APPENDIX F
Fish and Aquatic Life Monitoring Plan

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COFFEE

REPORT

Fish and Aquatic Life Monitoring Plan

Coffee Gold Mine

Prepared for:

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REVISION TRACKING LOG

Revision Tracking Log			
Version	**Date**	**Section Updated**	**Description of Update**
0	November 2023	-	First submission of the Fish and Aquatic Life Monitoring Plan
1			
2			

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
AFDM	Ash-Free Dry Mass
ANOVA	Analysis-of-Variance
BA	Before-After
BACI	Before-After-Control-Impact
CA	Correspondence Analysis
CABIN	Canadian Aquatic Biomonitoring Network
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CES	Critical Effect Size
COC	Chain of Custody
CPUE	Catch Per Unit Effort
CRC-ICP-MS	Collision Cell Inductively Coupled Plasma-Mass Spectrometry
CVAFS	Cold Vapour Atomic Fluorescence Spectrophotometry
DFO	Fisheries and Oceans Canada
DQR	Data Quality Review
EDI	Environmental Dynamics Inc.
EEM	Environmental Effects Monitoring
EPT	Ephemeroptera-Plecoptera-Trichoptera
FALMP	Fish and Aquatic Life Monitoring Plan
FFG	Functional Feeding Group
GPS	Global Positioning System
HPG	Habit Preference Group
HR-ICP-MS	High Resolution Inductively Coupled Plasma-Mass Spectrometry
IC	Intermediate Components
LPL	Lowest Practical Level
MCI	Multiple Control-Impact
MDMER	Metal and Diamond Mining Effluent Regulations
ML/ARD	Metal Leachate/Acid Rock Drainage
MMER	Metal Mining Effluent Regulations
MS	Microsoft
NAR	Northern Access Route
Newont	Kaminak Gold Corporation, a wholly owned subsidiary of Goldcorp Inc.
NMDS	Nonmetric Multidimensional Scaling
PCA	Principal Components Analysis
PDF	Portable Electronic Document
PECG	Palmer Environmental Consulting Group

Acronym / Abbreviation	Definition
PEL	Probable Effect Level
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
Project	Coffee Gold Mine
QA/QC	Quality Assurance / Quality Control
QC	Quality Control
QEP	Qualified Environmental Professional
RCA	Reference Condition Approach
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SALM	Strong Acid Leachable Metals
SQG	Sediment Quality Guideline
TEL	Threshold Effect Level
TOC	Total Organic Carbon
VC	Valued Component
WRSF	Waste Rock Storage Facility
YESAA	Yukon Environmental and Socio-economic Assessment Board
YESAB	Yukon Environmental and Socioeconomic Assessment Board

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
cm	centimetre
kg	kilogram
km	kilometre
km^2	square kilometre
L	litre
m	metre
m^2	square metre
mg	milligram
mg/kg	milligram per kilogram
mg/L	milligram per litre
mL	millilitres
Mt/a	million tonnes per annum
t/d	tonnes per day
µg	microgram
µm	micron (micrometre)
%	percent
°C	degrees Celsius

1.0 INTRODUCTION

This Fish and Aquatic Life Monitoring Plan (FALMP) describes monitoring of fish, fish habitat, benthic invertebrates, periphyton, and creek sediment in the area in and around the proposed Coffee Gold Mine Project (the Project)[1]. Fish and aquatic life have been identified as being important to local First Nation communities and other residents and are of broad interest to regulators and other stakeholders. Furthermore, fish and fish habitat were assessed as a Valued Component (VC; EDI 2017) and periphyton and benthic invertebrates were analysed as Intermediate Components (IC; Minnow and EDI 2017) as part of the Coffee Gold Mine Project Proposal to the Yukon Environmental and Socioeconomic Assessment Board (YESAB), updated in 2019 (Newmont Goldcorp 2019). Following on the assessment/analysis, the environmental components included in this FALMP are important to the health of fish and include availability of habitat, sediment quality, and the presence of periphyton and benthic invertebrates as food sources.

Construction, operation, and closure of the Project have the potential to affect the fish and fish habitat VC and/or the periphyton and benthic invertebrates IC by physical disturbance, flow alteration, toxicity, and productivity alteration. Residual change associated with the project was limited to low to moderate changes in fish habitat and periphyton community composition associated with flow alteration in three creeks (Latte Creek, Halfway Creek, and YT-24 Creek) and low magnitude stimulation of periphyton and benthic invertebrate productivity in Halfway Creek (Newmont Goldcorp 2019). No residual change associated with toxicity was predicted.

This Fish and Aquatic Life Monitoring Plan (FALMP) provides a statistically robust aquatic environmental monitoring program that will characterize physical, chemical, and biological conditions in the aquatic receiving environment adjacent to the Project and monitor / evaluate potential effects of the Project on the aquatic receiving environment by comparison to baseline conditions, reference conditions, and environmental quality guidelines. The FALMP will also include assessment of change over time. This FALMP was prepared to meet the Aquatic Environmental Monitoring requirements of the Environmental Monitoring and Adaptive Management Plan (EMAMP) required for Quartz Mining projects in Yukon. Accordingly, this Plan has been written to meet the guidance provided in the *Plan Requirement Guidance for Quartz Mining Projects* (YWB and EMR 2013).

This Plan is provided in conjunction with several other plans to meet the requirements for quartz mine applications for a Quartz Mining License and a Water Use Licence under the *Quartz Mining Act* and the *Waters Act*, respectively. Other applicable regulations related to aquatic environmental monitoring are detailed in Section 2.

2.0 FISH AND AQUATIC LIFE MONITORING FRAMEWORK

2.1 Predicted Project-Related Effects on Fish and Aquatic Life

The assessment of potential effects that the Project may have on fish and aquatic life, provided in the *Coffee Gold Mine Project Proposal for Executive Committee Screening* (Goldcorp 2017), included an assessment of potential effects on fish and fish habitat (EDI 2017) and a separate analysis of periphyton

[1] This FALMP is focused on the mine site and its surrounding area and does not included monitoring specific to the Northern Access Route.

and benthic invertebrates (Minnow and EDI 2017). The assessment/analysis was updated in 2019 (Newmont Goldcorp 2019). The assessment (fish and fish habitat) focused on the key fish species that interact with the Project, and that are of primary importance to First Nations. These include Arctic Grayling (*Thymallus arcticus*), Chinook Salmon (*Oncorhynchus tshawytscha*), and Chum Salmon (*Oncorhynchus keta*). These species provide a valued food source, are of recreational value and, in the case of the salmon, are of commercial and cultural value to First Nations. The analysis (periphyton and benthic invertebrates) focused on potential productivity and community-level responses.

Potential mechanisms of effects to fish and aquatic life from the Project include:

- Changes to habitat suitability – potential changes to flow in Latte, Halfway and YT-24 creeks; changes to habitat from erosion or sediment deposition in streams throughout the Project area
- Increased risk for contaminant toxicity — potential changes in water quality resulting from Project activities (predicted changes to Latte, Halfway and YT-24 creeks)
- Changes to stream productivity — potential changes in nutrient inputs (including predicted changes to Latte, Halfway and YT-24 creeks).

This FALMP focusses on monitoring the aquatic biological receptors considered during the effects assessment (Table 2-1 and Table 2-2). While the effects or changes were determined to be not significant, this monitoring program will provide data that can determine if such predictions were correct and provides a foundation for adaptive management. Monitoring for surface water hydrology and surface water quality is detailed in the Hydrology Monitoring Plan and Surface Water Quality Monitoring Plan. The Surface Water Quality and Aquatic Life Adaptive Management Plan (AMP) is provided in the Appendix L of the EMAMP.

Table 2-1 Overview of Residual Effects on Fish and Fish Habitat.

Potential Residual Effect	Location	Residual Change or Effect
Changes in habitat suitability	Latte Creek	Localized, low magnitude effects as a result of changes to stream flow hydrology and associated changes to fish habitat suitability.
	Coffee Creek	No residual adverse effects are anticipated.
	YT-24 Creek	Localized, moderate magnitude effects (positive) as a result of changes to stream flow hydrology and associated changes to fish habitat suitability.
	Halfway Creek	Localized, low magnitude effects (positive and negative) as a result of changes to stream flow hydrology and associated changes to fish habitat suitability.
Changes in habitat accessibility	Latte Creek	No residual adverse effects are anticipated.
	Coffee Creek	No residual adverse effects are anticipated.
	YT-24 Creek	No residual adverse effects are anticipated.
	Halfway Creek	No residual adverse effects are anticipated.
Contaminant toxicity	Latte Creek	No residual adverse effects are anticipated.
	Coffee Creek	No residual adverse effects are anticipated.
	YT-24 Creek	No residual adverse effects are anticipated.
	Halfway Creek	No residual adverse effects are anticipated.
Changes in stream productivity	Latte Creek	No residual adverse effects are anticipated.
	Coffee Creek	No residual adverse effects are anticipated.
	YT-24 Creek	No residual adverse effects are anticipated.
	Halfway Creek	Low magnitude stimulation of periphyton and benthic invertebrate productivity may affect grayling and Chinook food sources.

Table 2-2 Overview of Residual Changes to Periphyton and Benthic Invertebrates.

Potential Residual Change Category	Location	Residual Change to Periphyton	Residual Change to Benthic Invertebrates
Physical Disturbance	Latte Creek	Low magnitude change in periphyton community composition (more filamentous green algae / less mucilaginous blue-green algae [cyanobacteria] and diatoms) due to decreased flow.	No residual change anticipated
	Coffee Creek	No residual change anticipated	No residual change anticipated
	YT-24 Creek	No residual change anticipated	No residual change anticipated
	Halfway Creek	Low to moderate magnitude change in periphyton community composition (more mucilaginous blue-green algae [cyanobacteria] and diatoms / less filamentous green algae) due to increased flow (scouring and short-term augmentation of suspended solids).	No residual change anticipated
Toxicity	Latte Creek	No residual change anticipated	No residual change anticipated
	Coffee Creek	No residual change anticipated	No residual change anticipated
	YT-24 Creek	No residual change anticipated	No residual change anticipated
	Halfway Creek	No residual change anticipated	No residual change anticipated
Productivity	Latte Creek	No residual change anticipated	No residual change anticipated
	Coffee Creek	No residual change anticipated	No residual change anticipated
	YT-24 Creek	No residual change anticipated	No residual change anticipated
	Halfway Creek	Low magnitude stimulation of periphyton productivity due to increases in nutrient concentrations (and potential temperature increase due to water ponding in the alpha pond) and potential for greater productivity and/or proportion of blue-green algae [cyanobacteria] and diatoms.	Low magnitude stimulation of benthic invertebrate productivity due to increases in nutrient concentrations (and potential temperature increase due to water ponding in the alpha pond) and potential for greater productivity and/or proportion of scrapers, mayflies, and Orthocladinae midges.

2.2 Fish and Aquatic Life Monitoring Components

The FALMP consists of four general components that will be used to monitor for potential adverse effects. These components and the measurable parameters that will be evaluated for each component are informed by the findings of the Project Proposal.

1. **Fish and Fish Habitat** — Potential Project-related effects on fish and fish habitat may include changes in water quality and quantity that could result in changes to habitat productivity and usage by fish and prey items.
2. **Benthic Macroinvertebrates** — Potential Project-related changes to benthic invertebrates may include low magnitude productivity stimulation and subtle changes in community composition in Halfway Creek due to increases in nutrient concentrations and temperature (Table 2-2). Benthic invertebrate monitoring (biomass, community composition, and tissue quality) is also highly sensitive to changes in metal concentrations, nutrient concentrations, and physical conditions and thus serves as an effective monitor of unexpected change. Benthic invertebrate community monitoring is also required under Metal and Diamond Mining Effluent Regulations (MDMER) Environmental Effects Monitoring (Environmental Effects Monitoring (EEM); Section 2.3).
3. **Periphyton** — Potential Project-related changes to periphyton may include low magnitude change in periphyton community composition due to changes in flow in Latte Creek and Halfway Creek and low magnitude productivity stimulation in Halfway Creek (Table 2-2). Periphyton monitoring (biomass and community composition) is sensitive to changes in metal concentrations, nutrient concentrations, and physical conditions and thus serves as an effective monitor of unexpected change.
4. **Creek Sediments** — Potential Project-related changes to creek sediment quality were not evaluated as the creeks affected by the Project are highly erosional with limited sediment deposition. Furthermore, sediment quality monitoring is not required under MDMER EEM when the dominant habitat is erosional. Nonetheless, it is recognized that the Project has some potential to influence sediment quality despite the few areas of sediment deposition (through change in flow and water quality). Therefore, sediment quality monitoring (particle size, organic carbon content, and metal concentrations) at limited locations of sediment deposition is included in the FALMP.

Indicators, measurable parameters, and supporting monitoring data that will be used to assess potential effects on fish, fish habitat, and aquatic life are summarized in Table 2-3 and discussed in more detail in Sections 3 to 6. Measurable parameters are components that can effectively track an effect (i.e., with confidence) and upon which adaptive management thresholds can be applied. Supportive monitoring data provides additional perspective and may help identify why an effect is occurring; however, cannot be used on their own to make definitive conclusions.

