1.3	
Simpson's Diversity	0.5	
Simpson's Evenness	0.2	
Total No. of Taxa	11.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-591 [Q2]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone St.Elias Mountains EcoRegion
Coordinates (decimal degrees)	61.42923 N, 139.53664 W
Altitude	1136
Local Basin Name	Unnamed Tributary to Wade Creek
	White River
Stream Order	2

Metrics

Name	YPS-591	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	15.0	
% Ephemeroptera	66.5	
% EPT Individuals	70.5	
% Plecoptera	4.0	
% Tricoptera	0.0	
Total Abundance	8000.0	
Richness		
Shannon-Wiener Diversity	1.3	
Simpson's Diversity	0.6	
Simpson's Evenness	0.3	
Total No. of Taxa	9.0	

Site Description

Study Name	Yukon Territory - AHM
Site	YPS-591 [Q3]
Sampling Date	Jul 19 2019
Know Your Watershed Basin	White
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone St.Elias Mountains EcoRegion
Coordinates (decimal degrees)	61.42923 N, 139.53664 W
Altitude	1136
Local Basin Name	Unnamed Tributary to Wade Creek
	White River
Stream Order	2

Metrics

Name	YPS-591	Predicted Group Reference Mean \pmSD
Bray-Curtis Distance	--	--
Number Of Individuals		
% Chironomidae	14.5	
% Ephemeroptera	68.8	
% EPT Individuals	73.0	
% Plecoptera	4.2	
% Tricoptera	0.0	
Total Abundance	11020.0	
Richness		
Shannon-Wiener Diversity	1.2	
Simpson's Diversity	0.6	
Simpson's Evenness	0.3	
Total No. of Taxa	8.0	

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Stream Habitat Characteristics



Appendix B3

Table 3-1: Reference Sites Physical Habitat Characteristics

Watershed	Watercourse Name	Site	Year	Altitude (m)	Stream Order	Average Depth (cm)	Maximum Depth (cm)	Canopy Coverage	Slope (%)	Maximum Velocity (m/s)	Bankfull Width (m)	Wetted Width (m)	Dominant Substrate	Embeddedness	Periphyton Coverage (mm thickness)	
Alsek River	4th of July Creek	YPS-441	2010	1161	2	20	29	1–25%	0.5	1.1	7.1	4	small cobble	25%	nr	
			2018	1161	2	8.3	14	1–25%	0.4	0.4	3.7	3.3	small cobble	25%	0.5–1	
			2019	1161	2	10	12	26–50%	0.5	0.7	4.4	3.9	small cobble	25%	0.5–1	
		Larose Creek	YPS-618	2019	1216	2	12	14	26–50%	0.4	0.6	3.5	3.2	small cobble	25%	1–5
	McKinley Creek	YPS-445	2010	878	4	22.2	30	1–25%	0.15	0.92	12.5	9.2	large cobble	25%	nr	
			2016	878	4	25.5	43	1–25%	0.12	1.2	11.5	10.8	large pebble	0%	1–5	
			2017	878	4	27.2	47	1–25%	0.05	1.3	15.2	10.9	gravel	50%	1–5	
2018			878	4	17.8	26.5	1–25%	0.15	0.7	12.2	9.1	large pebble	25%	<0.5		
			2019	878	4	21.8	30	1–25%	0.15	0.8	11.8	8.4	small cobble	25%	0.5–1	
Big Creek	Bow Creek	YPS-410	2009	791	4	19.2	30	1–25%	0.2	0.36	11.7	8.5	large cobble	50%	nr	
			2016	791	4	41.1	65.5	1–25%	0.23	0.7	9.4	9.4	small pebble	50%	1–5	
			2019	791	4	16.8	26.5	26–50%	0.25	0.6	5.3	4.7	large cobble	25%	1–5	
Indian River	Wounded Moose Creek	YPS-482	2011	537	4	39.6	49	1–25%	0.1	0.87	5.4	3.5	large cobble	0%	nr	
			2013	537	4	26.2	28	1–25%	0.025	0.4	3.9	3.9	large cobble	25%	nr	
			2016	537	4	56.8	71	26–50%	0.05	0.8	4.5	4.5	small cobble	50%	0.5–1	
			2018	537	4	34.8	39	26–50%	0.05	0.4	3.5	3.3	small cobble	25%	0.5–1	
			2019	521	4	18.6	20	1–25%	0.2	0.5	3.6	3.6	small cobble	50%	<0.5	
	Montana Creek	YPS-480	2011	568	4	33	39	51–75%	nr	1.48	11.7	2.2	large cobble	25%	nr	
			2013	568	4	60	65	51–75%	0.1	0.34	2.6	2.4	small cobble	0%	nr	
			2018	568	4	33	37	76–100%	0.1	0.3	2.5	1.7	small cobble	50%	<0.5	
			2019	568	4	31	35	51–75%	0.15	0.3	2.3	1	small cobble	25%	<0.5	
Mayo River	Granite Creek	YPS-619	2019	1287	2	10.8	12.5	51–75%	0.55	0.4	2.2	2.2	small cobble	25%	1–5	
	Davidson Creek	YPS-620	2019	884	3	17.8	22	1–25%	0.2	0.2	4.5	4.5	large cobble	25%	5–20	
White River	Unnamed Tributary to Wade Creek	YPS-591	2016	1136	2	12.7	23	26–50%	0.35	1.4	8.9	5	small pebble	25%	<0.5	
			2019	1136	2	7.7	13	1–25%	0.3	0.3	11.5	4.2	large pebble	0%	<0.5	

