QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

January 2017

PLAIN LANGUAGE SUMMARY

This Plan describes the quality assurance and quality control procedures to be used at the TMAC Resources Inc. Hope Bay Project when conducting environmental sampling, analysis and reporting. This Plan outlines 1) the criteria for sample collection, preservation, documentation, transportation, and 2) data management and reporting practices associated with environmental sampling.

REVISION RECORD

Date	Section	Summary of Changes	Author	Approver
Feb 2002	Original	Original Document	MHBL	MHBL
Mar 2004	Throughout	Review	MHBL	MHBL
Oct 2007	Throughout	Review to include NWB specific concerns	MHBL	MHBL
Mar 2008	Throughout	Review to include changes	HBML	HBML
Feb 2009	Throughout	Annual Review	HBML	HBML
Jan 2011	Throughout	Annual Review	HBML	HBML
Jun 2011	Throughout	Added ST-6a and b, ST-11 to the required sampling stations; added ST-1, ST-2, ST-4, and ST-6a and b to the current sample stations; incorporated 2BE-HOP0712 and 2BB-BOS0712 within the document	HBML	HBML
Jun 2012	Throughout	Added ash characterization sampling, waste oil sampling, flow meter calibration and equipment blanks. Updated photos and samples lists to reflect camp status.	HBML	HBML
Nov 2012	Throughout	Minor edits, updated licence numbers. No technical content changes.	HBML	HBML
Jan 2017	Throughout	Updated to TMAC ownership and format; revision to section regarding soil sampling to expand beyond sampling hydrocarbon contaminated soils. Included subsequent Modules A, B and C to provide details for each site and the associated water licence.	TMAC	TMAC

GLOSSARY AND ACRONYMS

TERM	DEFINITION
Accuracy	A measure of the closeness of the analytical result to the true value
ALS	ALS Environmental Laboratories
CCME	Canadian Council of Ministers of the Environment
Composite Sample	Obtained by combining portions of multiple grab samples or by using specially designed automatic sampling devices. Provide a more representative sampling of heterogeneous matrices in which the concentration of the analytes of interest may vary over short periods of time and/or space
Grab Sample	An undiluted quantity of material collected at a particular time and place that may be representative of the total substance being sampled at the time and place it was collected
INAC	Indigenous and Northern Affairs Canada
NWB	Nunavut Water Board
Precision	A measure of the closeness with which multiple analyses of a given sample agree with each other
Quality Assurance (QA)	The system of activities designed to better ensure that quality control is done effectively
Quality Control (QC)	The use of established procedures to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability
Reliability	A measure of the frequency at which the standards of precision and accuracy are achieved
TMAC	TMAC Resources Inc.

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1. INTRODUCTION

This Quality Assurance and Quality Control Plan (QA/QC Plan or the Plan) has been prepared by TMAC Resources Inc. (TMAC) in accordance with the three Nunavut Water Board (NWB) water licences 2AM-DOH1323, 2BE-HOP1222, and 2BB-BOS1217 held by TMAC associated with developments throughout the Hope Bay region.

The Plan is intended primarily for use by TMAC and its contractors to ensure the use of best practices when conducting environmental sampling, analysis and reporting for the Hope Bay Project, and that the conditions of water licences and project permits are met.

This Plan is structured in a manner such that one document pertaining to quality assurance and quality control is approved and implemented across all TMAC Hope Bay project sites, while still addressing site- and licence-specific needs: the main document outlines TMAC's approach to conducting environmental sampling, analysis and reporting as it pertains to all TMAC Hope Bay developments; subsequent modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, only the specific modules pertaining to that licence and site may need to be revised. This is intended for consistency and efficiency across operations and for compliance management. This Plan has been developed to be applicable for all phases of the various Hope Bay Belt projects.

1.1. OBJECTIVES

The main objective of this Plan is to outline a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and legally defensible quality. Consistent with TMAC's intent to be a responsible operator, the following objectives will be applied to achieve a high level of quality assurance:

- Provide standard procedures for sample collection, preservation, documentation and transportation, to achieve precision, accuracy and reliability in data quality;
- Ensure personnel involved in sampling and analysis are trained and competent;
- Utilize high quality laboratory supplies and sampling equipment that are reliable and maintained in good working condition;
- Ensure that all chemical analyses are conducted at a certified external laboratory;
- Describe a standard process for managing analytical data results and completing internal and external reporting;
- Establish and review Data Quality Objectives (DQOs) to ensure that data required for environmental management is available;
- Implement quality control programs, based on recognized best operating practices, to assess the quality of analytical data, provide warning of unacceptable analytical or sample errors, and initiate prompt remedial action when deficiencies are identified;
- Apply these principals to all environmental samples, whether analyzed for the purpose of regulatory compliance monitoring, or for the purpose of internal environmental management.

1.2. RELEVANT LEGISLATION AND GUIDANCE

Table 1 provides a summary of federal and territorial regulations governing this Plan and associated guidelines. Additional regulations and standards govern other TMAC plans which are implemented in conjunction with this Plan.

Table 1. Regulations and Guidelines governing the Hope Bay QA/QC Plan

Regulation/Guideline	Year	Governing Body	Relevance
Quality Assurance and Quality Control Guidelines For Use by Class “A” Licensees	1996	INAC Water Resources Division	Describes information to be included in the development of a QA/QC Plan
Standard Methods for the Examination of Water and Wastewater	1999		Provides procedures and methods of analysis for examination of water quality
Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites Volume I	1993	CCME	Technical support document which provides approach to sampling, analysis and data management.

1.3. RELATED TMAC DOCUMENTS

The documents listed in Table 2 are expected to be referenced and utilized in conjunction with the QA/QC Plan.

Table 2. List of TMAC documents Related to the Hope Bay QA/QC Plan

Document Title	Year	Relevance
Hope Bay Project Doris Aquatic Effects Monitoring Plan	2016	Describes the monitoring schedule, sampling methods, analysis and determination of environmental effects, and the quality assurance and quality control procedures to conducted in aquatic environments.
Water Management Plan	2016	Describes effluent discharge quality, monitoring programs and sampling locations associated with water management at Hope Bay.
Hope Bay Project Groundwater Management Plan	2016	Describes monitoring schedule and analysis procedures associated with monitoring of mine groundwater.
Incinerator Management Plan	2016	Describers characterization sampling of incinerator bottom ash.
Doris North Landfarm Management and Monitoring Plan	2014	Describes sampling of soil and effluent placed in the Landfarm facility. Outlines remediation criteria for hydrocarbon contaminated soil.
Hope Bay Project Hazardous Waste Management Plan	2016	Describes waste oil and bottom ash characterization sampling.
Waste Rock and Ore Management Plan	2016	Describes environmental monitoring required in pollution control ponds and seep sampling programs.
Hope Bay Project Doris Tailings Impoundment Area Operations, Maintenance and Surveillance Manual	2016	Describes sample schedule, documentation and reporting required for confirmatory monitoring of tailings geochemical characterization and thermal monitoring of infrastructure associated with the TIA.

1.4. PLAN MANAGEMENT AND EXECUTION

In accordance with the requirements of the General Conditions (Part B) of the applicable water licences, this plan will be immediately implemented following its submission, subject to any modifications proposed by the NWB as a result of the review and approval process.

This plan will be reviewed annually and updated as necessary. Personnel responsible for implementing and updating the QA/QC Plan are identified in Table 3.

