2020 Quality Assurance/Quality Control Plan for Surface Water Monitoring Samples Former Nanisivik Mine, Nanisivik, Nunavut, Canada Final Report

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Project No. 121622846

March 27, 2020

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A Quality Assurance / Quality Control (QA/QC) plan for water samples collected as part of the surface water quality monitoring is developed for the former Nanisivik Mine site, located near Arctic Bay, Nunavut. The plan updates and supersedes the previous QA/QC Plan prepared by Stantec, dated March 24, 2015.

The water quality analyses required by the Water Licence (1AR-NAN2030) issued by the Nunavut Water Board include the following analytical groups:

Group	Parameters
NAN-1	Metals Analysis: total cadmium, lead and zinc. Major Cations: calcium, magnesium, sodium, potassium, ammonia and hardness. Major Anions: chloride, sulphate, bicarbonate, carbonate, nitrate+nitrite and alkalinity. Other Laboratory Analysis: Total Suspended Solids (TSS). Field parameters: specific conductivity, temperature, pH, and visual observations for hydrocarbon sheen.
NAN-2	Petroleum Hydrocarbon Analysis of F2-F4 hydrocarbons.

The QA/QC plan describes the quality control measures to be implemented during water collection, documentation, and analysis. It includes recommendations related to sampling methods, sample identification, sample containers and preservation, field duplicates, chain-of-custody forms, and sample packaging and shipping. The QA/QC plan also describes requirements for the laboratory QA/QC program as well as information related to the quality assessment of reported data for the annual report.

1.0 INTRODUCTION

This report outlines the revised (2020) Quality Assurance/Quality Control (QA/QC) Plan (QA/QC Plan) for the surface water quality monitoring program at the former Nanisivik Mine site, located near Arctic Bay, Nunavut. This report updates and supersedes the previous QA/QC Plan prepared by Stantec, dated March 24, 2015.

2.0 BACKGROUND

The surface water quality monitoring program is required by Water Licence 1AR-NAN2030 issued by the Nunavut Water Board. This QA/QC plan is a requirement of the Water Licence, Part H, Item 9, which states:

11. *The Licensee shall submit to the Board for review, within sixty (60) days following the approval of the Licence, an updated "Quality Assurance/Quality Control (QA/QC) Plan" that reflects changes made to the monitoring requirements in the Licence. The QA/QC Plan shall be modified to include up-to-date sampling methods to all applicable standards, acceptable to an accredited laboratory as required by Part H, Items 7 and 8.*

The frequency of monitoring for surface water quality is defined in Schedule H, Table 1 of the Water Licence. The water quality analyses required by the Water Licence are defined in Schedule H, Table 2, and include the following Water Quality Monitoring Groups (Table 1):

Table 1 Water Quality Monitoring Groups

Group	Included Parameters
NAN-1	Metals Analysis: total cadmium, lead and zinc. Major Cations: calcium, magnesium, sodium, potassium, ammonia and hardness. Major Anions: chloride, sulphate, bicarbonate, carbonate, nitrate+nitrite and alkalinity. Other Laboratory Analysis: Total Suspended Solids (TSS). Field parameters: specific conductivity, temperature, pH, and visual observations for hydrocarbon sheen.
NAN-2	Petroleum Hydrocarbon Analysis of F2-F4 hydrocarbons.

3.0 QA/QC PLAN

3.1 FIELD SAMPLING AND MEASUREMENT PERSONNEL

No specific training of field personnel is required for this activity. However, the technician employed by Canzinco Mines Ltd. (Canzinco) should have experience in performing this task; and must have completed health and safety training acceptable to Canzinco.

3.2 FIELD DOCUMENTATION AND RECORDS

Field collected data will be documented using previously-prepared, printed, field data collection sheets. The original field data sheets should be retained on permanent file by the performing contractor, and an electronic copy of the field data sheet must be sent to Canzinco immediately following each sampling event, for their records and retention.

Field-measured parameters include specific conductivity, water temperature, and pH. These measurements will be performed using field instruments, which will be calibrated in advance of each sampling event (in the case of pH and conductivity) according to the manufacturer's instructions, using standard calibration solutions. For pH, calibration will involve the use of two pH standards, having values of 4.0 and 7.0. For conductivity, a standard solution of known conductivity can be used.

The field notes will record:

- the sampling locations, including GPS coordinates of the sampling station, and the date and time of sample collection;
- the type of samples collected (*e.g.*, NAN-1 - water samples for general chemistry and trace metals; and/or NAN-2 – water samples for petroleum hydrocarbon analysis);
- the types of field instruments used to collect field measurements, including date of calibration of the field instruments;
- results of field measurements (*e.g.*, water temperature, pH, and conductivity); and
- results of a visual inspection of the sampling site (*i.e.*, presence of hydrocarbon sheens or other unusual observations).