Notes: nr = not reported

Appendix B3

Table 3-2: Alek River Watershed Physical Habitat Characteristics

Watercourse Name	Site	Year	Altitude (m)	Stream Order	Average Depth (cm)	Maximum Depth (cm)	Canopy Coverage	Slope (%)	Maximum Velocity (m/s)	Bankfull Width (m)	Wetted Width (m)	Dominant Substrate	Embeddedness	Periphyton Coverage (mm thickness)
Larose Creek	YPS-585	2016	1138	3	19	30	1–25%	0.52	1.6	23.8	5.1	large pebble	25%	<0.5
		2017	1138	3	19.5	29	1–25%	0.45	0.8	13	4	large pebble	50%	<0.5
		2019	1138	3	12.7	16	0%	0.45	0.5	11.3	5	small cobble	25%	0.5–1
4th of July Creek	YPS-617	2019	1025	4	18.3	25	26–50%	0.2	0.7	4.8	4.8	small cobble	25%	0.5–1
4th of July Creek (lower)	YPS-442	2010	956	4	40.2	65	1–25%	0.2	0.87	17.4	5	gravel	25%	nr
		2016	956	4	36	58	1–25%	0.13	1.6	22.5	9.5	small pebble	25%	<0.5
		2017	956	4	46	51	1–25%	0.25	1.2	21.6	6.1	small pebble	0%	<0.5
		2018	956	4	15.8	25	1–25%	0.25	1.4	20.1	5.1	small cobble	50%	0.5–1
		2019	956	4	17.6	23	1–25%	0.2	0.7	23.5	9.3	small cobble	25%	0.5–1
Jarvis River	YPS-597	2017	931	4	30.9	47	1–25%	0.15	1.4	19.6	7.6	small pebble	25%	<0.5
		2018	931	4	11.8	18	1–25%	0.2	1	13.2	6.2	large pebble	25%	0.5–1
		2019	931	4	27.5	36	1–25%	0.2	0.9	9.7	7	large pebble	25%	0.5–1

Notes: nr = not reported

Appendix B3

Table 3-3: Big Creek Watershed Physical Habitat Characteristics

Watercourse Name	Site	Year	Altitude (m)	Stream Order	Average Depth (cm)	Maximum Depth (cm)	Canopy Coverage	Slope (%)	Maximum Velocity (m/s)	Bankfull Width (m)	Wetted Width (m)	Dominant Substrate	Embeddedness	Periphyton Coverage (mm thickness)
Big Creek	YPS-577	2015	751	4	35.2	56	1-25%	0.05	0.6	22.6	11.4	large pebble	50%	0.5-1
		2016	751	4	69.1	92	1-25%	0.05	1.5	25.3	20.1	large pebble	50%	<0.5
		2017	751	4	29.6	73	1-25%	0.05	1.4	24.4	20.2	large pebble	50%	<0.5
		2019	751	4	30	59	1-25%	0.05	0.9	24.2	13	large pebble	0%	0.5-1
Mechanic Creek	YPS-411	2009	690	2	11	11	1-25%	0.4	0.12	12.2	2.2	large pebble	25%	nr
		2014	690	2	7.3	11	1-25%	0.3	0.3	11.4	1.2	large pebble	25%	nr
		2015	690	2	7.9	11.4	1-25%	0.5	0.1	8.2	1.7	small cobble	25%	<0.5
		2019	690	2	4.8	7	1-25%	0.2	0.2	3	1.2	large pebble	0%	<0.5
Big Creek	YPS-412	2009	680	4	62.2	86	1-25%	0.05	0.2	35	13.7	large pebble	25%	nr
		2014	674	4	82.8	94	1-25%	0.025	0.9	42.1	18.6	large pebble	25%	nr
		2015	674	4	37	73	1-25%	0.1	0.8	34.5	13.1	large pebble	25%	0.5-1
		2017	674	4	53.6	83	1-25%	0.075	1.3	24.5	24.5	large pebble	50%	<0.5
		2019	680	4	20.3	31.5	1-25%	0.15	0.7	80	15.3	small cobble	25%	1-5
Seymour Creek	YPS-414	2009	632	5	21.6	27	1-25%	0.15	0.55	28	6.7	large pebble	25%	nr
		2014	638	5	23.9	33	1-25%	0.15	1.1	18.1	7.1	large pebble	50%	nr
		2015	638	5	15.3	20.5	26-50%	0.1	0.7	12.3	11.7	large pebble	50%	<0.5
		2019	632	5	17.7	29	1-25%	0.2	0.8	23	6.2	small cobble	0%	<0.5

