YUKON GOVERNMENT – ASSESSMENT AND ABANDONED MINES

SURFACE WATER QUALITY SAMPLING FIELD MANUAL

CONFIRMATORY MONITORING PROGRAM

MOUNT NANSEN SITE

Prepared for the 2016/2017 Fiscal Year

Confirmatory Monitoring Program (CMP)

Assessment and Abandoned Mines (AAM) has established a Confirmatory Monitoring Program (CMP) for the Mount Nansen site. The CMP was originally implemented as a confirmatory inspections program to ensure that the Site Operations Contractor and Water Resources Contractor are reporting appropriate surface water quality information in their monthly environmental reports to AAM, and to verify the robustness of surface water quality sampling at the site. In 2015/16, the CMP will involve AAM performing confirmatory inspections to ensure consistency with results reported by the Water Resources Contractor. This program confirms that the aquatic environment at the Mount Nansen site is protected, by confirming effluent discharge levels.

The Water Resources Contractor samples surface water at Mount Nansen bi-weekly or more during freshet (May-June), and monthly during the remainder of the year (July-April). The Water Resources Contractor monitors surface water quality through a large program in order to collect full baseline data for closure planning and design. Sampling procedures followed by AAM match procedures followed by the contractors.

This program will add defensibility to the comments and statements issued from the Site Operations Contractor and Water Resources Contractor regarding effluent quality at the Mount Nansen site. In addition, the collection of tertiary data at the reference points and discharge points will provide additional data at sites of interest. Comparisons between data collected by the Water Resources Contractor and AAM will be undertaken in three sampling events by AAM to ensure the integrity of all surface water sampling conducted. AAM will continue to track water quality through monthly summaries issued by the Water Resources Contractor.

This CMP Field Manual was designed as a reference guide for AAM staff conducting surface water quality sampling, to ensure consistency within the CMP.

Contents

NOTE: This document is evolving and will be reviewed annually for appropriate changes.

1. Site Safety and Responsibilities

Upon arrival to the Mount Nansen site, all persons must check in at the bunkhouse. A site safety orientation must be completed annually. All persons are required to follow site safety guidelines while on the Mount Nansen site; which includes wearing required Personal Protective Equipment (PPE).

Required PPE that each individual must wear while on the Mount Nansen site includes, but is not limited to:

- CSA approved steel-toed footwear;
- Hi-vis safety vest or clothing with equivalent safety markings; and
- Hard hat.

Where the use of a life vest is required to sample safely, personnel should put on the life vest before entering the environment where it is required. For example, if work is being conducted on the banks of a fast flowing creek or river, personnel should don the life vest well before arriving at the bank of the river.

Personnel collecting data for the CMP must be aware of their personal safety at all times. Abandoned mine sites have many risks and personnel must be aware of those risks. Some risks to personal safety may include:

- Fast moving water;
- Contaminated areas;
- Open water;
- Heavy machinery (operational);
- Vehicle traffic;
- Adverse weather including ice conditions;
- Wildlife; and
- Unstable structures or terrain.

Personnel must be comfortable evaluating situations to determine risks to personal safety and whether those risks are acceptable. If there are any concerns about site safety, the AAM supervisor responsible should be consulted, and the Site Operations Contractor should be notified. Personnel should not sample surface water quality sites or proceed on the Mount Nansen site if personal safety risks are too great or unknown.

All equipment, instruments and sampling will be operated and conducted by trained personnel to ensure safety of personnel, and quality of the data collected. All sample collection will follow this Field Manual, with an emphasis on safety at each sample location.

2. Sample Site Locations and Sampling Schedule

The Water Resources Contractor will undertake comprehensive surface water quality sampling at sites on affected drainages, as well as unaffected reference sites, as per its contract with AAM. AAM will conduct surface water quality sampling at compliance locations to ensure quality of effluent discharge.

The CMP will begin in May; in order to coincide with spring freshet. AAM will collect samples during three sampling events, scheduled to coincide with the sampling conducted by the Water Resources Contractor.

A map of the Mount Nansen site with the specific sample site locations is provided in Figure 1 in the Figures Section of this report.

Table 1 lists each surface water quality site that is sampled, as well as the rationale for selecting that particular site for sampling and the frequency with which each party conducts sampling. Additional sites are monitored by the Water Resources Contractor during freshet; some seep sites are monitored 2 to 3 times per year, others are sampled opportunistically. The Water Resources Contractor also undertakes a comprehensive hydrology program.