Table 2-3 Indicators, Monitoring Components, Measurable Parameters and Supporting Monitoring Data for Fish and Aquatic Life

Indicator	Monitoring Component	Measurable Parameters	Supporting Monitoring Data
Physical Disturbance	Fish habitat assessment (Section 3)	• Channel Width • Pool Depth/Frequency • Bed Material	• Fish community sampling - fish use, species diversity and size/condition
Toxicity	Water quality monitoring (see Water Monitoring Plan) Benthic macroinvertebrates (Section 4)	• Water quality (nutrients, cyanide, metals) • Benthic macroinvertebrates ○ Productivity ○ Density ○ Richness ○ Community composition ○ Tissue quality	• Fish community sampling – providing data on fish use, species diversity and size/condition • Sediment quality
Productivity	Water quality monitoring (see Water Monitoring Plan) Benthic macroinvertebrates (Section 4) Periphyton (Section 5)	• Water quality (temperature, nutrients, total suspended solids (TSS)) • Benthic macroinvertebrates ○ Productivity ○ Density ○ Community composition • Periphyton ○ Productivity ○ Community composition	• Fish community sampling – providing data on fish use, species diversity and size/condition • Water Temperature

2.3 Metal and Diamond Mining Effluent Regulations

Under the MDMER of the federal *Fisheries Act*, Environmental Effects Monitoring (EEM) is required and includes biological monitoring. Biological monitoring is triggered when a mine discharges mine effluent at a rate of 50 m^3/day or more (Government of Canada 2022). A fish population study is required '*if the highest concentration of effluent in the exposure area, during a period in which there are deposits, is greater than 1% at any location that is 250 m from a point at which the effluent enters the area from a final discharge point*'. Similarly, a benthic invertebrate community study is required '*if the highest concentration of effluent in the exposure area, during a period in which there are deposits, is greater than 1% at any location that is 100 m from a point at which the effluent enters the area from a final discharge point'*. MDMER also requires fish tissue quality sampling if effluent concentrations of mercury and selenium are above defined limits (0.10 µg/L mercury and 5 µg/L selenium).

In the case of the Coffee Project, it is expected that effluent discharge to Halfway, Latte, and YT24 drainages may trigger the MDMER, and a study respecting fish populations and the benthic invertebrate community at a three-year interval. At mine sites with multiple discharges, biological studies (and sublethal toxicity testing) are required 'at the mine's final discharge point that has potentially the most adverse environmental impact on the environment' and thus may only be required at Halfway Creek. It is anticipated that Project effluents will not contain mercury or selenium at concentrations greater than the triggers for a fish tissue quality study, but this will be verified prior to preparation of the Phase 1 EEM Study Design Report required under the MDMER (one year after the initiation of discharge).

Regardless of MDMER-EEM requirements, monitoring under this FALMP will allow for determination of Project-related changes in fish and fish habitat, benthic invertebrates, and periphyton. Federal EEM will be harmonized with the FALMP to the greatest extent possible.

2.4 Monitoring Areas

Monitoring is proposed in the three drainages (Latte Creek, Halfway Creek, and YT-24) in which the mine infrastructure will be located (Figure 3-1), as well as Coffee Creek, which Latte Creek flows into and is a tributary to the Yukon River. Upper Coffee Creek, upper Carlisle Creek, and two unnamed streams that flow into the Yukon River (XE0.2 and SYT0.2) are monitored as reference stations un-affected by mine activities. More detailed descriptions of these monitoring areas are provided in association with the study designs for each monitoring component (Sections 3 [Fish and Fish Habitat] to Section 6 [Creek Sediments]).

3.0 FISH AND FISH HABITAT MONITORING

3.1 Background and Objective

The objective of fish and fish habitat monitoring is to assess the key Project interactions and predicted residual effects in comparison to baseline and reference conditions in a quantitative and statistically robust manner (where possible), and to also comprehensively monitor aquatic environments that could potentially be influenced by Project activities. The following Fish and Fish Habitat components will be monitored:

- Fish community (general abundance/diversity)
- Fish condition
- Fish habitat.

3.2 Study Design Overview

Fish community sampling includes assessing fish species diversity, condition, and general catch per unit effort (CPUE) results through sampling efforts[2]. Sampling methods will include electrofishing (open site), minnow trapping, and beach seining, where appropriate. Table 3-1 summarizes the monitoring components for fish community and condition as well as fish habitat quality.

Fish habitat in the Project area has been unaffected by previous anthropogenic development in the watershed. Chronic sediment mobilization or changes in hydrology from development projects has the potential to change physical habitats in downstream areas. Monitoring of fish habitat will focus on measurements of fish habitat attributes within fish-bearing locations downstream of the mine infrastructure Index areas for each stream will be used. Specifically, stream habitat units (i.e., riffles, pools, and glides) will be delineated and measured (width, length, and depth) and bed materials within each unit will be documented. Wolman Pebble Counts and hourly water temperature data will also be collected. The monitoring locations and timing will be consistent with fish sampling efforts.

Table 3-1 Overview of Fish Community, Condition and Habitat Monitoring

Monitoring Component	Description	
Indicator	Fish Community Sampling and Fish Condition	Fish Habitat Quality
Monitoring Category	Environmental Effects	Environmental Effects
Design	Before-After-Control-Impact (BACI)	Before-After-Control-Impact (BACI)
Measurable Parameters	Fish CPUE, fish species diversity, Fulton's condition factor, presence of various stages/ages (based on length/weight data).	Number and depth of pools; channel width.
Key Project Interactions	Changes in water quality/quantity, changes in prey item availability and habitat primary productivity.	Changes in water quality (sediment mobilization/deposition) and quantity (erosion).
Goal	The Project will not have a significant adverse effect on fish populations, including community structure or fish condition.	The Project will not have a significant adverse effect on fish habitat when compared to control/reference areas.

[2] As reported in EDI (2018), low fish densities in receiving waters do not allow for statistical confidence when evaluating CPUE data.

Monitoring Component	Description	
Objective	Evaluate how the Project may influence fish use and fish condition in habitat downstream of the Project.	Evaluate how the Project may influence habitat in fish-bearing streams downstream of the Project.
Scope of Monitoring Work	Fish sampling in receiving watersheds, including Latte, Halfway, and YT-24 creeks and reference sites via electrofishing. Sampling will also be conducted in Coffee Creek via beach seining, electrofishing, and minnow trapping. Monitoring to be conducted annually during Construction and then every three years during Operation, Reclamation and Closure.	Detailed habitat assessment in receiving watersheds, including Halfway, Latte, YT-24, and Coffee creeks (at fish-bearing monitoring stations) and a matched reference area. Monitoring to be conducted annually during Construction and then every three years during Operation, and Reclamation and Closure.
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to prevent or reduce changes in the downstream aquatic environment.	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to prevent/reduce changes in the downstream aquatic environment.
Project Terms and Conditions	To be determined following YESAA and Yukon Water Board process	To be determined following YESAA and Water Board processes

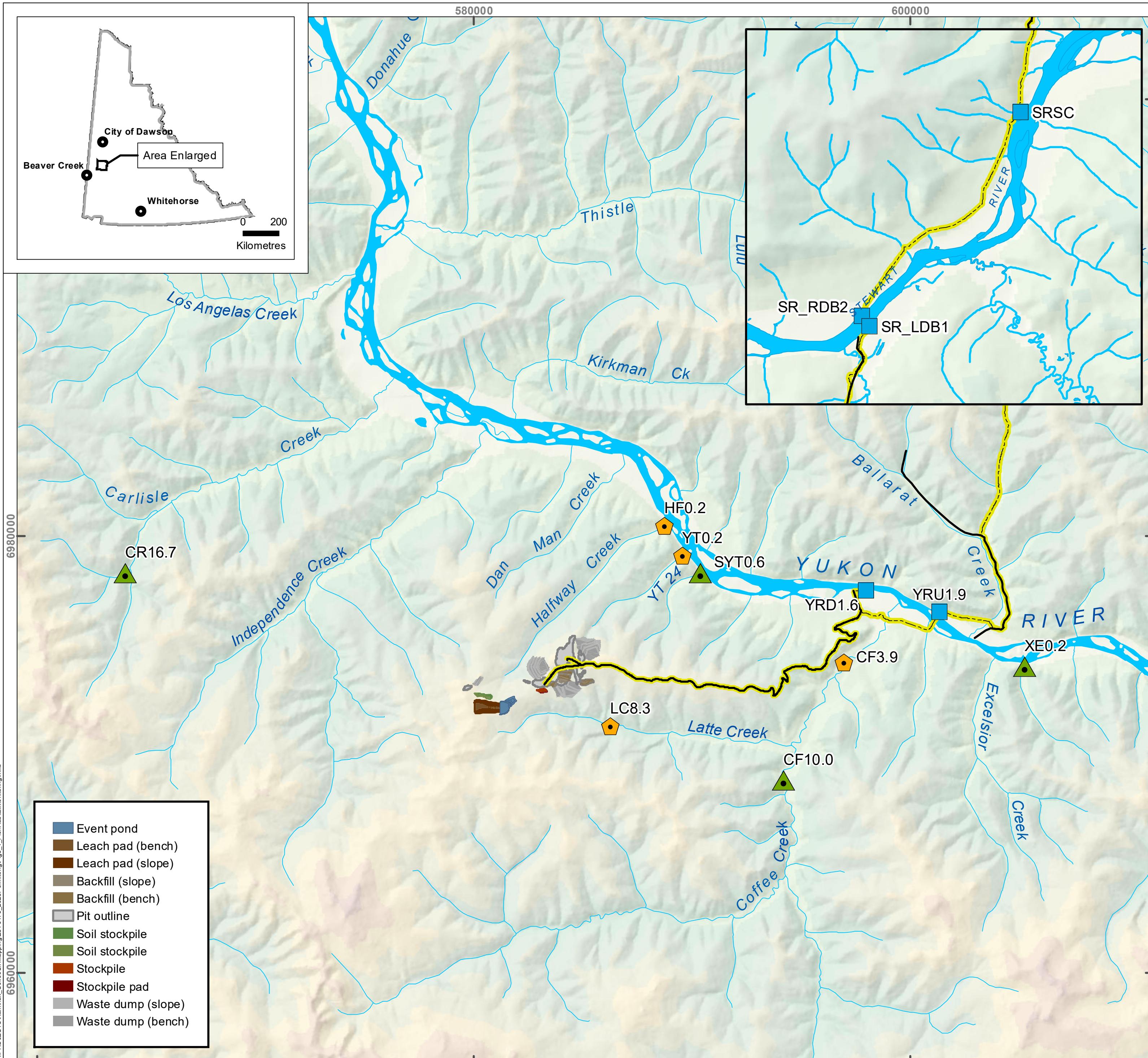
3.3 Monitoring Locations and Frequencies

Fish community, condition and habitat monitoring will be conducted at stations on Latte, YT-24, Halfway and Coffee creeks, with reference sites on upper Carlisle, Independence and an unnamed stream south of YT-24 (SYT; Figure 3-1), as outlined in Table 3-2. These monitoring stations will be consistent with the locations of baseline fish habitat sampling stations. Where possible, monitoring stations will be located in or near areas surface water quality stations. The surface water quality monitoring program is included in the Surface Water Quality Monitoring Plan.

Monitoring for fish community, condition, and habitat will be conducted throughout the construction, operations, closure, and post-closure phases of the Project, as summarized in Table 3-2. Fish and fish habitat monitoring (for fish abundance, species diversity, fish habitat and fish condition) will be conducted once during the Construction Phase, in Year –2. Sampling will be conducted during late July or early August. During mine operations and during the reclamation and closure phases of the Project, fish and fish habitat monitoring will be conducted at all the same stations as during the construction phase (Table 3-2). Post-closure, fish and fish habitat monitoring will only be conducted in the event that site-specific water quality objectives are not maintained or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Adaptive management actions are detailed in Appendix L of the Environmental Monitoring and Adaptive Management Plan.

Table 3-2 Fish and Fish Habitat Monitoring Stations and Sampling Frequency

Station	Location	Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Coffee Creek Watershed							
CF3.9	Coffee Creek below Latte Creek	596860	6974237	Downstream of confluence	Annually	Every 2 years	Every 3 years
CF10.0	Coffee Creek above Latte Creek	594191	6968831	Reference site for fish habitat	Annually	Every 2 years	Every 3 years
Latte Creek Watershed							
LC8.3	Lower Latte Creek	591817	6970662	Downstream of influence	Annually	Every 2 years	Every 3 years
Halfway Creek							
HF0.2	Lower Halfway Creek	588716	6980472	Downstream of influence	Annually	Every 2 years	Every 3 years
YT-24 Watershed							
YT0.2	Lower YT-24	589575	6979154	Downstream of influence	Annually	Every 2 years	Every 3 years
Carlisle Creek Watershed							
CR16.7	Upper Carlisle Creek	564251	6976963	Reference Area	Annually	Every 2 years	Every 3 years
Unnamed Watersheds							
SYT0.6	Unnamed Creek	590011	6978135	Reference Area	Annually	Every 2 years	Every 3 years
XE0.2	Unnamed Creek	605159	6973987	Reference Area	Annually	Every 2 years	Every 3 years



COFFEE PROJECT

Fish and Fish Habitat Monitoring Locations

Notes

1. 1:250,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
2. Digital Elevation Models provided by Geomatics Yukon.
3. Project data displayed is site specific. Survey data collected by EDI Environmental Dynamics Inc. (2015)
4. This document is not an official land survey and the spatial data presented is subject to change.

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Figure 3-1	Date: Sep 12, 2023	Drawn by: MP	Reviewed: BSc/PT

Newmont

3.4 Methods

3.4.1 Fish Community Monitoring

Monitoring of fish utilization of creeks will be conducted through the use of standard fish capture methods, including electrofishing, beach seining, and minnow trapping at downstream of the Mine Site and beach seining at the Northern Access Route (NAR) sites. Baseline fish capture data associated with the Mine Site indicates that the watersheds in the Project area support relatively small populations of fish (EDI 2017 and EDI 2018) and attempts to complete density sampling (i.e. triple-pass electrofishing) have not provided results that would be statistically reliable. As such, single pass electrofishing over a linear distance of 500 m will be completed at each site. Electrofishing settings, effective time and captures/observations will be recorded. At each site, six minnow gee type minnow traps (0.6 cm mesh size) baited with Yukon River salmon roe will be deployed overnight (set length between 20-24 hours) along stream margins in slow water habitats. Trap set locations, depths and captures will be recorded. In addition, beach seine hauls will be completed in six pools at each site in Coffee Creek. The beach seine will be 10 m in length, 2 m deep and constructed of 5 mm mesh. GPS coordinates, haul dimensions and captures will be recorded.