Table 3. Roles and Responsibilities

Role	Responsibility
VP Environmental Affairs	• Overall responsibility for and implementation of this management plan; • Provide the on-site resources to operate and maintain environmental sampling in accordance with this plan.
Environmental Director	• Review and update this plan as required; • Ensure Environmental staff are trained in monitoring and quality assurance and quality control procedures; • Support implementation of this management plan.
Environmental Coordinator	• Provide training and support to environmental staff on the procedures contained in this plan; • Ensure that required sampling is carried out in accordance with this plan and licence/permit requirements; • Conduct regular inspections of the monitoring stations and audits of the maintenance records; • Manage analytical data in accordance with this plan; • Assess whether samples have met applicable regulatory standards and guidelines; • Ensure sampling gear is in good working order and calibrated; • Prepare and submit compliance reports to regulatory agencies.

2. SAMPLE COLLECTION IN THE FIELD

Environmental sampling is conducted to provide information required by TMAC for effective environmental management of the site, to provide information on follow-up monitoring of previous spill sites, and to monitor regulatory compliance. It is necessary to ensure sample integrity is maintained for all samples collected whether for regulatory compliance or internal management decisions.

2.1. SAMPLE LOCATIONS

The Surveillance Network Program (SNP) is required by each water licence. The SNP defines a specific water-sampling program for the site, including sampling locations, sampling frequency and analytical parameters.

The SNP samples must always be taken at the same location and these sampling stations must be clearly identified in the field by posted signs. The location of signs and the precise location of sampling will be approved by the designated Inspector for the site. Sampling locations will be relocated as required by the water use permits or as recommended by the designated site Inspector. The appended modules provide information on the SNP stations to be monitored for each of the water licence areas.

Additional sampling sites will be added on an as needed basis in response to regulatory requirements or an identified internal monitoring need. These include samples taken on ice to compare water quality before and after a drilling effort, sites of new or previous petroleum product or chemical spills, and spring runoffs associated with construction activities. GPS coordinates of all sampling sites will be recorded using a handheld GPS and maintained on file.

2.2. SAMPLE TYPES

Different sample types, such as composites or grabs, can be collected at various sampling locations. Water and liquid effluent samples (ie., natural lakes, streams, treatment ponds, process streams, sumps, effluent discharges) will generally be grab samples. Solid material samples (i.e., soil, ash, tailings solids) will usually be composite samples, although the purpose of the sampling program will dictate whether grab samples or composite samples will be used (i.e., characterization, delineation). For example, monitoring of the remediation levels in the land treatment area will usually require a composite sample within a homogenized area. Sampling hydrocarbon contaminated sites may require grab samples from various locations within the area to delineate a zone of contamination.

2.3. SAMPLE BOTTLES

The laboratory analytical method and the parameter of interest will dictate the size and type of bottle (i.e., glass, plastic, amber glass) to be used for the sample. All sample bottles will be prepared and supplied by the contracted laboratory. Only clean unused bottles will be used to collect all samples to limit field generated contamination or preservation errors. If there is a need for bacterial testing, the bottles must be autoclaved (sterilized) by the contracted laboratory prior to use. New powder-free nitrile gloves will be worn at all times when handling sample bottles.

Some sampling bottle types require rinsing with the water to be sampled prior to collecting the sample. The contracted laboratory can provide instruction for the type of bottle and the rinsing requirements for each analytical parameter. If the sample bottle requires rinsing, the sample bottle should be partially filled with the water to be sampled and rinsed with the cap in place three times. Rinse water will be emptied away from the sampling point so that surface water is not contaminated and sediments are not disturbed. As a general rule:

- Plastic bottles require triple rinsing
- Glass bottles should not be triple rinsed because hydrocarbons can adsorb to the glass surface and increase sample concentrations during the rinsing process
- Sample bottles that are pre-charged with preservative must not be rinsed to prevent loss of the sample preservative

Bottles should be filled to near full capacity while allowing enough room for the preservative addition and mixing. Some bottles must be filled to the indicated fill-line on the bottle. Some analytical parameter samples must be collected without leaving head-space, which means that the bottle will be filled in such a way to prevent inclusion of air or bubbles. This is very important when sampling volatile parameters (e.g., volatile organic carbon or chlorine) which may evaporate out of solution if airspace is present. Typically, the easiest way to accomplish this is to place the cap on the bottle while the bottle is submerged. This can also be accomplished by filling the bottle to form a meniscus at the top and then carefully replacing the cap to ensure no water is lost. The contracted laboratory can provide instruction for the specific bottle filling requirements for each analytical parameter.

The sample bottles necessary for the different analyses required by the water licence SNPs are provided in the Appendix B.

2.4. FIELD SAMPLING LOG BOOK

Details of all sampling activities are recorded in a field logbook. The sampler will record the sampling stations visited, the samples taken at each station, the date and time for each sample collected and the names of the individuals collecting the sample. The results of any field measurements (i.e., temperature, pH, etc.) will be recorded as well as information on sample preservation.

The sampler will also record any information that may influence the analytical results, such as weather conditions, stream flow rates, and unusual conditions at the site. Any necessary deviations from standard procedures or sampling location need to be documented and reasons for the change included in the field log book.

A scanned copy of the field log book pages should be made as soon as possible after sample collection and filed on the Environment server. This copy serves as backup in the event the log book were lost or destroyed, and as a reference for others who may need to review this data.

Field notes and the field log book are considered legal documents and should be kept legibly in permanent ink. In the event that an error is made it should be crossed out with a single line and initialled by the one making the correction. Pages should never be removed and space or pages being left blank should be labelled with a single diagonal line and the phrase “intentionally left blank”. When filled, the field log book should be filed and retained in case of future need.

2.5. SAMPLING METHODS

The following sections discuss methods that should be used to collect samples in different sampling locations. The bottle rinsing and filling techniques described in Section 2.3 will be incorporated into each of these methods.

2.5.1. STREAMS

The sample should be collected as close as practical to the middle of the stream, where water flows freely and is free of debris. If wading into the stream to collect the sample, the sampler should face upstream and wait to allow any sediment that may have been stirred up to settle or wash away. A sample pole may also be used to collect the sample from shoreline in situations where it is unsafe to enter the flowing stream. If a sample pole is used, the collection end of the pole will be cleaned prior to arriving at the sample location, transported to the sample site covered in a plastic bag and then rinsed in the water to be sampled prior to inserting the sample bottle into the collection end.

Ideally, the bottle will be submerged into the stream to a depth of approximately half the total stream depth to collect the sample. At minimum, the sample bottle will be submerged to approximately 10cm below the water surface. If the stream is too shallow to submerge the bottle to 10cm below the surface, care will be taken to prevent surface debris or sediments from contaminating the sample. If necessary, a smaller bottle or an individually-packaged sterile plastic syringe provided by the contract laboratory can be used to transfer water to the larger sample bottles, provided that these are rinsed as required.

2.5.2. LAKES AND PONDS

Surface samples from lakes and ponds should be collected using the same procedures as above. Subsequent samples should always be taken at the same location. Sample bottles should be submerged to a depth of approximately 10cm below the water surface.

Water quality samples collected at depth in lakes or ponds will be collected with a clean discrete water sampler (e.g., Niskin sampler, Van Dorn sampler), which is lowered to the required depth and triggered to trap a sample of water by releasing a messenger weight from the surface down the roper used to lower the sampler. The sampler is lowered to depth three times and rinsed with the water to be sampled before collecting the sample the fourth time it is lowered to depth.