Notes: nr = not reported

Appendix B3

Table 3-4: Indian River Watershed Physical Habitat Characteristics

Watercourse Name	Site	Year	Altitude (m)	Stream Order	Average Depth (cm)	Maximum Depth (cm)	Canopy Coverage	Slope (%)	Maximum Velocity (m/s)	Bankfull Width (m)	Wetted Width (m)	Dominant Substrate	Embeddedness	Periphyton Coverage (mm thickness)
Gold Run Creek	YPS-103	2006	557	3	26.5	nr	nr	nr	nr	nr	4.5	small cobble	50%	nr
		2017	557	3	26.2	36.5	1–25%	0.05	0.4	3	3	gravel	25%	<0.5
		2019	557	3	15.2	20	0%	0.25	0.2	10.3	3.1	large pebble	50%	0.5–1
Australia Creek	YPS-481	2011	536	4	35	75	1–25%	0.1	0.88	22	9.6	large cobble	25%	nr
		2013	536	4	26.4	53	1–25%	nr	0.8	10.4	8.8	large cobble	25%	nr
		2014	536	4	30.6	41	1–25%	0.15	0.8	10.2	10	small cobble	25%	nr
		2016	536	4	46.4	55	1–25%	0.1	1.1	13.2	12.4	small cobble	25%	0.5–1
		2019	536	4	22	30	0%	0.1	0.8	5	5.5	large pebble	25%	<0.5
Wounded Moose Creek	YPS-610	2019	507	4	18	22	0%	0.1	0.8	6.1	3.4	large pebble	25%	0.5–1
Montana Creek	YPS-606	2018	499	4	23.2	29	51–75%	0.05	0.2	6.6	5	small cobble	25%	<0.5
		2019	499	4	25.5	34.5	1–25%	0.1	0.3	4.7	5.3	small cobble	25%	0.5–1
Quartz Creek	YPS-615	2019	501	4	12.8	16.5	0%	0.2	0.1	4.7	4.1	small cobble	25%	<0.5
Quartz Creek	YPS-546	2013	441	4	13.6	15	1–25%	0.1	0.6	6	4.5	sand/silt/clay	75%	nr
		2017	441	4	13.2	23	1–25%	0.05	0.8	9.3	9.1	small cobble	50%	<0.5
		2018	441	4	10.6	14	26–50%	0.05	0.3	7.6	6	large pebble	25%	0.5–1
		2019	441	4	15	18	1–25%	0.1	0.3	5.6	4.9	small cobble	50%	1–5
Indian River at Water Resources Station	YPS-090	2006	366	6	51.4	nr	0%	nr	nr	nr	nr	gravel	75%	nr
		2009	366	6	19	28	0%	0.1	0.84	31.8	19.6	large cobble	50%	nr
		2013	366	6	39.2	42	1–25%	nr	1.01	34.3	19.5	small cobble	0%	nr
		2014	366	6	39	45	0%	0.11	0.5	30	30	small cobble	50%	nr
		2016	366	6	63.5	83	0%	0.05	1.6	37	28	large cobble	0%	0.5–1
		2017	366	6	29	39.5	1–25%	0.075	1.6	41	27.7	small cobble	50%	0.5–1
		2018	366	6	19.5	28.5	1–25%	0.075	0.7	46	37	large pebble	25%	1–5
2019	366	6	27.2	31	0%	0.25	0.6	19.8	19.8	small cobble	0%	0.5–1		

Notes: nr = not reported

Appendix B3

Table 3-5: Klondike River Watershed Physical Habitat Characteristics

Watercourse Name	Site	Year	Altitude (m)	Stream Order	Average Depth (cm)	Maximum Depth (cm)	Canopy Coverage	Slope (%)	Maximum Velocity (m/s)	Bankfull Width (m)	Wetted Width (m)	Dominant Substrate	Embeddedness	Periphyton Coverage (mm thickness)
Hunker Creek upstream of Ontario Cr.	YPS-078	2006	585	3	20.4	nr	nr	nr	nr	nr	2.5	small cobble	0%	nr
		2008	585	3	8.7	12	26–50%	nr	0.44	9.2	3.8	sand/silt/clay	50%	nr
		2010	586	3	6	12	51–75%	0.2	0.75	3.8	2.3	sand/silt/clay	25%	nr
		2012	585	3	8.7	13	26–50%	0.3	0.53	6.4	3.6	large cobble	25%	nr
		2013	585	3	10	16	1–25%	0.3	0.4	6.7	3.2	small cobble	25%	nr
		2016	586	3	20.6	23	1–25%	0.3	0.8	4.4	3.4	small cobble	50%	<0.5
		2018	586	3	7.3	9	1–25%	0.2	0.5	8.7	3.3	small pebble	25%	<0.5
2019	585	3	8	11	0%	0.2	0.4	5.5	2.4	large pebble	50%	<0.5		
Hunker Creek	YPS-611	2019	519	3	10	11	26–50%	0.25	0.2	2.4	1.6	large pebble	25%	1–5
Hunker Creek upstream of Gold Bottom Cr.	YPS-079	2006	492	3	13.4	nr	nr	nr	nr	nr	3.9	small cobble	25%	nr
		2019	492	3	6.3	9	0%	0.1	0.5	8	3.2	gravel	0%	<0.5
Hunker Creek downstream of Gold Bottom Cr.	YPS-080	2006	460	4	27.4	nr	nr	nr	nr	nr	5.1	large pebble	0%	nr
		2019	460	4	13	15	26–50%	0.25	0.4	6.4	4	small cobble	75%	1–5
Hunker Creek	YPS-614	2019	433	4	14.3	17.5	26–50%	0.15	0.5	6.4	4	large pebble	25%	0.5–1
Hunker Creek downstream of Hester Creek inflow	YPS-051	2005	420	4	22.9	nr	nr	nr	nr	nr	7.7	gravel	25%	nr
		2006	420	4	35.9	nr	nr	nr	nr	nr	5.8	gravel	25%	nr
		2019	420	4	15.2	22	1–25%	0.2	0.8	13.1	3	small pebble	25%	<0.5
Hunker Creek	YPS-621	2019	382	4	23.4	40	26–50%	0.2	0.3	6.6	6.2	small pebble	50%	0.5–1
Hunker Creek	YPS-613	2019	382	4	21.7	26	1–25%	0.2	0.5	9.1	2.4	small cobble	50%	<0.5
Hunker Creek	YPS-612	2019	389	4	22.4	33	26–50%	0.1	0.6	9.4	4.8	small cobble	75%	0.5–1
Hunker Creek	YPS-544	2006	360	4	29.5	nr	nr	nr	nr	nr	4.5	large pebble	50%	nr
		2013	359	4	19	31	1–25%	0.05	0.63	8.9	5.8	sand/silt/clay	50%	nr
		2014	360	4	24.8	31	1–25%	0.05	0.4	8.7	8.1	gravel	50%	nr
		2015	359	4	18.2	25	1–25%	0.05	0.9	8.8	6.7	large pebble	50%	<0.5
		2016	359	4	47	72	26–50%	nr	0.8	9.1	8.2	sand/silt/clay	100%	<0.5
		2017	359	4	23.4	34	26–50%	0.075	0.8	8.9	7.2	large pebble	75%	<0.5
		2018	359	4	10.8	15	51–75%	0.05	0.5	9	6.4	large pebble	25%	<0.5
2019	360	4	10.2	18.6	1–25%	0.1	0.2	7.9	6.6	small pebble	25%	<0.5		