Statistically valid fish density estimates cannot be developed from these methods; however, this method will provide an indication of relative abundance and fish species and life stage diversity. All fish captured will be identified to species, measured for fork length (total length for sculpin) and weighed.

3.4.2 Fish Condition

Fish condition data will be collected from fish sampled during fish community monitoring. Length and weight will be collected from all fish sampled. Fulton’s condition factor (weight-length relationship that can be used to quantify the condition of fish) will be calculated for each captured fish species. If sample sizes allow, non-parametric Whitney-Wilcoxon tests will be used to compare condition factor data. Similar to fish abundance sampling, length/weight/condition assessments will be made using non-lethal methods. Existing (baseline) length-at-age data will be used to determine the presence of various fish ages, based on fork lengths.

3.4.3 Fish Habitat

Fish habitat mapping and habitat quantification will be conducted for a length of 500 m in of each of the creeks in consistent fish bearing locations (NAR sites not included). Sites will be geo-referenced and marked in the field to allow for sampling at the same site though all Project phases. Data on the physical attributes of the channel will be collected following BC Fish Habitat Assessment Guidelines (Johnston and Slaney 1996). Following this procedure, habitat units will be delineated, and various measurements will be collected for each (including channel and wetted widths, depths, cover, bed materials and gradient). In addition, Wolman Pebble Counts will be completed at each site to understand particle size distribution of bed material. This will provide perspective on the amount of fine sediments that may be accumulating.

3.4.3.1 NAR Fish and Fish Habitat Monitoring

One year post completion of the NAR, a fish and fish habitat survey will be completed. This will include fish sampling via beach seining at the barge sites and the Stewart River backchannel which the NAR encroaches on. Sampling results will be compared to pre-project results as well as from sampling adjacent areas where possible. A general assessment of fish habitat barge landings and backchannel will be completed. This will include photographs and notes on habitat at each site as well as the habitat features installed at the back channel. Fish bearing and assumed fish bearing crossings will be visited by a fish biologist in the summer (following freshet) to ensure that the crossings still provide suitable conditions for fish passage. General observations will be recorded and, where relevant, water velocities will be recorded. Notes on habitat and any concerns such as erosion or sediment issues will be recorded.

Following the first year of inspection, Newmont environment staff will complete yearly inspections of the crossings, the barge landings, and Stewart River Backchannel. Any significant changes to these sites will be recorded and input will be sought from a qualified professional in fish biology to determine if any action is required.

3.4.4 Supporting Monitoring

Supporting information collected to the fish and fish habitat monitoring data include:

- Temperature Data: Water temperature tidbit loggers will be installed in the bottom of a pool, weighted down, near each fish habitat monitoring site and will be set to collect hourly temperature readings. Data will be downloaded during each fish habitat assessment field visit.
- Water Quality/Quantity Data: Data collected as part of the water monitoring program will be valuable supporting information.
- Benthic invertebrate, periphyton and stream sediment quality data: Data collected as outlined in Sections 4, 5, and 6 will be valuable to interpret fish and fish habitat results.

3.5 Data Analysis, Interpretation and Reporting

Collected fish and fish habitat data will be assembled by sample date, monitoring station, sampling site, and sample method into a program-specific database.

For each monitoring station, the following metrics will be evaluated at each sampling station: fish species diversity, CPUE for each method and species, lengths, weights, and condition factors. Low densities of fish in the stream around the project will prevent detailed statistical analysis on CPUE; as such, a large focus will be on species presence and evaluating if the numbers are similar to pre-project data and reference sites.

Size distributions will be analyzed using station-specific length data; if needed, data will be pooled with data from other monitoring stations to increase the sample size for each condition metric. An analysis of weight-length relationships will be completed among areas and over time using an ANCOVA test.

Fish habitat data collected will be compiled and compared to the pre-project and reference data. The pool depth and channel width measurements will be compared to pre-project data using a Kolmogorov-Smirnov test. Pool frequency will be evaluated, but no statistical test can be completed on this metric. Resulting reports will include methods, results and a data analysis/assessment of the results in relation to predicted effects.

4.0 BENTHIC INVERTEBRATE MONITORING

4.1 Background and Objective

Benthic invertebrates were identified as independently valuable resources for environmental assessment and were a focus of an Intermediate Component Analysis Report that supported the overall environmental assessment of the Coffee Project (Minnow and EDI 2017; Newmont Goldcorp 2019). Benthic invertebrates are excellent biomonitors for assessing potential effects of physical and/or chemical changes in aquatic systems (Taylor and Bailey 1997; Barbour et al. 1999; ESG 1999; Feltmate and Fraser 1999; Beatty et al. 2006). Benthic invertebrate productivity is sensitive to changes in nutrient concentrations, primary productivity, and temperature. Benthic invertebrate density, richness, and community structure are sensitive to water quality due to direct effects of elevated concentrations of metals (and other constituents) and to different tolerances and sensitivities among taxon groups (e.g., Taylor and Bailey 1997; Barbour et al. 1999; Mandaville 2002; Mebane et al. 2015). Benthic invertebrates are sessile, therefore evaluation of benthic invertebrate tissue quality can provide an important measure of localized chemical conditions and of the spatial extent of a chemical influence, as well as of potential direct or indirect exposure of fish and wildlife to metals, metalloids, and nutrients.

Key Project interactions with benthic invertebrates include predicted residual changes in surface water hydrology (flow reductions or increases with associated changes to the seasonal distribution of low and high flows) and changes in surface water quality (some localized increases in concentrations of sulphate, nitrate, arsenic, and/or aluminum) in Latte Creek, YT-24 Creek, and/or Halfway Creek (Table 2-1). The Periphyton and Benthic Invertebrates Analysis (Minnow and EDI 2017; Newmont Goldcorp 2019) predicted no residual effects to benthic invertebrates due to physical changes in any of these creeks (or downstream); no residual effects to benthic invertebrates due to toxicity in any of these creeks (or downstream; although uncertainty was noted for Halfway Creek); and no residual effects to benthic invertebrates due to productivity alteration in Latte Creek and downstream or in YT-24 Creek. However, benthic invertebrate communities of Halfway Creek were predicted to be affected by productivity stimulation due to a combination of projected increases in nitrate concentrations and water temperature in association with water discharge (Minnow and EDI 2017; Newmont Goldcorp 2019).

The objective of benthic invertebrate monitoring is to assess the key Project interactions and their predicted residual effects in comparison to baseline and reference conditions in a quantitative and statistically robust manner, and to comprehensively monitor aquatic environments that could potentially be influenced by Project activities.

4.2 Study Design Overview

Benthic invertebrate monitoring is designed to meet the objectives stated above by focusing on monitoring components and measurable parameters that are effective monitors of the Project interactions in general, and the predicted residual effects in particular, within a statistically robust study design that has the power to detect potential changes over time and relative to carefully selected reference areas. The design of the benthic invertebrate monitoring program is summarized in Table 4-1, Table 4-2, and Figure 4-1 and includes benthic invertebrate productivity, benthic invertebrate community, and benthic invertebrate tissue quality. Benthic invertebrate monitoring is focused on Halfway Creek, YT-24 Creek, Latte Creek, and Coffee Creek, with sampling areas located in the upper reaches (considered to be most sensitive to potential Project-related changes due to highest potential for mine-related change) and the lower reaches which are occupied by fish (Table 4-2; Figure 4-1).

Table 4-1 Overview of Benthic Invertebrate Monitoring

Monitoring Component	Description
Indicators	Benthic Invertebrate Productivity, Community Structure, and Tissue Quality
Monitoring Category	Environmental Effects
Design	Multiple Control-Impact Approach (MCI) and Before-After/Control-Impact (BACI)
Measurable Parameters	Biomass (dry weight/m^2), density (organisms/m^2), taxon richness, %EPT[1], %mayflies, %HPG[1], %FFG[1], metal concentrations in composite samples
Key Project Interactions	Changes in surface water hydrology and surface water quality
Goal	The Project will not have a significant adverse effect on benthic invertebrates when compared to baseline and/or reference conditions
Objective	Evaluate how the Project may influence benthic invertebrates
Scope of Monitoring Work	Benthic invertebrate community samples will be collected at five stations per area by Hess sampler (3-grab composites, 500 µm mesh, lowest practical level taxonomy) and analyzed following guidance for MDMER-EEM. Sampling areas will include upper areas on Halfway Creek, YT-24, and Latte Creek and two matched reference creeks. Lower areas on the same creeks (with Coffee Creek replacing Latte Creek) will also be evaluated using a similar design (with separate lower reference creeks). Monitoring of upper creek areas will be conducted at least once during Construction, annually in upper creek stations for the first three years of Operation, and every two years for subsequent years of Operation and during Reclamation and Closure. Monitoring of lower creek areas will be the same as for upper Creek areas, except for every 2 years through all years of Operation. Monitoring will be subject to Surface Water Quality and Aquatic Life AMP triggers for higher frequency based on FALMP findings.
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to avoid/reduce changes to the downstream aquatic environment.
Project Terms and Conditions	To be determined following YESAA and *Yukon Waters Act* licensing processes

[1]EPT = ephemeroptera, plecoptera, trichoptera (mayflies, stoneflies, and caddisflies); HPG = habit preference group; FFG = functional feeding group
[2] Where a significant change is a statistically significant difference of greater than two standard deviations of the reference mean.

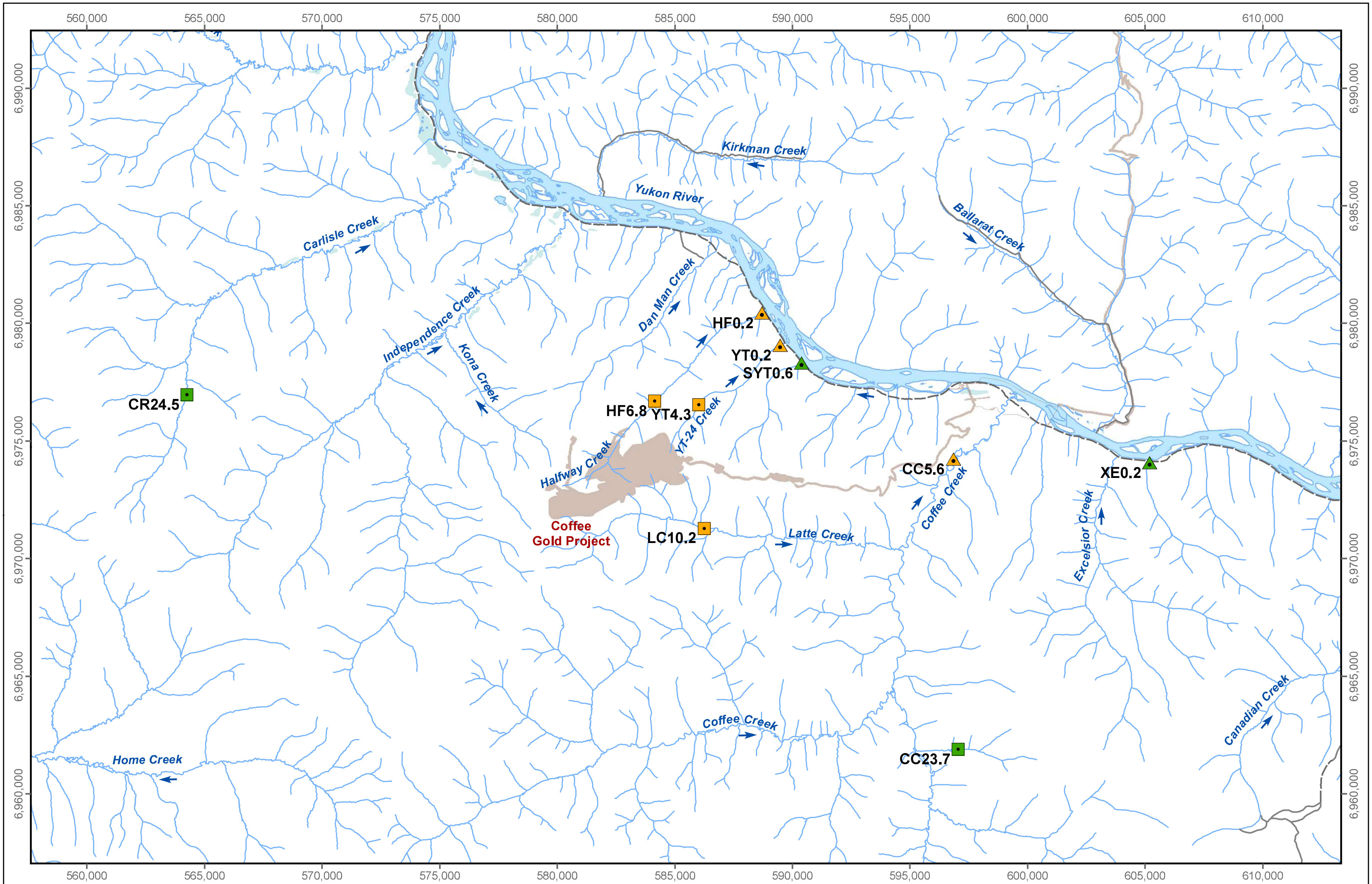
Table 4-2 Overview of the Benthic Invertebrate Monitoring Program Study Design