2.5.3. PROCESS STREAMS (PIPES, VALVES AND AUTO-SAMPLERS)

Some sampling of process streams may be required by the SNP and for environmental management purposes. These may be grab samples taken from a valve or pipe discharge, or composite samples collected by combining multiple grab samples or by an automated sampling system. The same principles used in natural stream sampling should be applied when collecting grab samples. Valves should be open for at least one minute before taking the sample to help ensure that the water is representative of the process stream.

2.5.4. SOIL SAMPLING

The location, number and depth of soil samples will depend on the purpose of the sampling program (i.e., characterization, delineation) and nature of the parameters of interest. All sampling equipment (e.g. trowel, scoop, augers) will be made of stainless steel or high density polyethylene, and will be cleaned prior to and between sample events. Powder-free nitrile gloves will be worn and gloves will be changed before each new sample is collected. Samples should be gathered from freshly exposed soil and preserved as soon as possible.

2.5.5. ASH SAMPLING

The monitoring, characterization and disposal of bottom ash generated through incinerating or open burning appropriate waste streams is a requirement of the water licences associated with the project. Ash is collected at intervals to be representative of all the ash and the analysis is used to determine suitability for landfill placement.

During each incinerator ash cleaning an ash sample is collected. These samples are combined together at month end into a composite which is then subsampled for analysis.

Each time ash is cleaned out of the burn pan an ash sample is collected. These samples are combined together at month end into a composite which is then subsampled and sent for analysis.

Bottom ash is analyzed for flash point, paint filter test, leachable metals, leachable mercury and leachable BTEX. Sub-samples are packed tightly into glass jars with no headspace and submitted to the contract laboratory for analysis.

2.5.6. WASTE OIL SAMPLING

Feedstock oil to be burned in a waste oil burner must be analyzed to determine the content of metals and other substances known to exist in used oil from the lubrication of machinery components and internal combustion engines. This is a requirement of territorial guidelines, federal regulations and the water licences issued to TMAC by the NWB.

An annual supply of waste oil totes is identified and a representative sample is collected from each of the totes to create a composite which is then sent for analysis.

The samples are analyzed for, glycol, PCBs, ash, flashpoint, metals, sulphur, total chlorine, heating value, viscosity, and water.

2.5.7. ENVIRONMENTAL SURVEILLANCE MONITORING

Some of the monitoring required under the water licences does not involve collection of samples or laboratory analysis. This may include monitoring shoreline erosion or ground temperatures around infrastructure facilities. The timely acquisition and preservation of this data provides documentation for aspects relating to how the camp is affecting the local environment. For example, if runoff from the site is not properly controlled permafrost degradation may be observed and documented. On the same note, a warming trend in a temperature monitoring station could be an early indicator of permafrost degradation. Field notes and measurements are collected for these programs and are an important part of the site environmental management.

2.5.8. FLOW MEASUREMENTS

Seametric TX-115 Flow meters are used to measure piped water movements and discharge within the water management facilities. The calibration procedure for the Seametric TX-115 Flow meters includes testing of the flow measurement reading against a known flow to determine accuracy, adjusting the K-factor to ensure the flowmeters are within 10% and recording the information in a flowmeter calibration log. This calibration is conducted prior to deployment in the field for water management related activities.

2.5.9. FIELD MEASUREMENTS

Water temperature, electrical conductivity and pH are typically measured and recorded in the field when the sample is taken. The calibration of the meters must be verified against a known standard solution and recalibrated if necessary prior to each day's sampling activities. The calibration data is recorded in a calibration log. Additionally, the calibration of the meter should be checked against a known standard at the end of the days sampling. Any issues with the meter calibration, or discrepancies with the end of day calibration check should be noted in the field log book along with that days sampling data. Calibration check data will not be used to alter any reading taken during the day. Instead, these results may be used to help explain anomalous data.

Field measurements should be taken directly from the water body being sampled. Where this is impractical, perhaps due to high velocity of a sample stream, the measurements can be taken from a triple rinsed sample jug or pail. It is important that field meters are never introduced into sample bottles that are destined for laboratory analysis to prevent sample contamination.

3. SAMPLE HANDLING

3.1. SAMPLE IDENTIFICATION

Prior to beginning a sample event, the required sample bottles and preservatives should be gathered, prepared and organized into sample sets inside a plastic bag which should be supplied by the contract laboratory.

When sampling and sample preservation is completed, the bottles should be clearly marked with all information that the laboratory analyst will need to report the result. The following information should be included:

- Sample location (or SNP station number)
- Date of sampling
- Parameters to be analyzed
- Preservation method used
- Filtering method used
- Name or initials of sampler
- Temperature and pH (where applicable)
- Company name, and
- Property name

Prior to taking the bottles to the field, each bottle will be labelled with as many of the items above as possible using waterproof pre-printed labels. The sampling time, temperature and pH (where applicable) will be recorded on the label in the field using permanent waterproof ink

In some cases, permanent markers can be used to identify sample bottles. , however these markings can be erased with wear and may not be clearly legible. Whenever possible pre-printed waterproof labels can be used to mark the sample bottles.

3.2. CHAIN OF CUSTODY FORMS

A Chain-of-Custody (CoC) form has to be completed for each sample collected. Template CoC forms are saved on the Environment server. The completed form is to be filed on the server in the EQWin Data folder. A copy of this form must also be printed, signed and sent accompanying the samples.

3.3. SAMPLE PRESERVATION

As samples cannot be delivered to the analytical laboratory within two hours of sampling, preservation may be required for some parameters to prevent chemical reactions that may affect the concentration of the parameter of interest. The samples must be preserved within two hours of sampling. Preservative must be analytical grade and must not be used after the expiry date. Expired preservative is returned to the laboratory for proper disposal. The contracted laboratory can provide instruction for the preservative requirements for each analytical parameter and will provide appropriate preservatives for parameters to be analyzed.

Samples must be kept dark and cool (~4°C), but not frozen. Samples will be packed in a cooler with ice packs for transport and for shipment to the laboratory. Samples will be stored in a refrigerator if they will not be shipped to the laboratory immediately after sampling. Samples should be delivered to the analytical laboratory as soon as possible after collection.

The sample preservatives necessary for the different analyses required by the water licence SNPs are provided in Appendix B.

3.4. TRANSPORTATION

Care should be taken when packing samples for shipment. To help prevent leakage and cross contamination, sample bottles should be packed standing upright in the cooler. Sample bottles laid on their side are much more likely to leak, especially if they have other samples on top of them. When possible, samples known or suspected to have elevated contaminate levels should not be shipped together with samples expected to be clean (i.e. sewage samples not shipped in same cooler as potable water samples).

The contracted laboratory can provide details on the storage or holding time for each parameter to be analyzed (i.e. can be as little as 24 hours). Where possible, sample dates will be scheduled so that a flight is available to transport the sample to the lab within the specified holding time. In all cases, samples will be shipped to the laboratory as quickly as possible and will be labelled as “Time Sensitive, Keep Cool” to ensure proper handling during shipment.

4. QUALITY CONTROL SAMPLES

There are six types of QC samples that can be collected and analyzed to verify the quality of the sample collection and analysis methods. These are described in the section below. These QC samples are analyzed for the same suite of analytical parameters as the SNP sampling station samples.