Notes: nr = not reported

Appendix B3

Table 3-6: Mayo River Watershed Physical Habitat Characteristics

Watercourse Name	Site	Year	Altitude (m)	Stream Order	Average Depth (cm)	Maximum Depth (cm)	Canopy Coverage	Slope (%)	Maximum Velocity (m/s)	Bankfull Width (m)	Wetted Width (m)	Dominant Substrate	Embeddedness	Periphyton Coverage (mm thickness)
Granite Creek	YPS-574	2015	1079	3	37	52	1-25%	0.15	0.9	6.7	5.7	large cobble	25%	<0.5
		2016	1079	3	33.2	43	1-25%	0.15	0.7	7.1	5.6	large cobble	25%	0.5-1
		2017	1079	3	24.4	38	0%	0.175	0.8	8	5.1	large cobble	75%	1-5
		2018	1079	3	26	35	1-25%	0.25	1.3	6.3	6.3	large cobble	50%	1-5
		2019	1079	3	15.7	25	26-50%	0.2	0.3	5.3	5.2	small cobble	0%	1-5
Keystone Creek inflow to Mayo Lake	YPS-053	2005	671	4	23	nr	nr	nr	nr	nr	7	small cobble	0%	nr
		2018	671	4	21.7	36	1-25%	0.25	1.1	8.7	5.5	small cobble	50%	<0.5
		2019	671	4	16	20	1-25%	0.25	0.7	8.6	3.6	small cobble	0%	0.5-1
Davidson Creek	YPS-573	2015	659	3	25.2	39	1-25%	0.1	1	10.7	7	large cobble	25%	<0.5
		2018	659	3	28.6	54	26-50%	0.15	1.2	10	6.8	small cobble	50%	0.5-1
		2019	659	3	7.8	11	1-25%	0.2	0.2	9.8	5.4	small pebble	0%	<0.5

Notes: nr = not reported

Appendix B3

Table 3-7: White River Watershed Physical Habitat Characteristics

Watercourse Name	Site	Year	Altitude (m)	Stream Order	Average Depth (cm)	Maximum Depth (cm)	Canopy Coverage	Slope (%)	Maximum Velocity (m/s)	Bankfull Width (m)	Wetted Width (m)	Dominant Substrate	Embeddedness	Periphyton Coverage (mm thickness)
Wade Creek	YPS-507	2011	897	4	55	55	0%	0.25	2.1	56	8.5	large cobble	0%	nr
		2019	897	4	19	22	0%	0.35	0.8	31	4.9	large pebble	25%	0.5-1
Burwash Creek	YPS-506	2011	870	4	44.8	62	1-25%	0.1	1.76	16.5	16.5	large pebble	25%	nr
		2015	870	4	26.1	40	1-25%	0.21	1.1	36	11.2	small cobble	0%	<0.5
		2019	870	4	17.6	37	1-25%	0.15	0.8	52	9.1	small cobble	0%	<0.5

Notes: nr = not reported

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Appendix B4

Summary Statistics for Benthic Metrics of Invertebrate Taxonomic Triplicate Samples



Appendix B4

Table 4-1: Summary Statistics for Total Abundance, Richness, Simpson's Diversity Index, and Simpson's Evenness Index at 2019 Sites with Three Replicate Benthic Invertebrate Taxonomy Samples