Future Project Exposed Creek Area	Reference Creek Area	Components	Replication [2]	Method Summary	Measurable Parameters [3, 4]	Frequency	Timing
Upper Creek Areas							
Upper Halfway (HF6.8)	Upper Carlisle (CR24.5) and Upper Coffee (CF23.7)	P, C, T [1]	5	**Productivity and Community:** Hess Sampler with 500 µm mesh (3 sub-sample composite); taxonomy to lowest practical level **Tissue Quality:** kick-and sweep and by hand (overturning rocks), taxon composition proportional to biomass	**Productivity**: dry weight per m² **Community**: density, taxon richness, %EPT taxa, %mayflies, %HPG, %FFG **Tissue Quality**: metal concentrations	**Baseline**: 2018, 2019, 2021 **Construction**: once **Operations**: Annually in years 1 to 3, Every 2 years starting Year 5. **Reclamation and Closure**: Every 2 years	Late summer
Upper YT-24 (YT4.3)		P, C, T [1]	5				
Upper Latte (LC10.2)		P, C, T [1]	5				
Lower Creek Areas							
Lower Halfway (HF0.2)	Lower Creek East of Excelsior (XE0.2) and Lower Stream South of YT-24 (SYT0.6)	P, C, T [1]	5	**Productivity and Community:** Hess Sampler with 500 µm mesh (3 sub-sample composite); taxonomy to lowest practical level **Tissue Quality:** kick-and sweep and by hand (overturning rocks), taxon composition proportional to biomass	**Productivity**: dry weight per m² **Community**: density, taxon richness, %EPT taxa, %mayflies, %HPG, %FFG **Tissue Quality**: metal concentrations	**Baseline**: 2018, 2019, 2021 **Construction**: once **Operations**: Every 2 years **Reclamation and Closure**: Every 2 years	Late summer
Lower YT-24 (YT0.2)		P, C, T [1]	5				
Lower Coffee (CF5.6)		P, C, T [1]	5				

[1] P = benthic invertebrate productivity; C = benthic invertebrate community; T = benthic invertebrate tissue quality

[2] number of replicate stations per area; basis for statistical contrasts among areas and over time

[3] the Measurable Parameters are those that were specifically identified as potentially affected by the Project (Minnow and EDI 2017; Newmont Goldcorp 2019) and do not preclude interpretation based on additional parameters. This is particularly true for community data, for which additional interpretive parameters will be calculated and contrasted (e.g., Simpson's Evenness, Simpson's Diversity, the Bray-Curtis index of dissimilarity, the Hilsenhoff biotic index, and ordination such as Correspondence Analysis).
[4] EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies); HPG = Habit Preference Group; FFG = Functional Feeding Group



LEGEND

Sampling Location

- Upper "Future" Exposure
- Lower "Future" Exposure
- Upper Reference
- Lower Reference
- Mine Footprint
- Limited-use road
- Trail

0 2.5 5 10 km

N W E S

Projection: North American Datum 1983 UTM Zone 8
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Benthic Invertebrate and Periphyton Monitoring Areas, Coffee Project FALMP

Date: March 2022
Project 217202.0040

minnow environmental inc.

Figure 4-1

Benthic invertebrate monitoring will include three components: 1) productivity; 2) community; and 3) tissue quality. These components were selected due to their sensitivity as monitoring tools and based on the type of potential effects and residual effects identified previously (Minnow and EDI 2017; Newmont Goldcorp 2019). Benthic invertebrate community monitoring is also a key element of Environmental Effects Monitoring (EEM) that will be required at the area affected by future mine effluent discharge under the MDMER of the federal *Fisheries Act* (Government of Canada 2022). Measurable parameters (Table 4-2) were identified based on a combination of potential and residual effects identified previously, and scientific consensus on appropriate effect endpoints (e.g., ESG 1999; Environment Canada 2012a; BCMOE 2016; Government of Canada 2022). The fundamental study design for the benthic invertebrate monitoring is a multiple control-impact (MCI) design that will also allow before-after-control-impact (BACI) analysis. This design represents a change from previous baseline sampling (PECG 2017; EDI 2017, 2018) which was implemented as a Reference Condition Approach (RCA) design. The MCI approach is considered more appropriate for application at the Coffee Project for several reasons:

1. The Control Impact (CI) approach (and the MCI approach) is generally considered to be more statistically powerful than the RCA approach (because within-area variability is generally lower than among-area variability).
2. There appears to be no reference database of suitable size for habitat directly comparable to the proposed study areas currently available (for example, the baseline data collected in 2017 was predominantly identified as mildly divergent from reference [EDI 2018] when reference was the 2013 Yukon Reference model [Reynoldson and Bailey 2014]).
3. The development of an appropriate RCA reference database (i.e., with closely matched habitat characteristics) would require a minimum of 20 reference sites per habitat type (Bowman and Somers 2005), which would be more than required for a robust CI (or MCI) design.

Furthermore, the sampling protocol proposed under this MCI/BACI design (Hess sampling) provides a quantitative measure of density (organisms/m^2) whereas sampling typically completed under an RCA design is semi-quantitative (total number of organisms/three-minute kick-and-sweep sampling effort). The within-area replication associated with the MCI design will also allow future statistical comparisons over time, including application of the BACI design, which is generally considered to be the optimal sampling design for situations where a future disturbance has yet to occur, but its location is known, and where one or more appropriate control (reference) areas can be found (Green 1979; Underwood 1992; Smith et al. 1993; Bowman and Somers 2005).

Based on predicted Project-associated residual changes to surface water hydrology and quality (Table 2-1), sampling areas include Halfway Creek, YT-24, Latte Creek, and Coffee Creek, with sampling areas located in the upper reaches (considered to be most sensitive to potential Project-related changes) and in the lower reaches which are occupied by fish (Table 4-2 and Figure 4-1). It is anticipated that the initiation of mine water discharge into upper Halfway Creek will cause it to be subject to MDMER-EEM. MDMER-EEM includes a benthic invertebrate survey of the effluent exposed area and statistical comparison of effect metrics (measurable parameters of density, taxon richness, and Simpson's Evenness to reference and calculation of a similarity index effect indicator (e.g., Bray-Curtis index of dissimilarity; Government of Canada 2022). The intent of the Coffee Project benthic invertebrate monitoring is to incorporate MDMER-EEM into the broader monitoring plan.

Accordingly, most of the collection methods, analytical methods, and data interpretation methods (outlined in Sections 4.3 and 4.5) are the same as those prescribed for MDMER-EEM (Environment Canada 2012a;

Government of Canada 2022). For effective application of the MCI design, reference areas must be as similar to exposure areas as possible with respect to habitat features including stream order, elevation, bankfull width, channel gradient, water depth, water velocity, substrate (cobble) size, and substrate embeddedness (Environment Canada 2012a). Based on these principles, reference areas for the upper creek areas have been identified (a tributary to upper Carlisle Creek and a tributary to upper Coffee Creek) and reference areas for the lower creek areas have also been identified ("South of YT-24" and "East of Excelsior"; Table 4-2 and Figure 4-1).

Monitoring will be undertaken in the late summer (which coincides with the timing of previous monitoring in 2014, 2015, 2017-2019, and 2021) to ensure comparability over time. This timing is considered optimal for benthic invertebrate sampling because communities are relatively stable (major aquatic insect emergence events generally do not occur late in the summer), and organisms are well developed, allowing identification to suitable taxonomic levels.

Five replicate benthic invertebrate stations/samples will be collected per area to allow statistical contrasts capable of detecting differences of two standard deviations at $\alpha=\beta=0.10$. This is consistent with technical guidance for EEM under MDMER (Environment Canada 2012a; Government of Canada 2022) and achieves a balance between low probability (10% risk) of type 1 (α or false positive) and type 2 (β or false negative) errors and can, on average, detect differences between reference and exposed areas of ± two reference area standard deviations. The five stations will be separated from one another by a distance of at least three bankfull widths to ensure that the area is effectively represented by the five stations/samples. This level of replication will facilitate the statistical contrast of future-exposed and reference areas to identify statistically significant differences (see Section 4.5).

Such differences will be interpreted further based on Critical Effect Sizes (CES) indicative of ecologically meaningful difference (as outlined under MDMER) and based on correlation with physical and chemical conditions to determine if observed differences were due to Project-associated influences or natural influences. Benthic invertebrate monitoring will provide important feedback information for the Project. For the key measurable parameters with identified residual changes (Minnow and EDI 2017; Newmont Goldcorp 2019), adaptive management actions are included in the Surface Water Quality and Aquatic Life AMP (Appendix L of the EMAMP). In addition, findings of the benthic invertebrate monitoring will also be used to adjust the monitoring based on recommendations associated with interpretive reporting. Adjustments could include changes or additions to reference areas, additional sampling areas within exposed creeks/river, additional interpretive techniques, or additional monitoring components (e.g., specific evaluation of metal availability and/or trophic transfer).

The benthic invertebrate monitoring program is expected to change over time in response to findings, in response to changes in Project phase (Construction, Operation, Reclamation and Closure), and any unforeseen operational changes.

4.3 Monitoring Areas and Frequencies

Benthic invertebrate monitoring will be completed through construction, operations, and reclamation and closure, as summarized in Table 4-3. Baseline benthic invertebrate data collected from the same areas and using the same methodology are available (2018, 2019, 2021; Minnow 2022). Benthic invertebrates will be monitored once during construction. During the Operation Phase of the Project, the benthic invertebrate monitoring program will be conducted annually at the upper creek areas for the first three years and every two years thereafter and will be conducted every two years at the lower creek areas[3]. During the Reclamation and Closure Phase of the Project, benthic invertebrate monitoring program will be conducted every two years (also subject to AMP). Post-closure, monitoring will only be conducted in the event that site-specific water quality objectives are not maintained or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Adaptive management actions are detailed in the Surface Water Quality and Aquatic Life AMP (Appendix L of the EMAMP).

Table 4-3 Benthic Invertebrate Monitoring Areas and Frequency

Station	Area	Mean* Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Halfway Creek Watershed							
HF6.8	Upper Halfway Creek	584040	6976554	Downstream of influence	Once	Annually**	Every 2 Years
HF0.2	Lower Halfway Creek	588708	6980454	Downstream of influence	Once	Every 2 Years	Every 2 Years
Latte Creek Watershed							
LC10.2	Upper Latte Creek	586245	6971292	Downstream of influence	Once	Annually**	Every 2 Years
Coffee Creek Watershed							
CF5.6	Coffee Creek	596860	6974237	Downstream of influence	Once	Every 2 Years	Every 2 Years
YT-24 Watershed							
YT4.3	Upper YT-24 Creek	607645	6976556	Downstream of influence	Once	Annually**	Every 2 Years
YT0.2	Lower YT-24 Creek	589471	6979077	Downstream of influence	Once	Every 2 Years	Every 2 Years
Upstream Reference Area 1							
CR24.5	Upper Carlisle Creek	564251	6976963	Reference Area	Once	Annually**	Every 2 Years
Upstream Reference Area 2							
CF23.7	Coffee Creek	597045	6961892	Reference Area	Once	Annually**	Every 2 Years
Downstream Reference Area 1							
XE0.2	Creek East of Excelsior	605198	6974086	Reference Area	Once	Every 2 Years	Every 2 Years
Downstream Reference Area 2							
SYT0.6	Stream South of YT-24 Creek	590395	6978316	Reference Area	Once	Every 2 Years	Every 2 Years

*Mean of n = 5 stations per area
**Sampling will be conducted annually for first three years of the Operation phase. Sampling will be conducted every two years after year three pending findings and application of the Surface Water Quality and Aquatic Life AMP. Annual frequency is the maximum recommended for temporal comparison and both annual and bi-annual frequencies are appropriate to detect potential changes and meet or exceed standard recommended frequencies AEMP and/or EEM biological studies.

[3] Subject to potential changes trigger by findings and application of the Surface Water Quality and Aquatic Life AMP (Appendix L of the EMAMP).

4.4 Methods

4.4.1 Field Methods

Shallow (i.e., ≤0.3 m) riffle-run habitat characterized by cobble-gravel substrate will be targeted for benthic invertebrate sample collection at Project exposure and reference areas. Conditions of substrate, depth, and water velocity will be carefully controlled to optimize comparability. Consistent with 2017 to 2021 sampling (Minnow and EDI 2017; Minnow 2022), benthic invertebrate monitoring will be conducted using a 0.1 m^2 Hess sampler outfitted with 500-µm mesh. One sample, representing a composite of three sub-samples (i.e., 0.3 m^2 total area), will be collected at each station to ensure adequate representation of benthic invertebrate community features. Each sub-sample will be collected by carefully inserting the base of the Hess sampler into undisturbed substrate and subsequently scrubbing all coarse material within the sampler area to a sediment depth of approximately 10 cm, allowing the current to carry all dislodged organisms into the sampler net. After all substrate within the sampler has been completely washed and all organisms have been rinsed into the collection net, the sampler will be moved to the next sub-sample location and the procedure repeated twice. Following collection of the third sub-sample using the above procedure, all material, and organisms retained in the collection net will be carefully transferred into pre-labelled wide-mouth plastic jars. As a precautionary measure, internal sample labels will also be used to ensure correct sample identification at the processing laboratory. The benthic samples will then be preserved to a level of 10% buffered formalin in ambient water and sampling will be repeated at five stations per area.

Benthic invertebrate samples for tissue quality will be collected at the same stations as benthic invertebrate community after the community sampling is complete. Samples will be collected using a combination of hand picking and kick-and-sweep collection. Hand picking entails overturning rocks in the streambed and collecting any of benthic invertebrates observed. The kick-and-sweep method involves a field technician moving upstream and across the stream channel (in a zig-zag pattern) while holding a kick net (a net with a triangular opening and a 400 µm mesh bag) immediately downstream and disturbing the substrate with his or her feet to dislodge benthic organisms into the net (a method modified from the Canadian Aquatic Biomonitoring Network [CABIN] 3-minute travelling kick-and-sweep; Environment Canada 2012b). The net will then be rinsed with water to move all debris and invertebrates to the collection cup at the bottom of the net. The collection cup will be removed and its contents (i.e., invertebrates and debris) will be placed into a plastic tote. Organisms will then be picked free of debris, and transferred into a labeled scintillation vial, without rinsing, to minimize the amount of water in each sample. One composite-taxa sample (containing a mixture of taxa that is proportional to biomass at the station) will be collected at each station. Samples will be stored in a cooler containing ice packs for transport to the camp, where they will be frozen.