4.1. TRAVEL BLANKS

Travel blanks are used to check for contamination during the movement process of samples and are subjected to the same potential sources of contamination as the samples to be analyzed. The travel blanks are prepared by the analytical laboratory with de-ionized water and appropriate preservative. The travel blank bottles are shipped to site, transported to the field, carried through the sample collection and shipped back to the laboratory with the field samples. Travel blank bottles should not be opened at any time.

4.2. EQUIPMENT BLANKS

Equipment blanks are collected after cleaning of field equipment and prior to sampling. De-ionized water provided by the contract laboratory is used to rinse the equipment. The field equipment is then filled with de-ionized water, and then collected and preserved in new sample bottles for the same analysis as the field samples (de-ionized water expires within six months of being produced by the laboratory; expired de-ionized water will not be used). The results from this blank sample assure adequate decontamination of the field equipment. The Niskin or other sampling equipment used to collect samples will be decontaminated prior to use.

4.3. FIELD BLANKS

Field blanks are samples of laboratory-grade de-ionized water that are subjected to the same procedures as routine field samples. Any measurement of the parameter of interest, above method detection limits, will indicate an analytical error, impurities in the laboratory distilled water supply, contaminated sample preservatives or contamination of the sample during the handling process. Combined with the results of other QC procedures, analysis of field blanks can help identify sources of contamination and error.

A set up of field blanks should be made up once each month and taken into the field when the SNP stations are sampled. New sample bottles will be rinsed as directed by the contract laboratory and filled using de-ionized water provided by the contracted laboratory (de-ionized water expires within six months of being produced by the laboratory; expired de-ionized water will not be used). The samples will be poured directly from the bottles provided by the laboratory into the sample bottles to replicate grab sample methods. The field blank set should represent all the parameters routinely analyzed at that sample location. The bottles should be preserved using the same protocol as the regular samples and submitted to the laboratory identified as field blanks.

4.4. REPLICATE SAMPLES

Replicate samples (sometimes referred to as duplicate samples) test precision and assure that sample results are reproducible. They are prepared by collecting two separate samples for each given analytical parameter at a given sample location. The replicate samples are collected, handled and analyzed using the same procedures applied to routine samples. The samples are also analyzed by the same analytical method in the laboratory. Replicate samples are usually used to identify sampling procedure errors. Once per operating season, for each active SNP station, a set of duplicate samples will be taken representing as many of the routine analyses as possible. Where possible, this should be carried out in conjunction with audit sampling conducted by the designated Inspector. Replicate sampling should rotate between prescribed SNP stations.

4.5. SPLIT SAMPLES

Two or more representative sub-samples are removed from one collected sample and analyzed separately at the laboratory. This data is used as a check of the precision of the analytical procedure employed by the laboratory and is a normal part of the laboratory QA/QC program. These can also be collected in the field by dividing a composite sample into two sets of samples. If field split samples are collected, it is common to label each sample with a different station name, to provide a blind assessment of the laboratory's analytical program.

4.6. METHOD "SPIKED" SAMPLES AND CERTIFIED STANDARDS

The recovery of "known additions" from "spiked" samples is used as a check on the recovery of the parameter to be analyzed using a given analytical procedure. It is periodically carried out at the laboratories employed to analyze the samples and forms part of the laboratory’s normal QA/QC program.

5. LABORATORY ANALYSIS

All environmental monitoring samples are submitted to an offsite analytical laboratory which is accredited by the Canadian Association for Laboratory Accreditation (CALA). Currently, TMAC uses ALS Environmental Laboratories (ALS) for analyses of all environmental samples. A cover letter from ALS confirming approval of the Plan for analyses to be performed under this Licence is provided in Appendix A of this plan. The quality control protocols used by ALS are provided in Appendix C of this plan and the CALA scope and Certificates for ALS can be found in Appendix D.

6. REPORTING

All analytical results are forwarded in electronic format to TMAC’s Environmental Coordinator for filing. TMAC uses an EQWin electronic database to manage data and make data easily accessible. This database is maintained by the Environmental Coordinator.

After receipt, the results are screened for anomalies and/or trends, and are placed into the appropriate environmental files on the Environmental server. Results that appear to be anomalous are flagged and a review is conducted to identify potential sources of the anomaly. In some instances, the analysis is repeated. Analyses that indicate contamination or changes are subjected to further study and reported to the appropriate agencies. The environmental files are maintained on the server as a management tool for environmental risk assessment and in preparation of summary reports for the regulatory agencies and company officials. In compliance with the Surveillance Network Program, reports of analytical results for SNP samples are submitted electronically to the NWB and the Inspector within 30 days following the month in which the samples were taken. The NWB distributes the reports to other agencies and interested parties.

7. REFERENCES

Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites Volume I: Main Report. 1993, Canadian Council of Ministers of the Environment

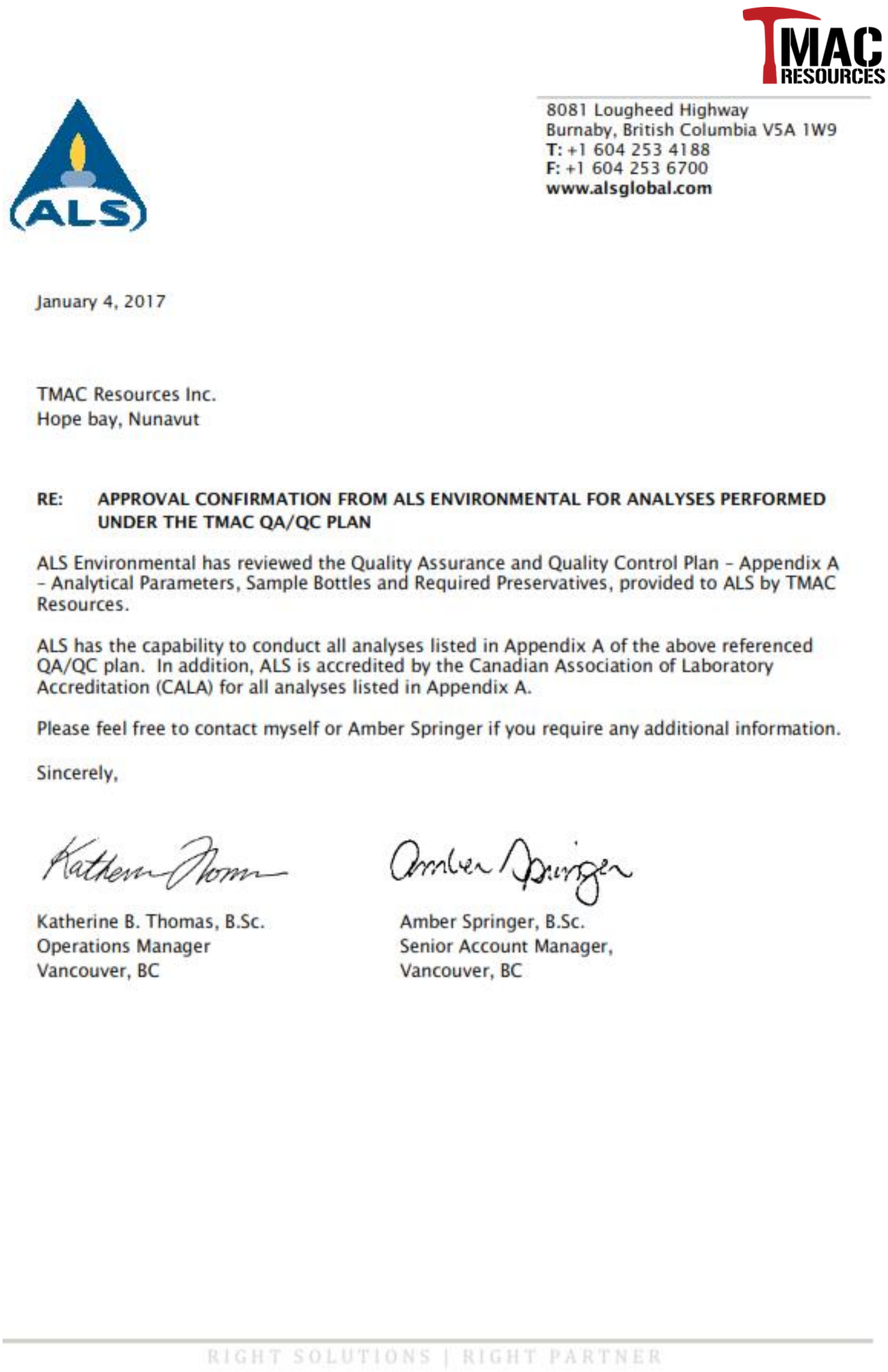
Protocols Manual for Water Quality Sampling in Canada. 2011, Canadian Council of Ministers of the Environment