Watershed	Watercourse Name	Site	Count	Abundance					Richness					Simpson's Diversity Index (SDI)					Simpson's Evenness Index (SEI)				
				Mean	Min	Max	SD	CV	Mean	Min	Max	SD	CV	Mean	Min	Max	SD	CV	Mean	Min	Max	SD	CV
Alsek River	4th of July Creek (reference)	YPS-441	3	5206	2379	7940	2782	53.4	13	11	15	2.1	15.6	0.74	0.74	0.75	0.01	1.16	0.30	0.26	0.37	0.06	20.32
Alsek River	Larose Creek (reference)	YPS-618	3	3608	3100	4325	639	17.7	8	7	10	1.5	18.3	0.77	0.75	0.79	0.02	2.99	0.54	0.40	0.69	0.15	27.24
Alsek River	McKinley Creek (reference)	YPS-445	3	6022	4388	7780	1700	28.2	13	12	14	1.0	7.7	0.60	0.55	0.65	0.05	8.45	0.20	0.17	0.24	0.03	17.01
Alsek River	Larose Creek	YPS-585	3	2342	1994	2579	308	13.2	10	9	11	1.2	11.9	0.68	0.66	0.69	0.02	2.34	0.32	0.29	0.36	0.03	10.49
Alsek River	4th of July Creek	YPS-617	3	2870	2721	3082	188	6.6	14	11	15	2.3	16.9	0.78	0.76	0.80	0.02	2.99	0.33	0.29	0.38	0.05	13.57
Alsek River	4th of July Creek (lower)	YPS-442	3	3395	2746	3800	568	16.7	11	10	12	1.2	10.2	0.76	0.75	0.79	0.02	2.62	0.38	0.33	0.47	0.08	20.08
Alsek River	Jarvis River	YPS-597	3	3315	2882	4033	626	18.9	14	14	14	0.0	0.0	0.80	0.76	0.82	0.04	4.69	0.36	0.29	0.40	0.06	16.89
Big Creek	Bow Creek (reference)	YPS-410	3	5464	3590	7120	1775	32.5	13	13	14	0.6	4.3	0.64	0.60	0.71	0.06	10.12	0.21	0.18	0.27	0.05	22.38
Big Creek	Big Creek	YPS-577	3	3685	3070	4813	978	26.5	16	15	16	0.6	3.7	0.74	0.71	0.78	0.04	4.83	0.25	0.22	0.30	0.05	18.62
Big Creek	Mechanic Creek	YPS-411	3	392	289	559	146	37.2	13	10	19	5.2	40.0	0.72	0.69	0.74	0.03	4.39	0.30	0.20	0.39	0.09	30.78
Big Creek	Big Creek	YPS-412	3	3529	2331	5650	1842	52.2	13	11	14	1.7	13.3	0.71	0.66	0.76	0.05	7.21	0.27	0.21	0.31	0.06	20.51
Big Creek	Seymour Creek	YPS-414	3	3265	2546	3789	644	19.7	13	11	16	2.6	20.4	0.72	0.71	0.74	0.02	2.34	0.28	0.24	0.31	0.04	13.03
Mayo River	Granite Creek (reference)	YPS-619	3	10047	9720	10480	391	3.9	15	14	16	1.0	6.7	0.61	0.57	0.66	0.04	7.17	0.17	0.15	0.21	0.03	18.28
Mayo River	Davidson Creek (reference)	YPS-620	3	4628	2454	6417	2009	43.4	11	11	11	0.0	0.0	0.46	0.43	0.50	0.04	7.76	0.17	0.16	0.18	0.01	6.85
Mayo River	Granite Creek	YPS-574	3	4401	3989	4914	471	10.7	15	14	16	1.0	6.7	0.73	0.71	0.75	0.02	2.89	0.24	0.24	0.25	0.00	1.63
Mayo River	Keystone Creek inflow to Mayo Lake	YPS-053	3	1859	940	2463	809	43.5	16	13	18	2.5	16.1	0.77	0.75	0.79	0.02	3.13	0.29	0.26	0.30	0.03	8.82
Mayo River	Davidson Creek	YPS-573	3	1456	1360	1565	103	7.1	18	17	20	1.7	9.6	0.74	0.70	0.77	0.04	4.80	0.22	0.20	0.26	0.03	14.86
White River	Unnamed Tributary to Wade Creek (reference)	YPS-591	3	7888	4643	11020	3190	40.4	9	8	11	1.5	16.4	0.57	0.55	0.59	0.02	4.36	0.25	0.20	0.28	0.04	17.14
White River	Wade Creek	YPS-507	3	1380	1063	1595	280	20.3	9	9	10	0.6	6.2	0.38	0.25	0.48	0.11	30.06	0.18	0.13	0.21	0.04	22.44
White River	Burwash Creek	YPS-506	3	241	197	324	72	29.7	10	10	10	0.0	0.0	0.73	0.72	0.74	0.01	1.02	0.37	0.36	0.38	0.01	2.76

Notes: SD = standard deviation; CV = coefficient of variation; min = minimum; max = maximum

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Appendix B5

Analysis of Substrate Composition Methods



Introduction

Identifying the optimal number of samples is important for cost-effective habitat monitoring programs. Too few samples can lead to biases, increased variance and inaccurate characterization of habitats, while diminishing returns on sampling effort can lead to inefficient use of time and resources, which is especially important when sampling remote habitats. The Aquatic Health Monitoring Program (AHMP) aims to monitor the impacts of placer mining on streams throughout the Yukon Territory. The Canadian Benthic Invertebrate Network (CABIN) is the standardized protocols used by the Aquatic Health Monitoring Program for sampling aquatic habitats. Historically the AHM program relied on a modified (not based on CABIN) substrate sampling method, which used a basic characterization of stream bed substrate composition (using 10 measurements) to reduce the sampling time required at each location. In 2019, 100 measurements were performed at each of the 39 sample sites, following standard CABIN protocols. Given the variability in substrate composition within and among sites monitored by our program we assessed the value of increasing substrate sample sizes to 100 measurements, which is a more standard sample number (Bain and Stevenson 1999, EC 2012).

Question: What is the difference in the mean values from 10 substrate measurements compared to mean values from 100 substrate measurements?

Objective: Compare the estimated mean substrate values between sample sizes of 10 and 100 substrate measurements.

Methods

In 2019, substrate sizes were randomly measured using the same methods as in previous years of the AHMP but sample sizes were increased from 10 to 100 substrate measurements at each site. Briefly, rocks were selected by conducting a random walk through the sampled area and stopping every few steps to select the closest rock. The intermediate axis of each rock was measured in the field using a ruler.