Supporting information collected at each benthic invertebrate monitoring station will include substrate description (type and approximate diameter), water velocity (m/s), sampling depth (cm), water quality at the sediment-water interface (temperature, dissolved oxygen, pH , and specific conductivity), stream dimensions (wetted and bankfull width), general habitat notes (e.g., stream morphology, extent of riparian cover, surrounding land use, potential confounding influences, etc.), and global positioning system (GPS) coordinates.

4.4.2 Sample Handling and Laboratory Methods

Benthic invertebrate community samples will be submitted to and processed by a qualified benthic invertebrate taxonomy laboratory using standard sorting methods. Sample material greater than 500 µm in diameter will be examined under a stereomicroscope at a magnification of at least ten times. If the estimated number of invertebrates in a sample is greater than 600 individuals and the sample is fine and non-clumping, a subsample will be taken using a Marchant Box (Marchant 1989) as described by Environment Canada (2020). Samples (or sub-samples) will then be sorted using a gridded Petri dish under a low power stereo microscope into family/order while maintaining counts (but totals exclude Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera, and any terrestrial drop-ins). All samples will be processed to a minimum 300 organism count, and if 300 organisms have not been reached by the 50th cell of the Marchant Box, then the entire sample will be sorted (i.e., all 100 cells). All sorted organisms will be stored in 80% ethanol by family/order in separate labeled vials and debris will be preserved and labeled separately. Identifications of all insects to the lowest practicable level (LPL; typically genus or species) and non-insects to the genus/species level (where possible, but to a minimum of family level) will be conducted by experienced, certified taxonomists using up-to-date taxonomic keys, comparisons to an externally-verified reference (voucher) collection, and effort lists compiled by CABIN, SAFIT (Southwest Association of Freshwater Invertebrate Taxonomists), and PNAMP (Pacific Northwest Aquatic Monitoring Partnership).

During taxonomic identification, representative specimens of each taxon will be preserved using a 75% ethanol/ 3% glycerol solution and retained to form a voucher collection for the Project for future reference. Benthic invertebrate community sample processing QA/QC measures will be conducted on a minimum of 10% of samples. These measures will be used to verify that sorting efficiency is greater than 95% and that sub-sampling accuracy and precision is within 20% (Environment Canada 2012a; 2020). Additional identification audits will be completed, and a voucher collection will be maintained for the Project (per Environment Canada 2020 recommendations).

Following taxonomic identification, the wet and dry biomass of total organisms in each sample will be determined. For wet biomass, samples will be poured through a piece of pre-weighed 212 μm Nitex mesh and dried gently between two pieces of absorbent paper. Each sample will then be weighed to the nearest 0.0001 g, and the weight of the mesh will be subtracted from the total weight to determine total sample wet weight. For dry biomass, wet samples will be then placed on a piece of pre-dried and pre-weighed glass fiber filter before being dried at 160^{0}F (71°C) for six hours. Following a short period of cooling, samples will be weighed as described above, and total sample dry weight will be calculated.

Benthic invertebrate tissue quality samples will remain frozen until overnight shipment on ice with completed Chains of Custody (COC) to an analytical laboratory accredited by the Canadian Association for Laboratory Accreditation (CALA). Samples will be sent to the laboratory with sufficient time to complete analyses within the recommended sample hold times. Upon sample receipt, the laboratory will provide a sample receipt confirmation when the samples are received and logged. These receipts will be reviewed to ensure that all samples are received and that the analytical requests are properly logged. Tissue quality samples will be analysed for metals by CRC-ICP-MS (Collision Cell Inductively Coupled Plasma-Mass Spectrometry; USEPA Method 200.3 (USEPA 1991)/6020A (USEPA 200)) or HR-ICP-MS (High Resolution Inductively Coupled Plasma-Mass Spectrometry; USEPA Method 200.3 (USEPA 1991)/ 200.8 (USEPA 1994)), mercury by CVAFS (Cold Vapour Atomic Fluorescence Spectrophotometry; USEPA Method 200.3 (USEPA 1991)/Method 245.7 (USEPA 2001)), and moisture content. The method selected for metals analysis will depend on sample weight, with HR-ICP-MS employed for smaller sample sizes. Tissue quality analytes and target Laboratory Reporting Limits (LRLs) are provided in Table 4-4. Upon completion of the analyses, the laboratory will provide a data report in Microsoft (MS) Excel™ and as an Adobe Acrobat Portable Document Format (PDF). Reporting will include the results of the laboratory QC sample results.

Table 4-4 Benthic Invertebrate Tissue Quality Analytes and Target Reporting Limits

Parameter	Units	Laboratory Reporting Limit
Aluminum	mg/kg dw	5
Antimony	mg/kg dw	0.01
Arsenic	mg/kg dw	0.03
Barium	mg/kg dw	0.05
Beryllium	mg/kg dw	0.01
Bismuth	mg/kg dw	0.01
Boron	mg/kg dw	1
Cadmium	mg/kg dw	0.01
Calcium	mg/kg dw	20
Chromium	mg/kg dw	0.2
Cobalt	mg/kg dw	0.02
Copper	mg/kg dw	0.2
Iron	mg/kg dw	5
Lead	mg/kg dw	0.05
Lithium	mg/kg dw	0.5
Magnesium	mg/kg dw	2
Manganese	mg/kg dw	0.05
Mercury	mg/kg dw	0.005
Molybdenum	mg/kg dw	0.04
Nickel	mg/kg dw	0.2
Phosphorus	mg/kg dw	10
Potassium	mg/kg dw	20
Selenium	mg/kg dw	0.1
Sodium	mg/kg dw	20
Strontium	mg/kg dw	0.1
Tellurium	mg/kg dw	0.02
Thallium	mg/kg dw	0.002
Tin	mg/kg dw	0.1
Titanium	mg/kg dw	2
Uranium	mg/kg dw	0.002
Vanadium	mg/kg dw	0.1
Zinc	mg/kg dw	1
Zirconium	mg/kg dw	0.2

4.5 Data Analysis, Interpretation, and Reporting

Upon receipt of all analytical data, a Data Quality Review (DQR) will be performed which will confirm that all requested analyses are complete. For benthic invertebrate community data, recovery checks and sub-sampling variability will be evaluated. For benthic invertebrate tissue quality, DQR will confirm that acceptable Laboratory Reporting Limits (LRLs) have been achieved. It will also include an evaluation of differences between duplicate (split) samples, as well as the QA/QC data reported by the laboratory. Completion of the DQR promptly following receipt of the benthic invertebrate monitoring data will ensure timely communication with the laboratory should any issues be identified.

Benthic invertebrate communities will be evaluated using measurable parameters (metrics) of biomass, density (average number of organisms per m^2), taxon richness, percent EPT taxa (Ephemeroptera-Plecoptera-Trichoptera), percent mayflies (Ephemeroptera), percent key Habit Preference Groups (HPG; burrowers, clingers), and percent key Functional Feeding Groups (FFG; collector-gatherers, filterers, scrapers). Benthic invertebrate community monitoring completed under the MDMER-EEM will be evaluated using primary metrics of mean taxonomic richness (as identified to family level), mean invertebrate density (average number of organisms per m^2), Simpson's Evenness Index, and the Bray-Curtis Index of Dissimilarity as required under the MDMER (Government of Canada 2022). Additional comparisons may also be conducted using percent composition of dominant or indicator taxa (calculated as the abundance of each respective taxonomic group relative to the total number of organisms in the sample), Simpson's Diversity index, Hilsenhoff Biotic Index, and any other metrics that may assist with data interpretation. Lastly, Correspondence Analysis (CA) will be used to further examine benthic invertebrate community structure. These are multivariate ordination methods used to reduce multivariate data into a manageable number of variables and will be applied to assist in the identification of key spatial or temporal differences in benthic invertebrate community (i.e., which stations have distinct benthic communities but also how these benthic communities differ among stations). The results of these multivariate analyses will be included in the comparison of benthic invertebrate metrics as described below. All metrics will be summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error, and sample size for each study area.

Statistical comparisons between the Project-exposed and reference areas will be conducted using Analysis-of-Variance (ANOVA). In addition, following the baseline phase, BACI analysis will be completed as a two-way factorial ANOVA to evaluate any key changes in benthic invertebrate endpoints at the future-exposed areas over time while taking changes in reference area endpoints into account. All data will be assessed for normality and homogeneity of variance, with data transformed as required to satisfy the assumptions of ANOVA. In instances where the residuals of the ANOVA model do not meet the assumptions of normality and homogeneity of variances, a non-parametric Kruskal-Wallis test will be conducted. When the overall results of an ANOVA or Kruskal-Wallis test are significant, differences between specific areas will be evaluated using post-hoc contrasts for ANOVA or Dunn's test for the Kruskal-Wallis test. A Bonferroni correction on the p-values will be used to conserve the overall Type I error rate. For the Two-Way ANOVA model (BACI analysis), assumptions of normality and homogeneity will be tested on the residuals of the model as described above using the Shapiro-Wilk test and Levene's test based on median values, respectively ($\alpha = 0.05$). Data will be transformed as necessary to satisfy assumptions of normality and homogeneity of variance and if these assumptions are not met, the analysis will be conducted on ranks (equivalent to a non-parametric test). When the interaction between *Area* and *Year* is significant ($\alpha = 0.1$), post-hoc contrasts will be conducted, and when the interaction between *Area* and *Year* is not significant, the effect of area and year will be assessed ($\alpha = 0.1$) using the *Area* and *Year* terms in the ANOVA model.

If exposed versus reference or temporal differences in benthic invertebrate community and/or productivity results are noted, potential relationships between benthic invertebrate community metrics and physical / chemical conditions of the study areas will be explored using Spearman correlation (often referred to as Spearman Rank-Order correlation). Following the derivation of correlation coefficients, a Bonferroni-type correction (i.e., p-value [0.05] divided by the total number of correlations examined for independent variables) will be applied to minimize the risk of declaring false positive correlations since at least 5% of derived correlations would be expected to occur by chance alone at an uncorrected p-value of 0.05. Any significant correlations observed at the Bonferroni-adjusted p-value or at a p-value of 0.01 will be further investigated using scatter plots to determine if a continuous distribution of data was realized (possible causal relationships) or if these relationships were leveraged by outlying points (or groups of points). Although it is recognized that a significant correlation or regression does not necessarily indicate cause (e.g., Norton et al. 2015), it is desirable to not only characterize the nature of a response (e.g., differences in benthic invertebrate community), but to also obtain evidence of cause. Correlation / regression analyses are commonly applied tools for identifying potential cause (e.g., Norton et al. 2015). Evidence of cause obtained from correlation or regression analysis will be carefully considered in light of the strength, range, and continuity of the relationships as well as mechanistic knowledge/understanding of potential cause.

Data analysis and interpretation of benthic invertebrate tissue quality results will focus on analytes predicted to be influenced by the Project (i.e., arsenic, uranium, and zinc). Benthic invertebrate tissue quality results will be compared to reference and over time using the same statistical approach as described above for the benthic invertebrate community measurable parameters.

An interpretive report based on the benthic invertebrate monitoring data will be prepared and will include the Data Quality Review (DQR), detailed description of all methodology, the results of all spatial and temporal statistical comparisons, and the associated interpretation, conclusions, and recommendations. All data interpretation will be summarized in clear text form supported by tables and data plots.

5.0 PERIPHYTON MONITORING

5.1 Background and Objective

As with benthic invertebrates, periphyton—an indicator of primary productivity in creeks—was identified as an independently valuable resource for environmental assessment and was a focus of an Intermediate Component Analysis Report that supported the overall environmental assessment of the Coffee Project (Minnow and EDI 2017; Newmont Goldcorp 2019). Periphyton represents an important component of aquatic food webs in creeks and consists of a complex matrix of organisms. Periphyton generally includes algae, fungi, bacteria, and protozoa attached to submerged substrate (e.g., rocks, bedrock, woody debris). These organisms are representative of the lowest trophic level in running water and take up nutrients such as nitrogen and phosphorus, as well as other substances dissolved in water (e.g., major ions, metals), which can thereby become available via dietary pathways to consumer organisms at higher trophic levels. Periphyton productivity and community characteristics can be influenced by factors such as physical disturbance (i.e., changes to surface water hydrology) and water quality (relating to toxicity or changes in productivity due to nutrient chemistry).

Key Project interactions with periphyton include predicted residual changes in surface water hydrology (flow reductions or increases with changes to the seasonal distribution of low and high flows) and changes in surface water quality (some localized increases in concentrations of sulphate, nitrate, arsenic, and/or aluminum) in Latte Creek, YT-24 Creek, and/or Halfway Creek (Table 2-1). The Periphyton and Benthic Invertebrates Analysis (Minnow and EDI 2017; Newmont Goldcorp 2019) predicted subtle changes in periphyton species composition (changes in the proportion of mucilaginous algae versus filamentous algae[4]) in Latte Creek, YT-24 Creek, and Halfway Creek due to changes in flows, no residual effects to periphyton due to toxicity in any of these creeks (or downstream; although uncertainty was noted for Halfway Creek), and no residual effects to periphyton due to productivity alteration in Latte and downstream or in YT-24. However, periphyton biomass and community composition of Halfway Creek were predicted to be affected by productivity stimulation due to a combination of increased nitrate concentrations and increased water temperature in association with mine water discharge to Halfway Creek (Minnow and EDI 2017; Newmont Goldcorp 2019).

The objectives of periphyton monitoring are to assess the key Project interactions and predicted residual effects in comparison to baseline and reference conditions in a quantitative and statistically robust manner, and to comprehensively monitor aquatic environments that could potentially be influenced by Project activities.