Standard Methods for the Examination of Water and Wastewater. 1999, American Public Health Association, American Water Works Association and Water Environment Federation

Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class “A” Licensees. 1996, Indian and Northern Affairs Canada Water Resources Division and Northwest Territories Water Board.

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

APPENDIX A – ALS QA/QC PLAN REVIEW CONFIRMATION LETTER



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ALS

January 4, 2017

TMAC Resources Inc.
Hope bay, Nunavut

RE: APPROVAL CONFIRMATION FROM ALS ENVIRONMENTAL FOR ANALYSES PERFORMED UNDER THE TMAC QA/QC PLAN

ALS Environmental has reviewed the Quality Assurance and Quality Control Plan – Appendix A – Analytical Parameters, Sample Bottles and Required Preservatives, provided to ALS by TMAC Resources.

ALS has the capability to conduct all analyses listed in Appendix A of the above referenced QA/QC plan. In addition, ALS is accredited by the Canadian Association of Laboratory Accreditation (CALA) for all analyses listed in Appendix A.

Please feel free to contact myself or Amber Springer if you require any additional information.

Sincerely,

Katherine Thomas

Katherine B. Thomas, B.Sc.
Operations Manager
Vancouver, BC

Amber Springer

Amber Springer, B.Sc.
Senior Account Manager,
Vancouver, BC

RIGHT SOLUTIONS | RIGHT PARTNER

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

APPENDIX B – ANALYTICAL PARAMETERS, SAMPLE BOTTLES AND REQUIRED PRESERVATIVES

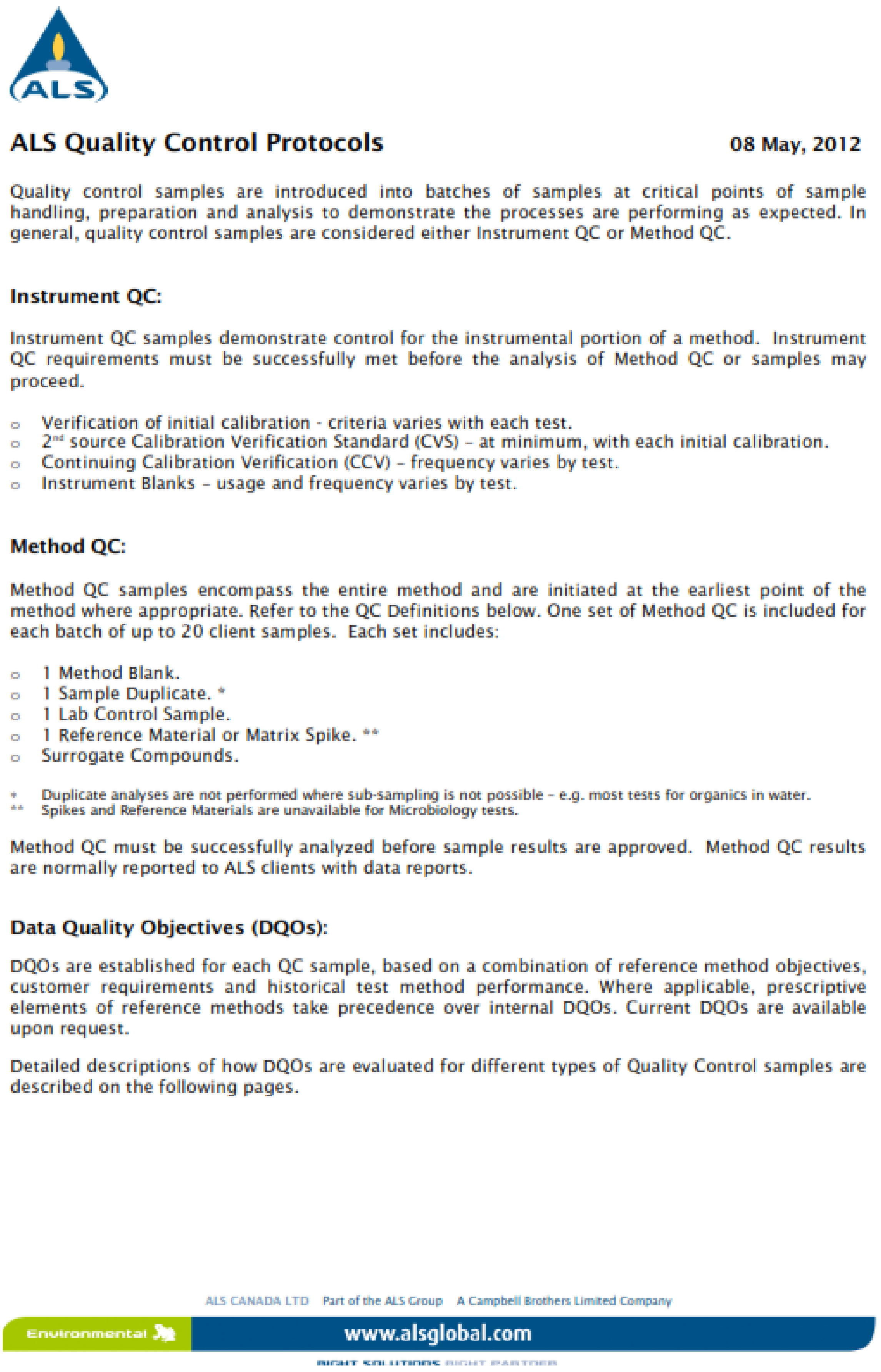
Analytical Parameters, Sample Bottles and Required Preservatives