Using the 100 substrate measurements for each site, we resampled the full dataset by drawing a random sample without replacement to generate 100 subsets of pebble measurements for sample size and site. Sample sizes ranged from 10 to 80 by increments of 5. We calculated the geometric mean of the subset and compared it to the geometric mean of the full dataset ($n=100$). Using the mean values for each sample size and site we calculated the coefficient of variation ($CV = [\text{standard deviation}/\text{geometric mean of the full dataset}] * 100$). We used a benchmark of a CV of 10% as an acceptable difference between the geometric means from smaller sample sizes when compared to the full dataset.

Results

The coefficient of variation in geometric mean diameter decreased with increasing sample size (Figure 1). The mean CV across all sites for sample sizes of 10 substrate measurements was 32% and ranged from 18% to 59%. CVs decreased to less than 10% with 75 or more samples for all sites.

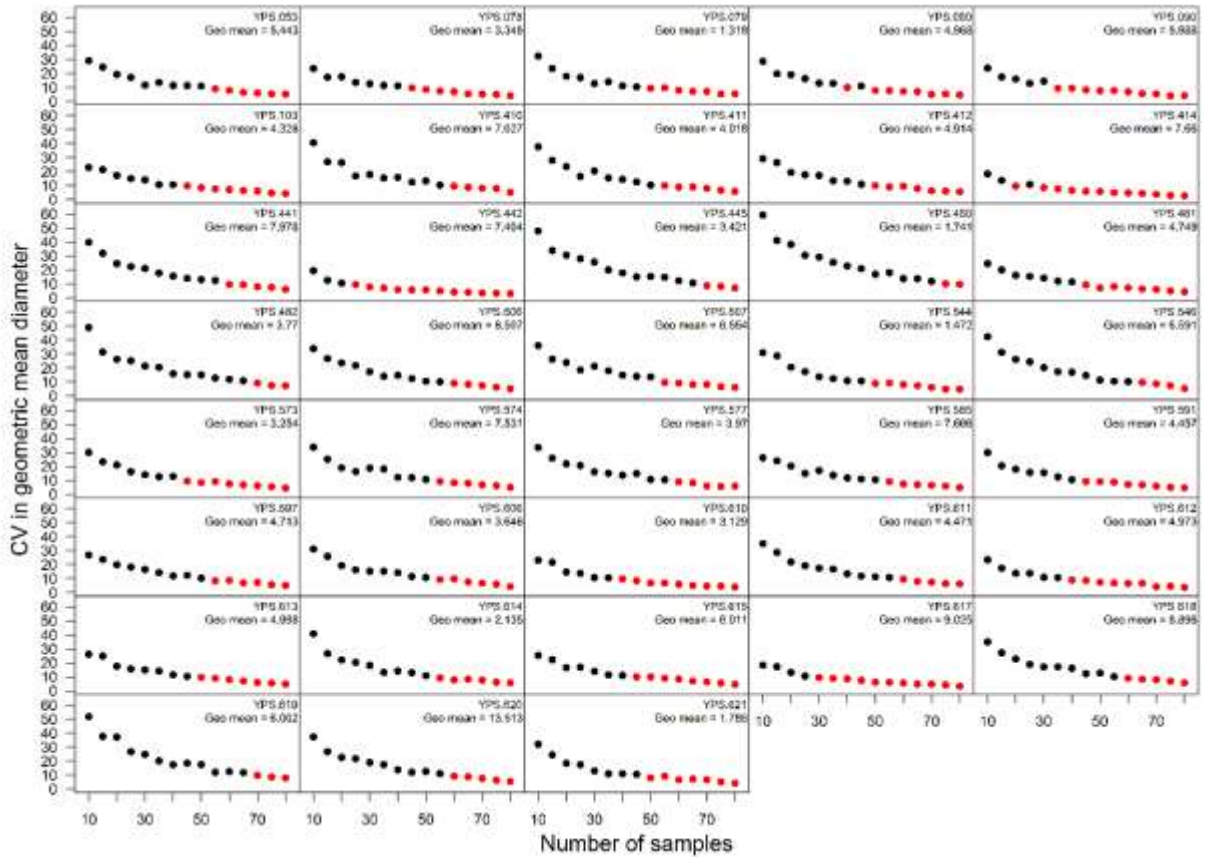


Figure 1. Change in coefficient of variation in geometric mean diameter by sample size. Number of samples are random subsets of substrate measurements from the total set ($n=100$) for each site. Coefficient of variation is calculated using mean values from 100 trials for each sample size. Red points indicate sample sizes with CVs less than or equal to 10 % (See Figure 2 for how different CVs translate to distributions in mean substrate size).

For context, Figure 2 shows distribution of mean values for samples from a site with a geometric mean value of 5 cm and a CV of 10, 20, 30 and 40%. Using site YPS.053 as an example (top left box in Figure 1), for a sample size of 10 the distribution of geometric mean substrate size would correspond to Figure 2C where the CV is 30%. If the sample size increased to ≥ 55 the distribution of potential geometric mean values would look more similar to Figure 2A where the CV is 10%.