Table 1 – Surface Water Quality Sites, Selection Rationale and Sampling Schedule

Site Name	Selection Rationale	Sampling Party and Frequency	
		AAM	Water Resources Contractor
Pit Lake[1]	Indicative of water quality in the Pit		
Seepage	Indicative of water quality at the seepage discharge; effluent flows into Dome Creek	3 sampling events between May and October	Monthly
Tailings Pond	Indicative of water quality in the tailings pond; flows into seepage pond	3 sampling events between May and October	Monthly
Dome Creek at DX	Indicative of water quality just above the Mill Site		Monthly
Dome Creek at DX+105	Indicative of water quality adjacent to Mill Site		Monthly
Dome Creek at D1b	Indicative of water quality downstream of the Mill Site		Monthly
Diversion Channel at Bridge	Indicative of water quality in the diversion		Monthly

[1] Due to ongoing health and safety concerns with pit wall stability, the pit lake is not currently being monitored.

	channel; adjacent to tailings pond		
Upper Dome Creek	Indicative of water quality just downstream of tailings pond and seepage discharge		Monthly
Dome Creek at Road	Downstream of tailings pond and seepage discharge; most downstream site on Dome Creek and indicative of water quality entering Victoria Creek	3 sampling events between May and October	Monthly
Upper Victoria Creek	Just upstream of confluence with Back Creek (an affected watercourse)		Monthly
Victoria Creek at Road	The most downstream site monitored; captures influence of all water quality effects		Monthly
Victoria Creek d/s of Back Creek	Victoria Creek downstream of confluence with Back Creek; indicative of influence of Back Creek water quality		Monthly
Victoria Creek u/s Minnesota Creek	Victoria Creek upstream of confluence with Minnesota Creek		Monthly
Back Creek	An affected watercourse downstream of Brown-McDade Pit; upstream of confluence with Victoria Creek (unaffected watercourse)		Monthly
Pony Creek u/s	Upstream of influence of Mount Nansen site, below influence of		Monthly

	placer mining activities on Pony Creek		
Pony Creek d/s	Downstream of Brown-McDade Pit; Pony Creek is a tributary to Back Creek and Victoria Creek	3 sampling events between May and October	Monthly

3. Parameters and Analytes

For each sampling event the following in situ parameters will be recorded:

- pH;
- Temperature (°C); and
- Conductivity (µS/cm).

Samples will be tested for the following analytes by an accredited laboratory:

- Acidity
- Alkalinity
- Chloride
- Nitrite
- Nitrate
- Sulphate
- Colour (true)
- Conductivity
- Ion Balance Calculation
- Dissolved Metals
- Total Metals
- Ammonia Nitrogen
- pH
- TDS
- TSS
- Turbidity

The Water Resources Contractor and the Site Operations Contractor will collect the same in situ parameters and have samples tested for the same analytes. Additional analytes will be tested as required for specific sites or sampling events of concern or interest; these are discussed in further detail in Section 8 (Chain of Custody and Sample Delivery).

Detection limits for total and dissolved metals should be set as listed in Table 3 below, or better.

Table 2 - Detection Limits for Total and Dissolved Metals

Analyte	Detection Limit (mg/L)
Aluminum	0.005
Antimony	0.0005
Arsenic	0.0005
Barium	0.02
Beryllium	0.001
Boron	0.1
Cadmium	0.000017
Calcium	0.1
Chromium	0.001
Cobalt	0.0003
Copper	0.001
Hardness (as CaCO3)	0.5
Iron	0.03
Lead	0.0005
Lithium	0.005
Magnesium	0.1
Manganese	0.0003
Mercury	0.00001
Molybdenum	0.001
Nickel	0.001
Potassium	2
Selenium	0.001
Silver	0.00002
Sodium	2
Thallium	0.0002
Tin	0.0005
Titanium	0.01
Uranium	0.0002
Vanadium	0.001
Zinc	0.005

4. Equipment and Supplies

For each sampling trip, the following surface water quality sampling equipment and field equipment is required:

- Bottles (enough for sample collection at relevant sites as well as duplicates, blanks and extras);
- Bottle labels and sharpie pen (waterproof permanent felt marker);
- Syringes;
- Filters;
- Nitrile gloves;
- Preservatives;
- De-ionized water (for preparing blanks and rinsing equipment);
- Cooler(s) and frozen ice packs;
- COC forms and ziploc bags (for COC forms during shipment);
- Field notebook and pencils;
- Multi-meter (for in situ measurements), calibrated, and extra batteries;
- Watch;
- Thermometer (for air temperature);
- Camera, charged;
- SPOT and extra batteries;
- Satellite phone, charged;
- Hand Held Radio (must be signed out at Guardhouse with Site Operations Contractor);
- PPE (See Section 1 Site Safety and Responsibilities);
- Rubber boots or waders;
- PFD (if required to sample safely);
- Garbage bags for sampling refuse;
- Backpack or tote (for carrying equipment and samples if sites are inaccessible by vehicle); and
- Any other equipment deemed necessary for the conditions.

Equipment Calibration

The HANNA combo pH and conductivity meter requires calibration prior to each field trip. This is likely more often than required; however, as the instrument is used for sampling on more than one project this will ensure accuracy of the readings. The instrument should be calibrated in the office just prior to the field trip, or alternately, in the field. Instructions on how to calibrate the instrument are stored with the instrument and should be kept together. Buffer solution can be ordered from Pine Environmental Services or ALS Environmental Services as required.

Following calibration, add a note in the field notebook detailing the parameters calibrated, date, and person who performed the calibration. Any issues suspected with the instrument should also be recorded, as this will offer insight into any irregular in situ data results.

5. Sample Collection Procedure

For CMP surface water quality sampling, the following procedure is to be followed:

1. At each site put on a new pair of nitrile gloves prior to sampling.

2. Write bottle labels and stick them on the bottles prior to sampling. Let the ink air dry for a minute. This practice ensures the labels stay on the bottles after submersion and the ink doesn't run and become illegible.

   Generally, bottle labels should include the following information (note: laboratories may require additional information which should be understood prior to leaving for the field):

   Example Label:

Client	Yukon Government
Project	Mount Nansen
Sample ID	Dome Cr. @ Road
Analysis	General Chemistry
Date/Time	10 Jun 2016 11:30am
Preservative Added	Yes / No
Known or Suspected Hazard	If applicable

3. While standing at the edge of the water or in shallow water, try not to disturb the sediment on the bottom. If the sediment is stirred up by your movement, wait until it has settled again before collecting the samples or recording any in situ measurements.

4. For **unfiltered** samples: Remove the cap from the bottle, making sure to not touch the rim of the bottle or the inside of the cap. Fill the bottle with sample water and place the bottle cap back on securely. Repeat for all unfiltered water samples (NOTE: samples should only be left unfiltered for certain parameters, e.g. total metals. If there is uncertainty, the AAM supervisor responsible should be consulted prior to leaving for the field.).

5. For **filtered** samples (dissolved analytes): Unwrap a new syringe from its packaging. Fill the syringe with sample water and place a new filter on the end of the syringe. Remove the cap from the dissolved metals bottle, making sure to not touch the rim of the bottle or the inside of the cap. Fill the dissolved metals bottle with **filtered** syringe water, using a new filter for every syringe volume, or more if required (if the water is dirty often multiple filters per syringe volume are required). Place the bottle cap back on securely.

6. Add preservatives to all water samples at each site. All samples except general chemistry require preserving.

7. Place the samples in the cooler with frozen ice packs as soon as possible after collection. During winter, ice packs may not be required, as long as temperatures are cool enough (approximately 4°C).

8. Following sample collection, take in situ measurements at each sample site and record results with field notes in the field notebook (See Section 7 Field Notebook). If there is an area to place the meter in the water without disturbing sediments on the bottom, take the measurements from there. If there is not enough water to do so, collect water in a container large enough to hold the meter and take measurements from there. Triple rinse the container with sample water before measuring in situ parameters.

   As described in Section 3 (Parameters and Analytes), in situ parameters include:

   - pH;
   - Temperature (°C); and
   - Conductivity (µS/cm).

   Additionally, field notes will include the following information:

   - Sampler's name, helper's name (if applicable);
   - Date;
   - Time;
   - Sample site name (Sample ID);
   - Approximate air temperature;
   - Weather conditions (e.g. sunny, overcast, cloudy, light rain, etc…);
   - Photo numbers and descriptions (if applicable); and
   - Additional observations/notes (e.g. nearby works which may affect sample quality, changes in site conditions since last visit, frozen areas, flooded areas, issues or concerns relating to the collection of samples, fresh snow, etc…).