SNP Monitoring Group Reference	Analytical Parameters	Measurement Units	Sample Bottle	Preservative
General (G)	pH	pH units	500 mL plastic	None
	TSS	mg/L		
Nutrients (N1)	Orthophosphate-P	mg/L		
	Nitrate-N	mg-N/L		
	Nitrite-N	mg-N/L		
Nutrients (N2)	Total Ammonia-N	mg-N/L	125 or 250 mL glass	1 mL of 1:3 H_2SO_4 or 1 mL of 1:1 H_2SO_4
	Total Phosphate-P	mg/L		
Total Metals - Unfiltered (MT)	T-Aluminum	mg/L	60 mL, 125 mL or 250 mL plastic	0.75 mL of 1:3 HNO_3, 1.5 mL of 1:3 HNO_3 or 3 mL of 1:3 HNO_3
	T-Arsenic	mg/L		
	T-Copper	mg/L		
	T-Iron	mg/L		
	T-Nickel	mg/L		
	T-Lead	mg/L		
	T-Zinc	mg/L		
Dissolved Metals - Filtered (MT)	D-Iron	mg/L	60 mL, 125 mL or 250 mL plastic	0.75 mL of 1:3 HNO3, 1.5 mL of 1:3 HNO3 or 3 mL of 1:3 HNO3
	D-Copper	mg/L		
	D-Arsenic	mg/L		
	D-Zinc	mg/L		
	D-Cadmium	mg/L		
	D-Nickel	mg/L		
Biological (B)	Biochemical Oxygen Demand	mg/L	500 mL plastic	None
	Fecal Coliforms	CFU/100 mL (colony forming units)	Sterile 250 mL plastic	Sodium Thiosulfate (precharged)
Hydrocarbons (HC)	Total Oil & Grease	mg/L	2 X 250 mL or 2 X 500 mL amber glass	1 mL of 1:1 H2SO4 or 2 mL of 1:1 H2SO4
	Benzene	mg/L	2 X 40 mL glass	Sodium Bisulpahte or Thiosulfate (precharged)
	Toluene	mg/L		
	Ethyl Benzene	mg/L		
Discharge (D)	Flow	m^3/day	None, field measured	N/A
	Volume	m^3		
	Duration	Day		

*ALS methodological change. Fecal coliforms now in MPN/100mL (Most Probable Number).

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

APPENDIX C – ALS QUALITY CONTROL PROTOCOLS



ALS Quality Control Protocols

08 May, 2012

Quality control samples are introduced into batches of samples at critical points of sample handling, preparation and analysis to demonstrate the processes are performing as expected. In general, quality control samples are considered either Instrument QC or Method QC.

Instrument QC:

Instrument QC samples demonstrate control for the instrumental portion of a method. Instrument QC requirements must be successfully met before the analysis of Method QC or samples may proceed.

- Verification of initial calibration - criteria varies with each test.
- 2nd source Calibration Verification Standard (CVS) – at minimum, with each initial calibration.
- Continuing Calibration Verification (CCV) – frequency varies by test.
- Instrument Blanks – usage and frequency varies by test.

Method QC:

Method QC samples encompass the entire method and are initiated at the earliest point of the method where appropriate. Refer to the QC Definitions below. One set of Method QC is included for each batch of up to 20 client samples. Each set includes:

- 1 Method Blank.
- 1 Sample Duplicate. *
- 1 Lab Control Sample.
- 1 Reference Material or Matrix Spike. **
- Surrogate Compounds.

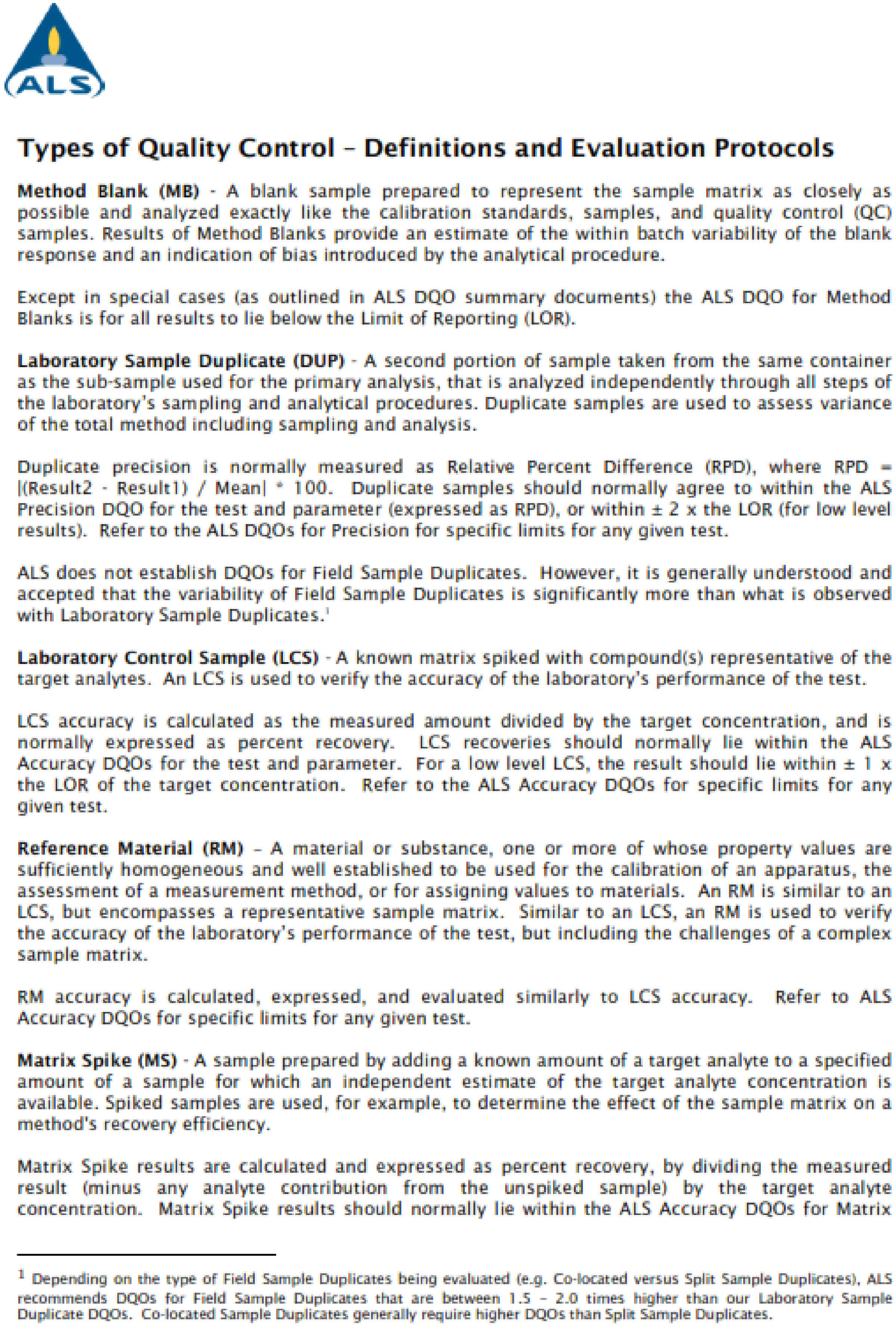
* Duplicate analyses are not performed where sub-sampling is not possible – e.g. most tests for organics in water.
** Spikes and Reference Materials are unavailable for Microbiology tests.

Method QC must be successfully analyzed before sample results are approved. Method QC results are normally reported to ALS clients with data reports.

Data Quality Objectives (DQOs):

DQOs are established for each QC sample, based on a combination of reference method objectives, customer requirements and historical test method performance. Where applicable, prescriptive elements of reference methods take precedence over internal DQOs. Current DQOs are available upon request.

Detailed descriptions of how DQOs are evaluated for different types of Quality Control samples are described on the following pages.