5.2 Study Design Overview

Periphyton monitoring is designed to meet the objectives stated above by focusing on key monitoring components and measurable parameters that are effective monitors of the Project interactions in general, and the residual effects in particular, within a statistically robust study design that has the power to detect potential changes in the measurable parameters over time and relative to carefully selected reference areas. The design of the periphyton monitoring program is similar to that for benthic invertebrates, is summarized in Table 5-1, Table 5-2, and Figure 4-1 and includes periphyton productivity and periphyton community. As with benthic invertebrate monitoring, periphyton monitoring is focused on Halfway Creek,

[4] Mucilagenous algae are those with a layer of mucilage, typically blue-green algae, and some diatoms. Filamentous algae are those that form filaments, typically green algae.

YT-24 Creek, Latte Creek, and Coffee Creek. Study design rationale is provided in the following paragraphs.

Table 5-1 Overview of Periphyton Monitoring

Monitoring Component	Description
Indicators	Periphyton Productivity and Community Structure
Monitoring Category	Environmental Effects
Design	Multiple Control-Impact Approach (MCI) and Before-After/Control-Impact
Measurable Parameters	Biomass (ash free dry mass/m^2), chlorophyll-a (mg/m^2), taxon richness, %green algae, %blue-green algae, %diatoms
Key Project Interactions	Changes in surface water hydrology and surface water quality
Goal	The Project will not have a significant adverse effect on periphyton when compared to baseline and/or reference conditions
Objective	Evaluate how the Project may influence periphyton
Scope of Monitoring Work	Periphyton samples will be collected at five stations per area by scraping carefully recorded surface areas to provide three samples, one for ash free dry mass, one for chlorophyll-a, and one for taxonomy. Sampling areas will include upper areas on Halfway Creek, YT-24, and Latte Creek and two matched reference creeks. Lower areas on the same creeks (with Coffee Creek replacing Latte Creek) will also be evaluated using a similar design (with separate lower reference creeks). Monitoring of upper creek areas will be conducted at least once during Construction, annually in upper creek stations for the first three years of Operation, and every two years for subsequent years of Operation and during Reclamation and Closure. Monitoring of lower creek areas will be the same as for the upper Creek areas except that it will be every 2 years throughout Operation.
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to avoid/reduce changes to the downstream aquatic environment.
Project Terms and Conditions	To be determined following YESAA and *Yukon Waters Act* licensing processes.

Periphyton monitoring will include two components: 1) productivity; and 2) community. These components were selected due to their sensitivity as monitoring tools and based on the type of potential effects and residual effects identified previously (Minnow and EDI 2017; Newmont Goldcorp 2019). The fundamental study design for the periphyton monitoring will be a multiple control-impact (MCI) design that will also allow before-after-control-impact (BACI) analysis as outlined in Section 4.2 for benthic invertebrates.

Table 5-2 Overview of the Periphyton Monitoring Program Study Design

Future Project Exposed Creek Area	Reference Creek Area	Components	Replication[2]	Method Summary	Measurable Parameters[3]	Frequency	Timing
Upper Creek Areas							
Upper Halfway (HF6.8)	Upper Carlisle (CR24.5) and Upper Coffee (CF23.7)	P, C [1]	5	**Productivity**: sample periphyton with razor blade from a measured surface area of five representative rocks, freeze two samples (one for AFDM and one for chlorophyll-a). **Community**: sample periphyton with razor blade from five representative rocks, preservation with Lugol's solution.	**Productivity**: dry weight per m^2 and chlorophyll-a (mg/m^2) **Community**: taxon richness, %green algae, %blue-green algae, % diatoms	**Baseline:** 2018, 2019, 2021 **Construction**: once **Operations**: Annually in years 1 to 3, Every 2 years starting Year 5. **Reclamation and Closure**: Every 2 years	Late summer
Upper YT-24 (YT4.3)		P, C [1]	5				
Upper Latte (LC10.2)		P, C [1]	5				
Lower Creek Areas							
Lower Halfway (HF0.2)	Lower Creek East of Excelsior (XE0.2) and Lower Stream South of YT-24 (SYT0.6)	P, C [1]	5	**Productivity**: sample periphyton with razor blade from a measured surface area of five representative rocks, freeze two samples (one for AFDM and one for chlorophyll-a). **Community**: sample periphyton with razor blade from five representative rocks, preservation with Lugol's solution.	**Productivity**: dry weight per m^2 and chlorophyll-a (mg/m^2) **Community**: taxon richness, %green algae, %blue-green algae, % diatoms	**Baseline**: 2018, 2019, 2021 **Construction**: once **Operations**: Every 2 years **Reclamation and Closure**: Every 2 years	Late summer
Lower YT-24 (YT0.2)		P, C [1]	5				
Lower Coffee (CF5.6)		P, C [1]	5				

[1] P = periphyton productivity; C = periphyton community
[2] number of replicate station per area
[3] the Measurable Parameters are those that were specifically identified as potentially affected by the Project (Minnow and EDI 2017; Newmont Goldcorp 2019) and do not preclude interpretation based on additional Parameters. This is particularly true for community data, for which additional interpretive parameters will be calculated and contrasted (e.g., Simpson's Diversity, and ordination such as Correspondence Analysis or Non-metric Multidimensional Scaling).

Based on predicted Project-associated residual changes to surface water hydrology and quality (Table 2-1), sampling areas include Halfway Creek, YT-24, Latte Creek, and Coffee Creek, with sampling areas located in the upper reaches (considered to be most sensitive to potential Project-related changes) and the lower reaches which are occupied by fish (Table 5-2; Figure 4-1). For effective application of the MCI design, reference areas must be as similar to exposure areas as possible with respect to habitat features including stream order, elevation, channel gradient, water depth, water velocity, substrate (cobble) size, and exposure to sunlight. Based on these principles, reference areas for the upper creek areas have been identified (a tributary to upper Carlisle Creek and a tributary to upper Coffee Creek) and reference areas for the lower creek areas have also been identified (“South of YT-24” and “East of Excelsior”; Table 5-2 and Figure 4-1).

As with benthic invertebrates, a replication level of five will be applied to each area (i.e., five replicate periphyton stations will be collected per area) to allow statistical contrasts capable of detecting differences of two standard deviations at $\alpha=\beta=0.10$. This is consistent with technical guidance for benthic invertebrate community monitoring under the MDMER (Environment Canada 2012a; Government of Canada 2022) and achieves a balance between low probability (10% risk) of type 1 (α or false positive) and type 2 (β or false negative) errors. The five stations will be separated from one another by a distance of at least three bankfull widths to ensure that the area is effectively represented by the five stations. This level of replication will facilitate the statistical contrast of future-exposed and reference areas to identify statistically significant differences (see Section 5.5).

Periphyton monitoring will provide important feedback information for the Project. For the key measurable parameters with identified residual changes (Minnow and EDI 2017; Newmont Goldcorp 2019), adaptive responses are included within the overarching Surface Water Quality and Aquatic Life AMP (Appendix L of the EMAMP). In addition, findings of the periphyton monitoring will also be used to adjust the monitoring based on recommendations associated with interpretive reporting. Adjustments could include changes or additions to reference areas, additional interpretive techniques, or additional monitoring components (e.g., specific evaluation of metal availability and/or trophic transfer).

The periphyton monitoring program is expected to change over time in response to findings and in response to changes in Project phase (Construction, Operation, Reclamation and Closure) and any unforeseen operational changes.

5.3 Monitoring Areas and Frequencies

Periphyton monitoring will be completed through construction, operations, and reclamation and closure, as summarized in Table 5-3. Baseline periphyton data collected from the same areas and using the same methodology are available (2018, 2019, 2021; Minnow 2022). Periphyton will be monitored once during construction. During the Operation Phase of the Project, the periphyton monitoring program will be conducted annually at the upper creek areas for the first three years and every two years thereafter and will be conducted every two years at the lower creek areas[5]. During the Reclamation and Closure Phase of the Project, the periphyton monitoring program will be conducted every two years. Post-closure, monitoring will only be conducted in the event that site-specific water quality objectives are not maintained

[5] Subject to potential changes trigger by findings and application of the Adaptive Management Plan (Appendix L of the EMAMP).

or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Adaptive management actions are detailed in Appendix L of the EMAMP.

Monitoring will be undertaken in the late summer to ensure comparability over time. Periphyton communities undergo patterns of seasonal succession and therefore it is important for the timing of sample collection to be consistent year-to-year to ensure temporal comparability. To simplify monitoring logistics and to facilitate linkages among monitoring components, periphyton monitoring stations will be the same as those for benthic invertebrate monitoring (Table 5-3 and Figure 4-1).

Table 5-3 Periphyton Monitoring Areas and Frequency

Station	Area	Mean* Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Halfway Creek Watershed							
HF6.8	Upper Halfway Creek	584040	6976554	Downstream of influence	Once	Annually**	Every 2 Years
HF0.2	Lower Halfway Creek	588708	6980454	Downstream of influence	Once	Every 2 Years	Every 2 Years
Latte Creek Watershed							
LC10.2	Upper Latte Creek	586245	6971292	Downstream of influence	Once	Annually**	Every 2 Years
Coffee Creek Watershed							
CF5.6	Coffee Creek	596860	6974237	Downstream of influence	Once	Every 2 Years	Every 2 Years
YT-24 Watershed							
YT4.3	Upper YT-24 Creek	607645	6976556	Downstream of influence	Once	Annually**	Every 2 Years
YT0.2	Lower YT-24 Creek	589471	6979077	Downstream of influence	Once	Every 2 Years	Every 2 Years
Upstream Reference Area 1							
CR24.5	Upper Carlisle Creek	564251	6976963	Reference Area	Once	Annually**	Every 2 Years
Upstream Reference Area 2							
CF23.7	Coffee Creek	597045	6961892	Reference Area	Once	Annually**	Every 2 Years
Downstream Reference Area 1							
XE0.2	Creek East of Excelsior	605198	6974086	Reference Area	Once	Every 2 Years	Every 2 Years
Downstream Reference Area 2							
SYT0.6	Stream South of YT-24 Creek	590395	6978316	Reference Area	Once	Every 2 Years	Every 2 Years

*Mean of n = 5 stations per area
**Sampling will be conducted annually for first three years of the Operation phase. Sampling will be conducted every two years after year three if that change in sampling effort is deemed appropriate. Annual frequency is the maximum recommended for temporal comparison and both annual and bi-annual frequencies are appropriate to detect potential changes and meet or exceed standard recommended frequencies AEMP and/or EEM biological studies.

5.4 Methods

5.4.1 Field Methods

Periphyton samples will be collected for Chlorophyll-a analysis and biomass (as ash-free dry mass; AFDM) by selecting five representative submerged rocks from each monitoring station. Representative rocks from each station will be selected from locations with similar habitat (depth, velocity, and substrate characteristics), while attempting to match depth and velocity among periphyton collection stations and areas as closely as possible. Selected rocks (excluding those that are too small, highly angular, or uncharacteristic in surface texture) will be taken to the creek bank. For chlorophyll-a sample collection, a thin acetate template with a 2x2 cm opening in the middle will then be placed firmly on each rock, and the periphyton within this area will be scraped off using a stainless-steel razor blade or scalpel.

Sample material from each of the five rocks will then be transferred from the razor blade or scalpel to a large (47 mm) 0.45 µm pore diameter Whatman mixed cellulose ester filter paper until a single composite sample of approximately 200 mg to 1 g wet weight is obtained per station. If material collected from the five rocks sampled is insufficient, additional rocks will be sampled from the same area with similar habitat characteristics until the required sample volume is obtained. The filter paper will then be folded and placed into a labeled opaque centrifuge tube. The total surface area sampled at each station (0.002 m^2: 5 x 4 cm^2, or any deviations from this surface area), will be recorded to allow calculation of chlorophyll-a on a unit area basis.

The same rocks sampled for chlorophyll-a analysis (and additional rocks if they are required) will be used to collect separate scrapings for analysis of AFDM. For AFDM sampling, methods will follow those outlined above for chlorophyll-a, however material on the razor blade or scalpel from scraping of each rock will be rinsed into a small pre-labelled plastic jar with additional water added to cover the tissue (as necessary). Immediately after collection, all Chlorophyll-a and AFDM samples will be placed in a cooler on ice for transport to the mine, where they will be frozen.

Periphyton community samples will be collected from the same five rocks used for Chlorophyll-a and biomass sampling whenever possible (and additional rocks if required), or from rocks of a similar size collected from the same general location and habitat (depth and velocity). Sample collection methods will be similar to those outlined for chlorophyll-a and AFDM. Briefly, a thin acetate template with a 2x2 cm opening in the middle will be placed firmly on each rock and all of the periphyton within this area will then be removed using a scalpel and/or brush and a squirt bottle filled with site water (BCMOE 2013, 2016; Stevenson and Bahls 2006). The collected periphyton will then be transferred into a labelled sample jar, and this process will be repeated for the five rocks, resulting in a single composite sample from each station. The total surface area sampled at each station (0.002 m^2: 5 x 4 cm^2, or any deviations from this surface area if additional rocks are sampled) will be recorded. Immediately after collection, the sample will be preserved with Lugol's iodine solution until the sample is the colour of weak tea (approximately 1 mL of Lugol's per 250 mL of sample; BCMOE 2013) and will be mixed gently by inverting the sampling jar. All samples will be stored at room temperature.

Supporting information collected at each of the creek periphyton monitoring stations will include GPS coordinates, average water depth at the sample locations, field meter measurements of temperature, specific conductance, dissolved oxygen and pH, photographs of samples, notes of the presence or absence of aquatic vegetation, and other physical observations (sediment texture, colour, density, etc.).

5.4.2 Sample Handling and Laboratory Methods

Periphyton productivity (chlorophyll-a and AFDM) samples will remain frozen until overnight shipment on ice to the analytical laboratory. Samples will be sent to the laboratory with sufficient time to complete analyses within the recommended sample hold times (28 days for chlorophyll-a, 6 months for AFDM, 1 year for tissue metals analysis). Analyses will be completed at an analytical laboratory accredited by CALA. Upon sample receipt, the laboratory will provide a sample receipt confirmation which will be reviewed to ensure that all samples are received and that the analytical requests are properly logged. Analysis of chlorophyll-a will follow procedures adapted from USEPA Method 445.0 (USEPA 1997).