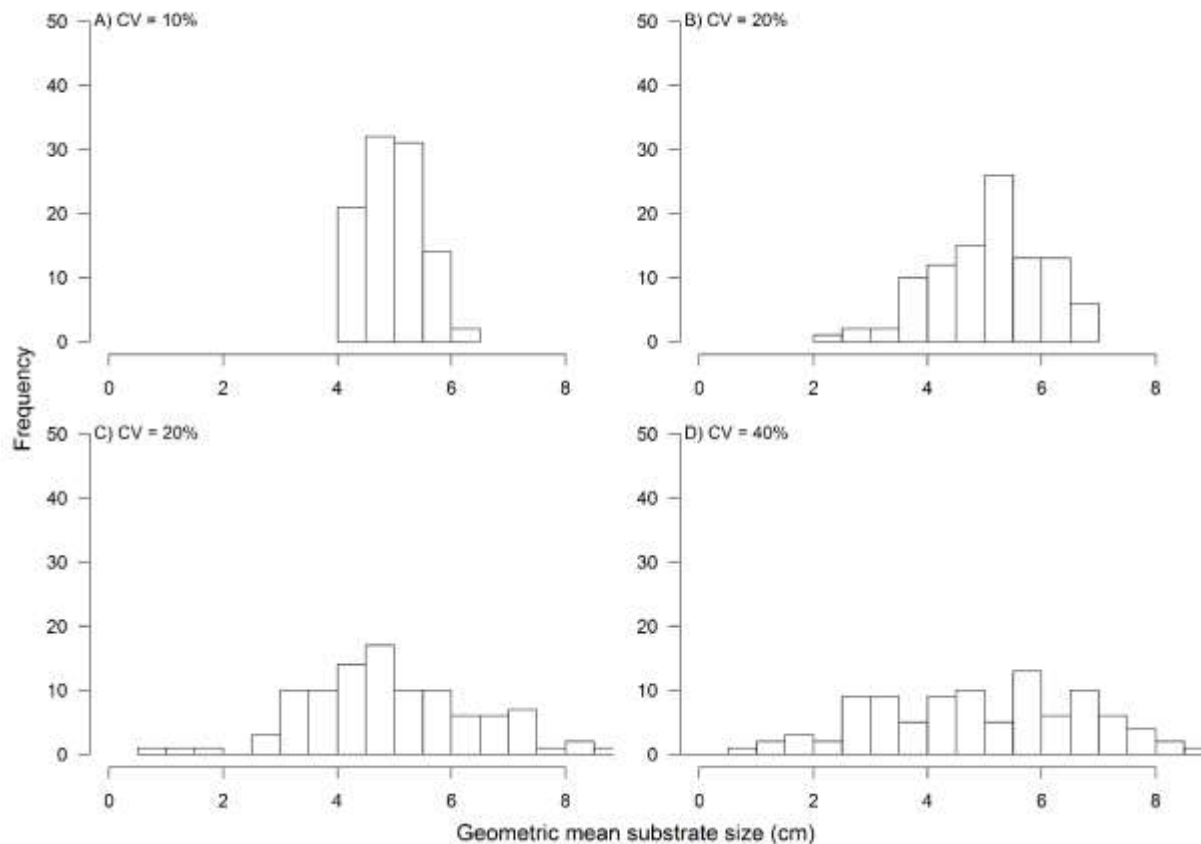


Figure 2. Simulated distributions of geometric mean substrate size assuming a geometric mean substrate size of 5 cm and CVs of A) 10%, B) 20%, C) 30%, and D) 40%.

Recommendations

Our analysis shows that substantial variation in calculated geometric mean substrate size can occur when sample sizes are <75. Therefore, we recommend that a sample size of 100 substrate measurements be used to characterize substrate composition at aquatic health monitoring sites.

References

Bain, M., and N. Stevenson. (1999). Aquatic habitat assessment: common methods. American Fisheries Society.

EC (Environment Canada). 2012. Canadian Aquatic Biomonitoring Network: Field Manual Wadeable Streams.