Types of Quality Control – Definitions and Evaluation Protocols

Method Blank (MB) - A blank sample prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of Method Blanks provide an estimate of the within batch variability of the blank response and an indication of bias introduced by the analytical procedure.

Except in special cases (as outlined in ALS DQO summary documents) the ALS DQO for Method Blanks is for all results to lie below the Limit of Reporting (LOR).

Laboratory Sample Duplicate (DUP) - A second portion of sample taken from the same container as the sub-sample used for the primary analysis, that is analyzed independently through all steps of the laboratory's sampling and analytical procedures. Duplicate samples are used to assess variance of the total method including sampling and analysis.

Duplicate precision is normally measured as Relative Percent Difference (RPD), where RPD = |(Result2 - Result1) / Mean| * 100. Duplicate samples should normally agree to within the ALS Precision DQO for the test and parameter (expressed as RPD), or within ± 2 x the LOR (for low level results). Refer to the ALS DQOs for Precision for specific limits for any given test.

ALS does not establish DQOs for Field Sample Duplicates. However, it is generally understood and accepted that the variability of Field Sample Duplicates is significantly more than what is observed with Laboratory Sample Duplicates.[1]

Laboratory Control Sample (LCS) - A known matrix spiked with compound(s) representative of the target analytes. An LCS is used to verify the accuracy of the laboratory's performance of the test.

LCS accuracy is calculated as the measured amount divided by the target concentration, and is normally expressed as percent recovery. LCS recoveries should normally lie within the ALS Accuracy DQOs for the test and parameter. For a low level LCS, the result should lie within ± 1 x the LOR of the target concentration. Refer to the ALS Accuracy DQOs for specific limits for any given test.

Reference Material (RM) – A material or substance, one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. An RM is similar to an LCS, but encompasses a representative sample matrix. Similar to an LCS, an RM is used to verify the accuracy of the laboratory's performance of the test, but including the challenges of a complex sample matrix.

RM accuracy is calculated, expressed, and evaluated similarly to LCS accuracy. Refer to ALS Accuracy DQOs for specific limits for any given test.

Matrix Spike (MS) - A sample prepared by adding a known amount of a target analyte to a specified amount of a sample for which an independent estimate of the target analyte concentration is available. Spiked samples are used, for example, to determine the effect of the sample matrix on a method's recovery efficiency.

Matrix Spike results are calculated and expressed as percent recovery, by dividing the measured result (minus any analyte contribution from the unspiked sample) by the target analyte concentration. Matrix Spike results should normally lie within the ALS Accuracy DQOs for Matrix

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[1] Depending on the type of Field Sample Duplicates being evaluated (e.g. Co-located versus Split Sample Duplicates), ALS recommends DQOs for Field Sample Duplicates that are between 1.5 – 2.0 times higher than our Laboratory Sample Duplicate DQOs. Co-located Sample Duplicates generally require higher DQOs than Split Sample Duplicates.

Spikes. Matrix Spike results cannot be calculated or reported in cases where the background concentration of the test parameter in the sample is too high relative to the spike level.

Surrogate Compounds (SURR) – Surrogate Compounds are added to every sample where applicable (organics tests only). They are substances with properties that mimic the analyte of interest, and which are unlikely to be found in environmental samples. They are added at known concentration to samples to establish that the analytical method has been properly performed.

Surrogate results are calculated and expressed as percent recovery, by dividing the measured result against the expected target concentration. Refer to ALS Accuracy DQOs for specific limits for any given test.

Automated Relational Checks

In addition to all our standard Quality Control checks, ALS also employs dozens of "Relational Checks", which are programmed into our Laboratory Information Systems (LIMS) to automatically highlight any situations where the expected relationships between different test parameters are violated, which can often point to errors. Such errors may originate with field sampling, or from laboratory processes, but should always be identified and pro-actively investigated.

Total versus Dissolved Metals ("D > T" Check) – One of the most important and common relational checks we do is a check for situations where Dissolved Metal concentrations significantly exceed Total Metal concentrations. By definition, this situation should not occur. However, there are a few reasons why this can occur:

i) Circumstances where Dissolved Metals slightly exceed Total Metals are expected in a small percentage of samples, simply due to normal random variability. In fact, when all metals in a test sample exist in the dissolved form, we expect that Dissolved Metals measurements will numerically exceed Total Metals measurements exactly half the time (by a small margin), simply due to random chance.

ii) Samples to be analyzed for Dissolved Metals must be filtered, which is normally done in the field. Filtration processes are a common source of low level metals contaminants. Contamination of a sample during filtration is the most common source of significant D > T issues.

iii) Field samples for Dissolved and Total Metals are normally collected independently, so variability of the sampling process is another common cause of D > T issues.

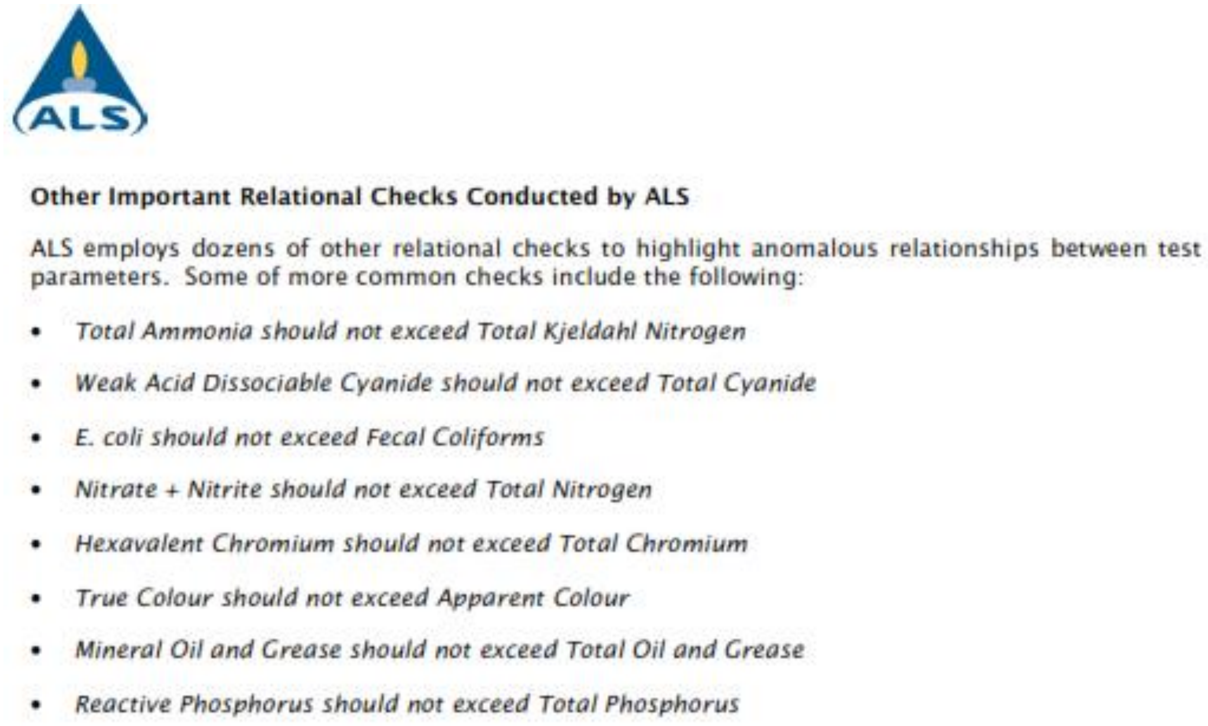
If none of the above causes can explain a situation where Dissolved Metals exceed Total Metals, then another type of error may be indicated, either with the collection of the sample in the field, or with sample containers or preservatives, or with the laboratory testing process.