Chlorophyll-a concentration will be determined by routine acetone extraction followed by fluorescence detection using a non-acidification procedure (a method that is not subject to interferences from chlorophyll-b). Determination of total AFDM will follow procedures adapted from APHA Method 10300 C (APHA 2010). Total AFDM will be calculated as the difference between the dried sample weight and the ash weight, both of which will be determined gravimetrically. Dry weight will be determined by drying the sample at 105 °C, and the ash weight will be subsequently determined by ashing the dried sample at 500°C. Upon completion of the analyses, the laboratory will provide a data report in MS Excel™ and as an Adobe PDF. Reporting will include the results of the laboratory QC sample results.

Periphyton community samples will be stored at room temperature until shipment to the taxonomy laboratory for taxonomic identification and enumeration. Samples will be shipped immediately after the completion of the field work, however there are no recommended hold times for analysis. For sample analysis, samples will be settled in Ütermohl chambers for 24 h, and all cells within randomly selected fields of view will be enumerated until a minimum count of 300 algal units (1 unit = >1 cell for colonial or filamentous taxa) is reached. Identification will be performed using an inverted phase contrast microscope, and algal taxa will be identified to minimum of genus-level according to the most up-to-date taxonomic references. Periphyton density will be determined using the area sampled, proportion subsampled, and the total area of the selected fields of view. Biomass estimates will be generated for each major taxon group using taxon-specific biovolume formulae (Hillebrand et al. 1999) for cell measurements, and taxon-specific densities.

5.5 Data Analysis, Interpretation, and Reporting

Upon receipt of all analytical data, a DQR will be performed, which will confirm that all requested analyses are complete and that acceptable results have been achieved. Completion of the DQR promptly following receipt of the periphyton monitoring data will ensure timely communication with the laboratory should any issues be identified.

Periphyton productivity (chlorophyll-a and AFDM) results will be converted to a standard area-based measurement (mg/m^2 and g/m^2 for chlorophyll-a and AFDM, respectively), and chlorophyll-a results will be compared to literature-based criteria for moderately enriched streams (21 mg/m^2; Biggs 1996). Periphyton productivity results will also be compared to previous data (where possible) and to reference results. Periphyton communities will be evaluated using measurable parameters of taxon richness, percent green algae, percent blue-green algae, and percent diatoms (Table 5-1). Additional comparisons may also be conducted using diversity indices. Lastly, CA will be used to further examine periphyton community structure. These are multivariate ordination methods used to reduce multivariate data into a manageable number of variables and will be applied to assist in the identification of key spatial or temporal differences in periphyton communities (i.e., which stations have distinct communities but also how communities differ among stations). The results of these multivariate analyses may be incorporated into the comparison of periphyton indices described above. All metrics will be summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error, and sample size for each study area.

Statistical comparisons and correlation analyses for periphyton biomass, chlorophyll a, and community comparing Project-exposed and reference areas will be conducted using the same methods as the benthic invertebrate data analysis (Section 4.5). Similarly, an interpretive report will be prepared for periphyton using the same approach and methods as for benthic invertebrates outlined in Section 4.5.

6.0 SEDIMENT QUALITY MONITORING

6.1 Background and Objective

Sediment is an important sink and potential source of metals, metalloids, nutrients, and other substances in aquatic environments (e.g., Horowitz 1991; Ingersoll et al. 1997; Simpson and Batley 2016). Sediment quality of receiving environments adjacent to mine projects can be influenced by the direct input of solids as well as by the introduction of dissolved constituents (e.g., metals) into water that subsequently associate with reactive materials on sediment surfaces (e.g., oxides, organic carbon) by surface complexation (Santschi et al. 1990; Stumm and Morgan 1996; Sposito 2004). Sediment also represents a pathway for the exposure of aquatic life to metals and other substances. Key Project interactions with sediment include predicted residual changes in surface water hydrology (flow reductions or increases with associated changes to the seasonal distribution of low and high flows that can affect levels of suspended solids) and changes in surface water quality (some localized increases in concentrations of sulphate, nitrate, arsenic, and/or aluminum that could affect sediment quality) in Latte Creek, YT-24 Creek, and/or Halfway Creek (Table 2-1).

The objectives of stream sediment quality monitoring are to assess the key Project interactions in comparison to baseline and reference conditions in a quantitative and statistically robust manner, in comparison to sediment quality guidelines for the protection of aquatic life (CCME 1999), and to comprehensively monitor aquatic environments that could potentially be influenced by Project activities. Sediment quality monitoring is an independent monitor of potential Project-related influence and provides supporting data for the interpretation of benthic invertebrate monitoring data.

6.2 Study Design Overview

Sediment quality monitoring is designed to meet the objectives stated above by focusing on measurable parameters that are effective monitors of the Project interactions in general, and the residual effects in particular, within a statistically robust study design that has the power to detect potential changes over time and relative to carefully selected reference areas. The design of the sediment quality monitoring program is summarized in Table 6-1, Table 6-2, and Figure 6-1 and includes physical characteristics (particle size distribution and organic carbon content) and chemical characteristics (nutrients and metal concentrations). Locations of sediment deposition in the erosional creeks flowing from the Project area are rare. Baseline attempts to collect sediment (in 2019 and 2021) identified that the only study areas that consistently supported the collection of fine sediment were Latte Creek (LC10.2) Coffee Creek (CC5.6; Minnow 2022). Some sediment was collected at the lower areas of YT-24 Creek and Halfway Creek, but this sediment was more sparsely distributed and was typically coarser (sand dominated; Minnow 2022). Study design rationale is provided in the following paragraphs.

Table 6-1 Overview of Sediment Monitoring

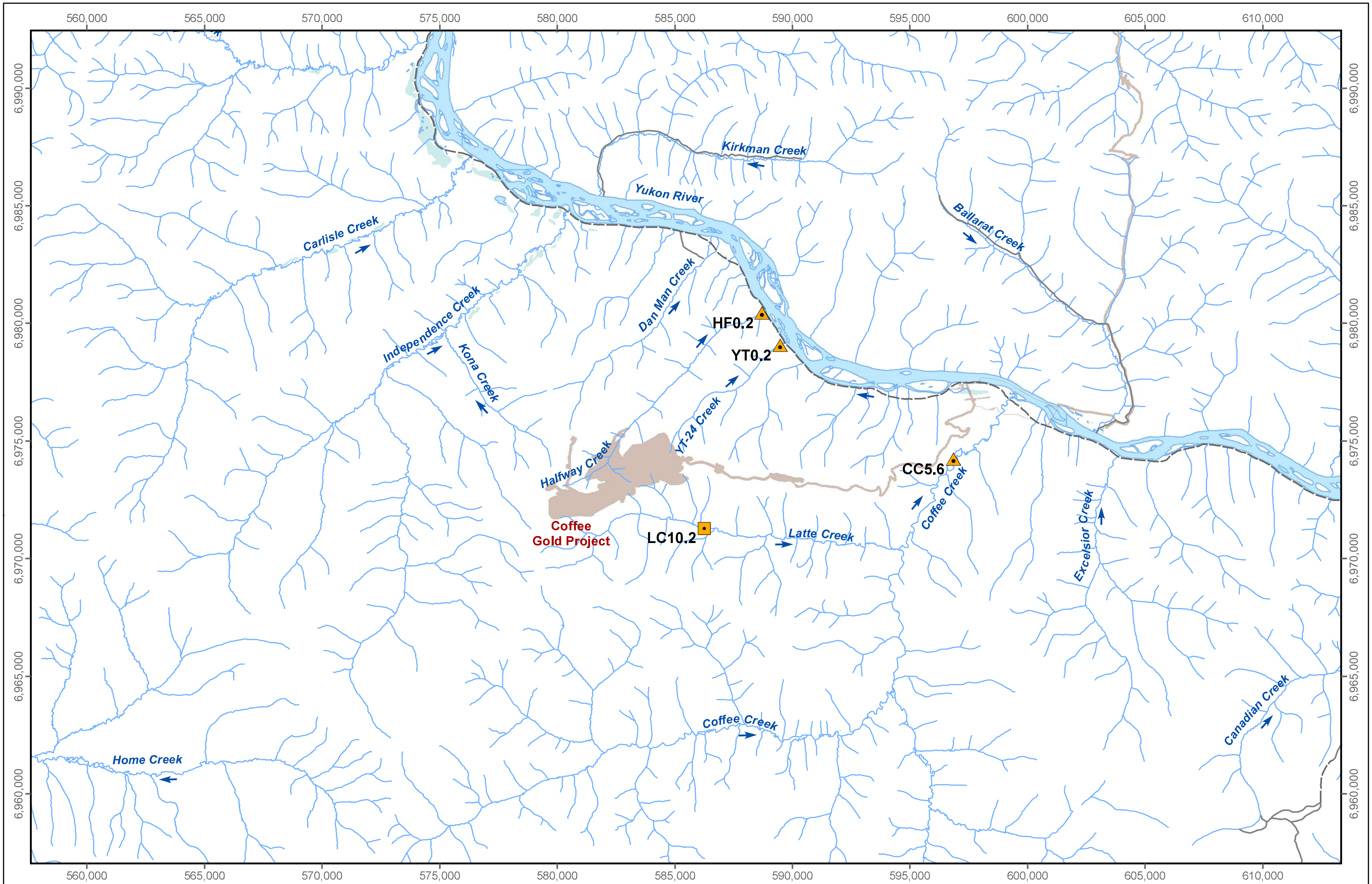
Monitoring Component	Description
Indicator	Sediment Quality
Monitoring Category	Environmental Effects
Design	Before-After
Measurable Parameters	Particle size distribution, total organic carbon content, total nitrogen, total metals scan (ICP-MS[1] on < 63 µm fraction)
Key Project Interactions	Changes in surface water hydrology and surface water quality
Goal	The Project will not have a significant adverse effect on sediment quality when compared to baseline conditions
Objective	Evaluate how the Project may influence sediment quality
Scope of Monitoring Work	Sediment samples will be collected at five stations per area. Sampling areas will include locations of sediment deposition on Latte Creek, Coffee Creek, lower YT-24 Creek, and Halfway Creek. No sampling will be undertaken at reference areas. Monitoring will be conducted at least once during Construction and every two years during Operation and during Reclamation and Closure.
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to avoid/reduce changes to the downstream aquatic environment
Project Terms and Conditions	To be determined following YESAA and *Yukon Waters Act* licensing processes.

[1] ICP-MS = inductively couple plasma - mass spectrometry

Table 6-2 Overview of the Sediment Quality Monitoring Program Study Design

Future-Exposed Creek Area	Replication[1]	Method Summary	Measurable Parameters	Frequency	Timing
Upper Latte Creek (LC10.2)	5	Collect fine sediment (silt and clay) from locations of deposition[2] using a spoon. Laboratory sieving to <63 µm to ensure only silt and clay fractions are included in chemical analysis.	**Physical**: Particle size distribution, total organic carbon content **Chemical**: total nitrogen, and metals by ICP-MS scan[3]	**Baseline:** 2019 and 2021 **Construction:** once **Operations:** every 2 years **Reclamation and Closure:** every 2 years	Late summer
Lower Halfway Creek (HF0.2)	5				
Lower YT-24 Creek (YT0.2)	5				
Lower Coffee Creek (CF5.6)	5				

[1] number of replicate stations per areas
[2] because the creeks are primarily erosional, area of sediment deposition are typically limited to small pools and backwater areas, often over coarser material (rock, cobble, and/or sand)
[3] inductively coupled plasma-mass spectrometry scan



LEGEND

Sampling Location

- Upper "Future" Exposure
- Lower "Future" Exposure
- Mine Footprint
- Limited-use road
- Trail

0 2.5 5 10 km

N E S W

Projection: North American Datum 1983 UTM Zone 8
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Sediment Monitoring Areas, Coffee Project FALMP

Date: March 2022
Project 217202.0040

minnow environmental inc.

Figure 6-1

Sediment quality monitoring parameters were selected due to their relevance as monitoring tools and based on the type of potential effects identified previously and typical of metal mines. The fundamental study design for the sediment quality monitoring will be a Before-After (BA) design[6].

Based on predicted Project-associated residual changes to surface water hydrology and quality (Table 2-1), sampling areas include Latte Creek, Coffee Creek, YT-24 Creek, and Halfway Creek. All are lower creek areas except for Latte Creek (Table 6-2; Figure 6-1). Due to the predominantly erosional characteristics of each of these areas, exact location of the stations within the areas will differ slightly from those for benthic invertebrate and periphyton monitoring as the sediment quality monitoring will target locations of sediment deposition (e.g., small pools and backwaters).

A replication level of five will be applied to each area (e.g., five replicate sediment stations per area) to allow statistical contrasts capable of detecting differences of two standard deviations at $\alpha=\beta=0.10$ and to provide a more representative basis for comparison to sediment quality guidelines (CCME 1999). This level of replication will facilitate the statistical comparisons of the same areas over time. Sediment quality monitoring will provide important feedback information for the Project and findings will be used to adjust the monitoring based on recommendations associated with interpretive reporting. Adjustments could include additional interpretive techniques or additional monitoring components (e.g., specific evaluation of metal availability and/or sediment toxicity).

6.3 Monitoring Areas and Frequencies

As with other elements of this FALMP, the sediment quality monitoring program is expected to change over time in response to findings and in response to changes in Project phase (Construction, Operation, Reclamation and Closure) and any unforeseen operational changes (e.g., substantive changes in sedimentation). Baseline sediment quality data collected from the same proposed sampling areas and using the same methodology are available (2019 and 2021; Minnow 2022).