3.3 SAMPLING METHODS

For this program, surface water samples will be collected as grab samples. These samples should be collected at a depth of 15 cm below the water surface (where the depth of water permits). Bottles and caps will be rinsed three times with site water before filling, unless the bottle is pre-treated with a preservative, in which case rinsing must not be performed. After rinsing (when applicable), the bottle should be filled by submerging it completely, facing into the current, until air bubbles are no longer present.

3.4 LABELS

Collected samples will be clearly labeled for proper identification in the field, and for the laboratory. At a minimum, the sample labels will include the sampling station identifier, the date of collection, the initials of the sampler, the intended analytical parameters, and the method of preservation (if relevant).

3.5 FIELD SAMPLING QUALITY CONTROL

Field QC samples (duplicates and blanks) will be submitted as part of the sampling program. Normally such samples comprise approximately 10% of the samples submitted. Due to the small number of samples to be collected on each sampling date, one field duplicate and one field blank sample will be submitted for each relevant Water Quality Monitoring Group in conjunction with each sampling event. These samples will be provided with unique (fictitious) sample identifications and will be submitted "blind" to the laboratory *(i.e.*, with a sample identification not indicating that the sample is a duplicate, and without any correspondence to parent samples). The identity of these "blind" field duplicate samples and their correspondence to parent samples will be recorded on the field data collection sheets.

3.6 SAMPLE CONTAINERS AND PRESERVATIVES

Sample containers will be provided pre-cleaned by the laboratory. In some cases, the laboratory may provide the sample bottles pre-treated with a preservative.

3.7 SAMPLE PACKAGING AND SHIPPING

After collection, samples will be placed in a cooler and kept cold. Glass bottles will be wrapped with bubble-wrap before being placed in the cooler, and other bottles will be placed in plastic bags and protected with suitable materials (*e.g.*, bubble wrap) to ensure that movement of and potential damage to or contamination of bottles during shipping is minimized.

The cooler will be sealed by the sample packer, using adhesive tape. The analytical laboratory will be notified by e-mail of the shipment, provided with waybill information, and the estimated date and time of arrival by air freight or courier.

3.8 CHAIN-OF-CUSTODY

Sample submission forms and chain-of-custody documents provided by the analytical laboratory will be completed by the field technician prior to packing the samples in a cooler. The chain of custody document will include details of the samples shipped, date of collection, the name of the field technician, the date of shipment, and the analyses requested. The chain-of-custody document will be placed in a plastic Ziploc® bag, on top of the samples, prior to sealing the cooler.

3.9 LABORATORY ANALYSIS METHODS

The analytical laboratory must be accredited by the Canadian Association for Laboratory Accreditation (CALA) or the Standards Council of Canada (SCC). Accreditation by either of these organizations provides an indication of the quality and competence of the performing laboratory.

Analytical methods must follow either US EPA approved methods or methods from the most recent edition of *Standard Methods for the Examination of Water and Wastewater*.

3.10 LABORATORY QA/QC

The laboratory will perform regular QA/QC during the analysis of field samples, including a program of method blanks, laboratory control samples, instrument calibration samples, matrix spikes, and laboratory duplicates.

3.11 ANNUAL REPORTING

An annual report on water quality monitoring results will be submitted to the Nunavut Water Board no later than March 31 of the year following the calendar year in which monitoring occurred (as required by Part B, Item 1 of the Water Licence). The format and content of the report will be similar to that proposed in the *2020 Contingency Plan for Water Quality Exceedances, Former Nanisivik Mine*, (the Contingency Plan, Stantec 2020). The annual report will include tables and figures as appropriate to identify trends in the data, or exceedances of action levels as established in the Contingency Plan.

Within the annual report, the acceptability of data will be evaluated qualitatively by examination of the field blanks, and by comparison of the field and laboratory duplicate sample data to the associated parent sample. Reproducibility of data will be expressed as relative percent difference (RPD) from the mean:

$$RPD = 100 \times ((|X_1 - X_2|) / ((X_1 + X_2) / 2)) \quad ,$$

where X_1 is the parent sample concentration, X_2 is the duplicate sample concentration, and $|X_1 - X_2|$ denotes the absolute value of the difference between these two concentrations.

4.0 CLOSING

This report has been prepared by Annick St-Amand, Ph.D. and Malcolm Stephenson, Ph.D., and was reviewed by Clayton Barclay, Ph.D., and Shereen Ismail, B.Sc. Eng., for the sole benefit of Canzinco Mines Ltd., and may not be relied upon by any other person or entity without the express written consent of Stantec Consulting Ltd. and Canzinco Mines Ltd. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

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