9. Following sample collection, take photos of each sample site. Record the photo numbers in the field notebook for future reference.

10. At one of the sites prepare a duplicate and/or a field blank (See Section 6 Quality Control for instructions). Indicate in the field notes which site these were prepared at. Label the samples with either "Dup" or "FB" for the sample ID on the label.

6. Quality Control

Quality control samples should be collected in addition to regular samples during each sampling event. For each sampling event 1 duplicate ("Dup"), 1 field blank ("FB") or 1 travel blank ("TB") sample will be submitted for analysis with the regular samples.

The field notes will indicate at which site the quality control samples were prepared. These samples should be prepared in the same manner as regular samples collected at the site (See Section 5 Sample Collection Procedure). For example, when preparing a duplicate or field blank for dissolved metals, the sample preparation will include preserving and filtering. Quality control samples will be labelled in same way as regular samples, except they will be named "Dup", "FB" or "TB" in the Sample ID section of the label.

Duplicate

The purpose of a duplicate is to check the precision and accuracy of the lab equipment used to analyze the samples.

Duplicate samples are secondary samples taken at a regularly scheduled sample site. Duplicates are collected at the same time and location of a regular sample, with all the same parameters and are prepared and analyzed following the same procedures as regular samples (filtering and preserving). When a duplicate is taken at a site, two full sample sets are collected with one being named the regular site ID, and the other being named "Dup".

Field Blank

The purpose of a field blank is to identify any contamination of the sample caused by the sampler, the filtration or preservation process, or the bottle itself.

Field blanks are made up of de-ionized water brought to site by the sampler and prepared at the sample site of a regular sample as though it is sample water. Field blanks are prepared at the same time and location of a regular sample, with all the same parameters, and are prepared and analyzed following the same procedures as regular samples (filtering and preserving). When a field blank is prepared at site, de-ionized water is used instead of sample water, and the sample ID is labelled "FB".

Travel Blank

The purpose of a travel blank is to identify any contamination of the samples caused by the transportation and storage process.

Travel blanks are prepared by the laboratory for transport to the site and around the site during the sampling field work. Travel blanks are never opened on site or at any time. Travel blanks are analyzed with the rest of the samples from the sampling event.

7. Field Notebook

The Mount Nansen CMP has a specific field notebook that should accompany the sampler during all sampling events for proper documentation of all relevant information and observations. The sampler should consider the following when recording notes in the field notebook:

- Although the field notebook is waterproof, pencil should be used rather than ink because ink will run or fade if the pages become wet or rub together.
- If a mistake is made, do not erase. Strike a line through the error and write the notes below.
- Keep the field notebook in a safe place. It contains original notes from the time and location of different sampling events and is considered legally binding.

Specific information to include in the field notebook is listed in Section 5 (Sample Collection Procedure), under item 8.

After each field visit, information from the field notebook will be transferred to an electronic field sheet at the office. These field sheets will be filed electronically and allow the data to be viewed in a reader-friendly format. In the event of a discrepancy between the electronic field sheets and the field notebook, the field notebook should be considered accurate. An example of the electronic field sheet is provided below.

FIELD NOTES – MOUNT NANSEN

PROJECT NAME: AAM Confirmatory Monitoring Program **DATE SAMPLED:**

SAMPLING CONDUCTED BY:

WEATHER CONDITIONS:

FIELD MEASUREMENTS:

Sample Site ID	Time of sample collection	In Situ Measurements			Parameters for Analysis	Photo #s
		Temp (°C)	Conductivity (µs/cm)	pH		

ADDITIONAL COMMENTS:

NAME:	SIGNATURE:	DATE:

8. Chain of Custody (COC) and Sample Delivery

Once all of the samples have been collected, a COC form will be filled out and accompany the samples to the lab for analysis. COC forms are provided by the accredited laboratory and indicate the samples collected, date, time, analysis requested, turnaround time requested, and report format requested for the samples. One form will be filled out and submitted with the samples for each sampling event. It should not be necessary to fill out a separate COC for each cooler if there is more than one cooler of samples, check with the laboratory in advance of submitting the samples.