Sediment quality monitoring will be completed through construction, operations, and reclamation and closure, as summarized in Table 6-3. Sediment will be monitored once during construction. During the Operation Phase and during the Reclamation and Closure Phase, sediment quality monitoring will be conducted every two years. Post-closure, sediment quality monitoring will only be conducted in the event that water quality objectives are not maintained or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Adaptive management actions are detailed in the overarching Surface Water Quality and Aquatic Life AMP (Appendix L of the EMAMP).

Sediment quality monitoring will be undertaken in the late summer to ensure comparability over time. To simplify monitoring logistics and to facilitate linkages among monitoring components, sediment monitoring will be completed at the same time as benthic invertebrate and periphyton monitoring, although the actual location of the stations will differ to accommodate the requirement for in-creek sediment deposition.

[6] Although an MCI/BACI design was considered to be the ideal design for sediment (i.e., the same design as applied to the benthic invertebrate and periphyton monitoring), the absence of sediment at matched reference areas forced the selection of the BA design.

Table 6-3 Sediment Quality Monitoring Areas and Frequencies

Station	Area	Mean* Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency**		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Halfway Creek Watershed							
HF0.2	Lower Halfway Creek	588708	6980454	Downstream of influence	Once	Every 2 Years	Every 2 Years
Latte Creek Watershed							
LC10.2	Upper Latte Creek	586245	6971292	Downstream of influence	Once	Every 2 Years	Every 2 Years
Coffee Creek Watershed							
CF5.6	Coffee Creek	596860	6974237	Downstream of influence	Once	Every 2 Years	Every 2 Years
YT-24 Watershed							
YT0.2	Lower YT-24 Creek	589471	6979077	Downstream of influence	Once	Every 2 Years	Every 2 Years

*Mean of n = 5 stations per area
** Annual frequency is considered appropriate to detect potential change over time.

6.4 Methods

6.4.1 Field Methods

Creeks in the vicinity of the Project are predominantly erosional and there are few locations of true sediment deposition. The limited sediment within these creeks tends to wash through during spring freshet and deposit as a thin layer of fines in quiescent areas on the lowering hydrograph. Thus, collection of true sediment (i.e., fines in the silt and clay size category) cannot be completed by conventional grab sampling as typically applied in depositional creeks (i.e., due to the dominant presence of sand, gravel, and cobble). An alternative method, sampling by spoon, will therefore be applied. This sampling will target the fine sediment fraction (i.e., silt and clay). Sampling will be undertaken in late summer when low flows support some sediment deposition, even if only as a thin layer over sand, gravel, or cobble.

As for benthic invertebrate monitoring and periphyton monitoring, sediments will be collected at five replicate stations per area. However, due to the non-uniform nature of sediment deposition in erosional creeks, the actual sampling stations will be determined opportunistically with each field sampling campaign and may vary slightly over time (i.e., a priority will be placed on the quality of the five replicate sediment samples collected within each area rather than the precise location of each sample within each area).

Sediment samples from creeks will be collected using a clean stainless-steel spoon. All samples will be collected from wetted sampling stations that support the accumulation of fine materials (i.e., small pools or backwaters). Sampling locations will be approached by foot in a manner that does not disturb sediment prior to sampling. At locations of sediment deposition, surficial sediment will be carefully collected by slowly placing the spoon on the sediment surface in a manner that minimizes disturbance. The spoon will then be inserted into the sediment to capture sediment to a depth of no greater than 3 cm and moved horizontally to fill the spoon. In reality, the collection depth may be much less than 3 cm, as fines often settle in a thin layer over coarser material (and sampling seeks to avoid coarse material as indicated above). The spoon will then be slowly retrieved to surface to avoid sample washout. The content of the spoon will then be inspected to ensure that it represents fine sediment (i.e., is predominantly silt and clay) and, if accepted, will be placed into a 250 mL glass sampling jar labeled with the project number, sample location and collection date.

This procedure will be repeated a minimum of four more times to form a composite sample representative of the sampling station and will be repeated at each of the replicate stations per area[7]. Sampling equipment will be rinsed between stations using site water. Duplicate sediment samples will be collected at a target frequency of 10% for QA/QC purposes (associated composite samples will be composed of twice the number of spoons to support the split samples). In addition, supporting information will be collected at each sampling station as outlined below. Immediately after collection, sediment samples will be placed into a cooler with ice packs, where they will be maintained cool prior to transport to the field laboratory where they will then be transferred to refrigerator and held until shipment to the analytical laboratory.

Supporting information collected at each of the creek sediment quality monitoring stations will include GPS coordinates, average water depth at the sample locations, average sediment depth collected, field meter measurements of temperature, specific conductance, dissolved oxygen and pH, photographs of sediment samples, notes of the presence or absence of aquatic vegetation, and other physical observations (sediment texture, colour, density, etc.).

6.4.2 Sample Handling and Laboratory Methods

Following completion of the field program, sediment samples will be shipped in coolers with ice packs to the analytical laboratory. Chemical analyses will be completed on the <63 µm fraction (silt and clay) at an analytical laboratory accredited by CALA and will include moisture content, pH, particle size distribution, total organic carbon (TOC), total nitrogen, total sulphur, and total metal concentrations. Following analyses, the laboratory will provide a data report in Microsoft (MS) Excel™ and as an Adobe™ Acrobat PDF. Reporting will include the results of the laboratory QC sample results.

Chemical analyses will be completed at an analytical laboratory accredited by CALA and will include moisture content, pH, particle size distribution, total organic carbon (TOC), total nitrogen, total sulphur, and total metal concentrations (Table 6-4). Nitrogen, carbon, sulphur, and total metals will be completed on the silt/clay fraction (<63 µm diameter). Analysis of metals will be based on the Strong Acid Leachable Metals digestion (SALM; BCMOE 2016). Analyses of pH will be completed by electrode, particle size analysis will be completed by sieve and pipette, total organic carbon will be completed by combustion and titration (total carbon minus total inorganic carbon), total nitrogen and total sulphur will be completed by combustion, metals will be completed by collision reaction cell inductively coupled plasma – mass spectrometry (USEPA Method 6020A; USEPA 2004), and mercury will be completed by cold vapor atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (USEPA Method 245.7; USEPA 2001). Following analyses, the laboratory will provide a data report in Microsoft (MS) Excel™ and as an Adobe Acrobat PDF. Reporting will include the results of the laboratory QC sample results.

[7] Despite the target sample size of five stations per area, this level of replication may not be supported at all areas under all conditions. In particular, sediment deposition is limited at YT0.2 and HF0.2 and lower level of replication may all that is achievable in some years.

Table 6-4 Creek Sediment Quality Analytes and Target Reporting Limits

Parameter	Units	Laboratory Reporting Limits
Physical Parameters		
Percent Sand (0.063 – 2 mm)	%	0.1
Percent Silt (4 µm – 0.063 mm)	%	0.1
Percent Clay (<4 µm)	%	1.1
Percent Moisture	% wet	0.25
pH	pH units	0.1
Nitrogen and Carbon		
Total Nitrogen	%	0.02
Total Organic Carbon	%	0.1
Sulphur		
Total Sulphur	%	0.02
Total Metals		
Aluminum	mg/kg dw	100
Antimony	mg/kg dw	0.1
Arsenic	mg/kg dw	0.2
Barium	mg/kg dw	1
Beryllium	mg/kg dw	0.1
Bismuth	mg/kg dw	0.1
Boron	mg/kg dw	5
Cadmium	mg/kg dw	0.05
Calcium	mg/kg dw	100
Chromium	mg/kg dw	1
Cobalt	mg/kg dw	0.3
Copper	mg/kg dw	0.5
Iron	mg/kg dw	100
Lead	mg/kg dw	0.1
Lithium	mg/kg dw	0.1
Magnesium	mg/kg dw	10
Manganese	mg/kg dw	0.4
Mercury	mg/kg dw	0.05
Molybdenum	mg/kg dw	0.1
Nickel	mg/kg dw	0.8
Phosphorus	mg/kg dw	10
Potassium	mg/kg dw	100
Selenium	mg/kg dw	0.1
Silver	mg/kg dw	0.1

Parameter	Units	Laboratory Reporting Limits
Sodium	mg/kg dw	100
Strontium	mg/kg dw	0.1
Thallium	mg/kg dw	0.1
Tin	mg/kg dw	0.2
Titanium	mg/kg dw	1
Uranium	mg/kg dw	0.05
Vanadium	mg/kg dw	2
Zinc	mg/kg dw	2

6.5 Data Analysis, Interpretation, and Reporting

Upon receipt of all analytical data, a DQR will be performed and will confirm that all requested analyses are complete and that acceptable LRLs have been achieved. The DQR will also include an evaluation of differences between duplicate samples, as well as the QA/QC data reported by the laboratory. Completion of the DQR promptly following receipt of sediment quality monitoring data will ensure timely communication with the laboratory should any issues be identified.

For all replicated data (typically based on a sample size of five stations per area), data will be summarized by calculating mean, median, standard deviation, standard error, minimum, maximum, 5th percentile, and 95th percentile for each analyte. Sediment quality data will then be evaluated in comparison to Canadian Sediment Quality Guidelines for the protection of aquatic life (SQGs; CCME 1999) and baseline (before) concentrations. Sediment quality guidelines are numerical criteria that are protective of sediment-dwelling organisms based on long-term exposure. CCME SQGs have two levels – a Threshold Effect Level (TEL) and a Probable Effect Level (PEL). The TEL represents the concentration below which adverse biological effects are expected to occur rarely and the PEL represents the level above which adverse effects are expected to occur frequently (CCME 2001). However, SQGs - even the PELs - are often naturally exceeded, particularly SQGs for metals in mineralized areas. In addition, SQGs were developed based on co-occurring bulk surficial sediment data and biological effect data (CCME 1995).

Bulk sediment chemistry can differ substantially from the <63 µm fraction, and this discrepancy between measurement (<63 µm fraction) and exposure (to bulk sediment to which SQGs are most applicable) should be considered in interpretation as “caution should be used in interpreting the biological significance of chemical concentrations in sediments for different types based on these guidelines” (CCME 1995). Analytes with concentrations greater than guidelines and baseline will be the focus of more detailed interpretation, as described below.

Multivariate statistical tools may also be applied to assist with sediment quality data interpretation. Specifically, ordination techniques such as Principal Components Analysis (PCA) or CA may be applied to assist in the identification of key spatial or temporal differences in sediment chemistry. Perhaps more importantly, these techniques will be used in the analysis of potential physical and/or chemical causes of differences in biological metrics (e.g., benthic invertebrate community condition) as a means of reducing data to focus on a small list of key components for focused correlation analysis.

Analytes with concentrations greater than guidelines and baseline will be the focus of more detailed interpretation, which may include, as required for data interpretation: formal statistical contrasts of exposed versus baseline concentrations and/or over time, and graphical comparisons to baseline data. This will include the following: graphical plots in relation to all guidelines and baseline values and examination of relationships to physical variables. Plots of the analytes of interest (those greater than SQG and baseline) will be prepared in MSExcel™. At a sample size of five, plots will include each replicate by area (i.e., will be presented as dot plots). SQGs and baseline concentrations (as available) will be added to the plots as lines to facilitate comparison of concentrations to these benchmarks.

Relationships between the analytes of interest and physical features (i.e., particle size) and other chemical variables (total organic carbon content) will be evaluated using correlation analysis. Spearman correlation (often referred to a Spearman Rank-Order correlation) will be completed. Following the derivation of correlation coefficients, a Bonferroni-type correction (i.e., p-value [0.05] divided by the total number of correlations examined for independent variables) will be applied to minimize the risk of declaring false positive correlations since at least 5% of derived correlations would be expected to occur by chance alone at an uncorrected p-value of 0.05. Any significant correlations found at the Bonferroni-adjusted p-value or at a p-value of 0.01 will be further investigated using scatter plots to determine if a continuous distribution of data was realized (possible causal relationships) or if these relationships were leveraged by outlying points (or groups of points).

An interpretive report that includes the sediment quality monitoring data will be prepared. The interpretive report will provide all data in an appendix and will include the DQR, detailed description of all methodology, the results of all spatial and temporal statistical comparisons, and the associated interpretation, conclusions, and recommendations. All data interpretation will be summarized in clear text form supported by tables and data plots.

7.0 COLLABORATION ON REGIONAL AND INDUSTRY RESEARCH

The FALMP will collect a large amount of information on fish and aquatic life in the Project area. Continuous review of this data will verify that, as predicted by the environmental assessment, there are no residual adverse effects to fish and aquatic life associated with the Project. This data will also be used to further the understanding of potential environmental effects resulting from mine development and operation. Moreover, during the process of reviewing and investigating the monitoring data, there may be further opportunities to collaborate with First Nations and interested agencies to publish scientific papers or complete value-added research.

8.0 REPORTING AND REVIEW

This FALMP is intended to be a living document which is expected to be revised as new information becomes available, new methods of monitoring are developed, or management issues arise that need to be addressed. Newmont will also continue to maintain a dialogue with regulators, governments, and Project stakeholders to further develop the details of this Plan. These parties will include, but will not be limited to: Yukon Government, DFO, First Nations, Renewable Resources Councils, and other land users.

The intent of monitoring activities will be to build a series of aquatic environmental monitoring data for the Project, and reporting will be completed in years when monitoring activities are undertaken. The resulting reports will present the methodologies used for the monitoring, a summary of the information collected, and full data interpretation including evaluation of the relationships among program components, and all associated conclusions and recommendations. Data will be compared to available guidelines, baseline conditions, and reference conditions. Comparison to baseline and reference will be by statistical contrast (e.g., Analysis-of-Variance).

Where data are available to complete Before-After/Control-Impact (BACI) analysis (see Sections 4.2 and 5.2), optimal BACI analysis will be completed, thereby addressing the focused question of has a Project exposed area changed relative to reference. Each report will provide a summary of key conclusions and a list of recommendations (if any). This analysis will fully support the Surface Water Quality and Aquatic Life AMP and findings of the FALMP will be subject to management actions detailed in the overarching Surface Water Quality and Aquatic Life AMP (Appendix L of the EMAMP).

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