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Appendix B6

2019 In-situ Sediment Data



Appendix B6

Table 6-1: 2019 Substrate Data

Watershed	Watercourse Name	Site	CABIN Field Data									Laboratory Data							
			Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Pebble (%)	Sand (%)	Silt+Clay (%)	Wolman D50 (cm)	Wolman Dg (cm)	Moisture (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Texture	Total Nitrogen (%)	Total Organic Carbon (%)
Alesk River	4th of July Creek (reference)	YPS-441	0	19	44	4	29	0	3	9.1	7.6	9.8	43.3	56.1	<1.0	<1.0	Sand	0.032	0.601
	Larose Creek (reference)	YPS-618	0	15	56	1	26	0	2	10.1	8.5	13.1	49.2	48.1	2.7	<1.0	Sand	0.037	0.713
	McKinley Creek (reference)	YPS-445	0	4	35	9	42	0	10	4.55	2.9	19.6	5.8	76.5	15.6	2.1	Loamy sand	0.035	0.58
	Larose Creek	YPS-585	0	7	57	3	31	0	2	8.35	7.5	10.8	29.2	69.1	1.7	<1.0	Sand	0.022	0.512
	4th of July Creek	YPS-617	0	4	72	3	21	0	0	10.75	9	10.1	17.6	76.7	4.4	1.2	Sand	0.026	0.598
	4th of July Creek (lower)	YPS-442	0	2	65	0	33	0	0	7.55	7.4	18	<1.0	81.4	15.5	2.2	Loamy sand	0.036	0.639
	Jarvis River	YPS-597	0	1	39	3	52	0	5	5.45	4.4	27.6	<1.0	83	14.6	2.1	Sand	0.046	0.795
Big Creek	Bow Creek (reference)	YPS-410	0	6	55	0	33	0	6	9.3	6.5	26	1.9	89.6	7.4	1.1	Sand	0.023	0.31
	Big Creek	YPS-577	0	0	36	3	56	0	5	5.4	3.6	19.5	11.6	84.6	3.4	<1.0	Sand	<0.020	0.238
	Mechanic Creek	YPS-411	0	1	33	2	55	0	9	4.95	3.5	22.9	6.3	81.4	10	2.3	Sand	0.031	0.402
	Big Creek	YPS-412	0	1	49	8	38	0	4	6.25	4.6	20.3	<1.0	98.3	1.1	<1.0	Sand	<0.020	0.138
	Seymour Creek	YPS-414	0	2	57	0	41	0	0	7.6	7.7	13.1	29.2	68.1	2.3	<1.0	Sand	0.02	0.247
Indian River	Wounded Moose Creek (reference)	YPS-482	0	2	45	13	35	0	5	5.95	3.4	14.5	36	49.3	12.9	1.9	Loamy sand	0.048	0.872
	Montana Creek (reference)	YPS-480	0	0	40	14	37	0	10	3.4	1.4	10.8	36.4	53.9	8.3	1.4	Sand	0.037	0.404
	Gold Run Creek	YPS-103	0	0	39	3	57	0	1	5.2	4.2	37.4	1.7	43.7	50.1	4.5	Sandy loam	0.082	1.23
	Australia Creek	YPS-481	0	0	38	1	61	0	0	5.5	4.7	20.3	9.2	73.3	15.8	1.7	Loamy sand	0.041	0.66
	Wounded Moose Creek	YPS-610	0	0	17	17	65	0	1	3.55	3.1	14.1	19.8	64.9	13.7	1.7	Loamy sand	0.025	0.415
	Montana Creek	YPS-606	0	0	35	13	48	0	4	4.5	3.4	14.7	16	65.8	15.9	2.3	Loamy sand	0.039	0.834
	Quartz Creek	YPS-615	0	0	61	0	38	0	1	7.05	5.8	19.2	23	67.1	8.6	1.4	Sand	0.027	0.212
	Quartz Creek	YPS-546	8	0	42	3	44	0	3	6	4.8	20.8	10.6	70.5	16.3	2.7	Loamy sand	0.04	0.863
Klondike River	Indian River at Water Resources Station	YPS-090	0	0	60	3	35	0	2	6.95	5.8	15.6	32.3	49.9	15.7	2	Loamy sand	0.038	0.48
	Hunker Creek upstream of Ontario Cr.	YPS-078	0	0	24	19	56	0	1	3.7	3.3	20.6	22.3	67.3	9	1.4	Sand	0.032	0.286
	Hunker Creek	YPS-611	0	0	39	7	51	0	3	4.65	4.2	35.6	3.1	50.6	37	9.3	Sandy loam	0.113	1.59
	Hunker Creek upstream of Gold Bottom Cr.	YPS-079	0	0	5	45	41	0	8	1.5	1.2	26.5	4.9	69.4	23.5	2.1	Loamy sand	0.045	0.567
	Hunker Creek downstream of Gold Bottom Cr.	YPS-080	0	0	52	4	42	0	2	6.45	4.8	24.9	<1.0	61.4	34.4	4.3	Sandy loam	0.084	1.1
	Hunker Creek	YPS-614	0	0	10	16	62	0	12	2.75	1.8	43.6	9.8	40.6	42.1	7.5	Sandy loam	0.133	1.96
	Hunker Creek downstream of Hester Creek inflow	YPS-051	0	0	32	6	61	0	1	3.6	3.8	36.3	35.8	39.5	21.9	2.8	Sandy loam	0.074	1.27
	Hunker Creek	YPS-621	0	0	3	27	61	0	9	2	1.6	11.9	30.1	56.6	11.6	1.8	Loamy sand	0.027	0.44
	Hunker Creek	YPS-613	0	0	54	3	41	0	2	6.45	4.8	19.9	34.6	53.5	10.4	1.5	Loamy sand	0.067	0.704
Mayo River	Hunker Creek	YPS-612	0	0	43	2	52	0	3	5.95	4.8	39	<1.0	26.9	60.1	12.6	Silt loam	0.181	2.68
	Hunker Creek	YPS-544	0	0	4	31	52	0	13	1.95	1.2	21	30.7	55.9	11.7	1.7	Loamy sand	0.033	0.442
	Granite Creek (reference)	YPS-619	0	17	44	4	32	0	2	9	5.6	26.4	14.6	57.9	25.4	2.1	Sandy loam / Loamy sand	0.106	1.12
	Davidson Creek (reference)	YPS-620	0	23	64	1	10	0	2	16.5	13.1	7.53	18.5	75.9	5.3	<1.0	Sand	0.027	0.338
	Granite Creek	YPS-574	0	5	61	3	29	0	2	9	7.3	12.2	16.4	64.7	18.2	<1.0	Loamy sand	0.028	0.342
	Keystone Creek inflow to Mayo Lake	YPS-053	0	0	56	5	37	0	2	6.5	5.3	39.7	6.9	50.3	39.5	3.4	Sandy loam	0.134	2.06
White River	Davidson Creek	YPS-573	0	0	25	8	63	0	4	3.2	3.1	13.3	22.1	65.1	12	<1.0	Sand	0.034	0.413
	Unnamed Tributary to Wade Creek (reference)	YPS-591	0	2	34	8	55	0	1	4.2	4.4	10.6	46.7	52.4	<1.0	<1.0	Sand	<0.020	0.115
	Wade Creek	YPS-507	0	17	32	3	44	0	4	6.1	6.2	10.6	37.6	60.5	1.8	<1.0	Sand	<0.020	0.24
Burwash Creek	YPS-506	0	20	44	5	29	0	2	8.6	8.3	10.4	20.4	68.2	9.6	1.8	Sand	<0.020	0.34	