Samples must be placed upright in a cooler to keep possible spillage to a minimum. Ice packs must be placed in each cooler to keep samples cool (as close to 4°C as possible) during transport in warmer months. The sampler will drop off the coolers with the COC to the accredited laboratory or a shipping agent as soon as possible after sampling is complete (ideally on the day of sampling). On delivery of the samples to the laboratory, a copy of the COC is to be kept and filed at AAM as a record of the submission.

The sampler should be aware of the following when filling out the COC:

- Report format in pdf and excel;
- Standard turn-around time;
- Send a copy of the invoice to aam-admin@gov.yk.ca; and
- Job# is Mount Nansen.

9. Data Management

Surface water quality analysis data will be requested from ALS Environmental Services in pdf and excel format, and will be received by email, as indicated on the COC. These files will be filed on the G: drive under the following directory:

> G:\AAM\Mt. Nansen\6040 Implementation\2016-17\6 Monitoring\6.2 Owner's Confirmatory Monitoring\Analysis

10. Reporting

A monthly compliance reporting summary should be issued to the AAM Senior Project Manager and Manager, highlighting results of the data collected for that month. Summaries will indicate any issues or concerns with the results from the laboratory, and will compare surface water quality results from sampling conducted by AAM to the results collected by the Water Resources Contractor. The summaries will identify parameters with results that vary significantly between sampling parties for that month, as well as parameters which consistently vary between sampling parties over several months. Additionally, the summaries will identify parameters which are consistently above water quality

thresholds. See Section 11 for relevant thresholds and guidelines. In the event that consistent issues occur with data collection or certain parameters, meetings with AAM CMP staff and/or Contractors will be held to address and manage these issues appropriately.

Monthly compliance reporting summaries will be filed on the G: drive under the following directory:

> G:\AAM\Mt. Nansen\6040 Implementation\2016-17\6 Monitoring\6.2 Owner's Confirmatory Monitoring\Monitoring Summaries

11. **Water Quality Thresholds**

In order to monitor water quality at the Mount Nansen site, results should be compared against relevant water quality thresholds/guidelines. These should be reported on by the YG Project Manager in the monthly reporting summaries. Results are compared against the Mount Nansen Effluent Quality Standards (EQS), as outlined in former water licence QZ94-004. See Table 3 for Mount Nansen EQS. Water quality results may also be compared to the Canadian Council of Ministers of the Environment (CCME) Protection for Aquatic Life (PAL) guidelines. See Table 4 for CCME guidelines. CCME guidelines have the potential to be updated throughout the year; it is the Project Manager's responsibility to ensure that updated CCME guidelines are being used for internal and external (i.e., Water Resource Contractor) reporting.

Table 3 – Mount Nansen Effluent Quality Standards

Parameter[2]	Concentration
pH	6.0 to 8.5 pH units
TSS	50 mg/L
WAD Cyanide	0.1 mg/L
Total Cyanide	0.3 mg/L
Antimony	0.15 mg/L
Arsenic (dissolved)	0.15 mg/L
Barium	1.0 mg/L
Cadmium	0.02 mg/L
Chromium	0.04 mg/L
Copper	0.2 mg/L
Iron	1.0 mg/L
Lead	0.1 mg/L
Manganese	0.5 mg/L
Mercury	0.005 mg/L
Nickel	0.3 mg/L
Silver	0.10 mg/L
Zinc	0.30 mg/L

[2] For metals parameters, the total concentration is reported unless otherwise indicated.

Table 3 – CCME Guidelines (2016)

Parameter	CCME Guideline
Aluminum[1]	0.1 mg/L
Ammonia[2]	0.75 mg/L
Arsenic	0.005 mg/L
Cadmium	0.00009 mg/L
Chloride	120 mg/L
Copper[3]	0.002 mg/L
Fluoride	0.120 mg/L
Iron	0.3 mg/L
Lead[3]	0.003 mg/L
Molybdenum	0.0073 mg/L
Nickel[3]	0.1 mg/L
Nitrate	13 mg/L
Nitrite	0.06 mg/L
pH	6.5 – 9.0
Selenium	0.001 mg/L
Silver	0.00025 mg/L
Thallium	0.0008 mg/L
Uranium	0.015 mg/L
Zinc	0.03 mg/L

Notes:

[1]pH dependent guideline; refer to CCME guidelines for specifics

[2]pH and temperature dependent guideline; refer to CCME guidelines for specifics

[3]Hardness dependent guideline; refer to CCME guidelines for specifics

FIGURES