ALS automatically highlights and investigates all circumstances where a Dissolved Metal result exceeds the Total Metal result by 20% RPD or more, but only if the absolute difference between the two results is greater than the sum of the Limits of Reporting (Detection Limits) of the two results.

The mechanism of this relational check is derived from the ALS Duplicate DQOs for Metals in Water.

All D > T relational checks that violate the rule above are flagged internally, and are investigated by ALS before sample results will be released to our clients. In most cases, results will be re-analyzed to confirm or correct the anomalous relationship. If results are confirmed by re-analysis, the following data qualifier is applied:

DTC: Dissolved concentration exceeds total. Results were confirmed by re-analysis.



Other Important Relational Checks Conducted by ALS

ALS employs dozens of other relational checks to highlight anomalous relationships between test parameters. Some of more common checks include the following:

- *Total Ammonia should not exceed Total Kjeldahl Nitrogen*
- *Weak Acid Dissociable Cyanide should not exceed Total Cyanide*
- *E. coli should not exceed Fecal Coliforms*
- *Nitrate + Nitrite should not exceed Total Nitrogen*
- *Hexavalent Chromium should not exceed Total Chromium*
- *True Colour should not exceed Apparent Colour*
- *Mineral Oil and Grease should not exceed Total Oil and Grease*
- *Reactive Phosphorus should not exceed Total Phosphorus*

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

APPENDIX D – ALS CALA CERTIFICATE AND SCOPE

Canadian Association
for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Environmental (Edmonton)
ALS Canada Ltd.
9936 - 67th Ave. NW
Edmonton, Alberta

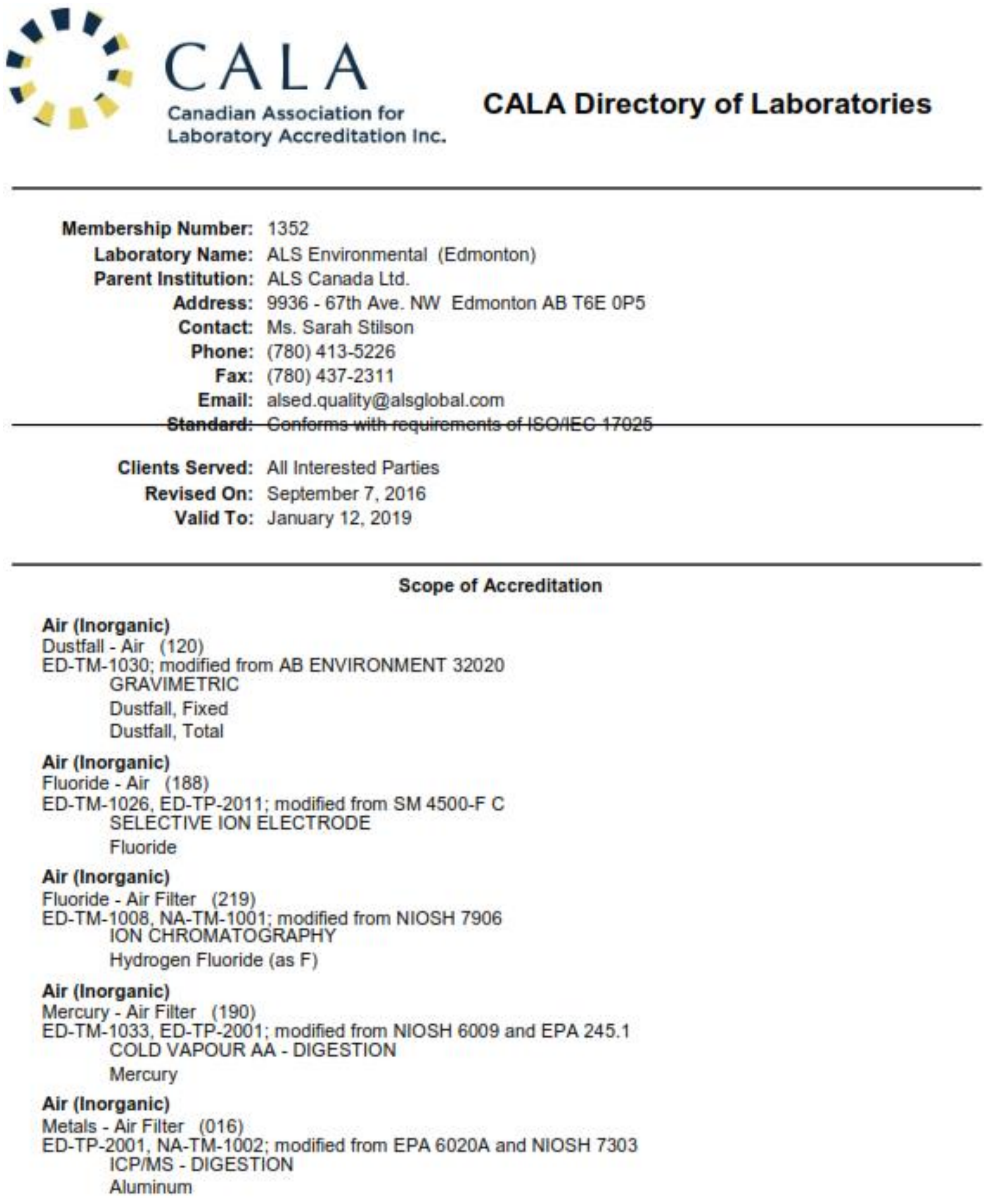
This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation No.: A1352
Issued On: July 14, 2016
Accreditation Date: January 3, 2005
Expiry Date: January 12, 2019

President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request; reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca



CALA
Canadian Association for
Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 1352
Laboratory Name: ALS Environmental (Edmonton)
Parent Institution: ALS Canada Ltd.
Address: 9936 - 67th Ave. NW Edmonton AB T6E 0P5
Contact: Ms. Sarah Stilson
Phone: (780) 413-5226
Fax: (780) 437-2311
Email: alsed.quality@alsglobal.com
~~**Standard:** Conforms with requirements of ISO/IEC 17025~~

Clients Served: All Interested Parties
Revised On: September 7, 2016
Valid To: January 12, 2019

Scope of Accreditation

Air (Inorganic)
Dustfall - Air (120)
ED-TM-1030; modified from AB ENVIRONMENT 32020
GRAVIMETRIC
Dustfall, Fixed
Dustfall, Total

Air (Inorganic)
Fluoride - Air (188)
ED-TM-1026, ED-TP-2011; modified from SM 4500-F C
SELECTIVE ION ELECTRODE
Fluoride

Air (Inorganic)
Fluoride - Air Filter (219)
ED-TM-1008, NA-TM-1001; modified from NIOSH 7906
ION CHROMATOGRAPHY
Hydrogen Fluoride (as F)

Air (Inorganic)
Mercury - Air Filter (190)
ED-TM-1033, ED-TP-2001; modified from NIOSH 6009 and EPA 245.1
COLD VAPOUR AA - DIGESTION
Mercury

Air (Inorganic)
Metals - Air Filter (016)
ED-TP-2001, NA-TM-1002; modified from EPA 6020A and NIOSH 7303
ICP/MS - DIGESTION
Aluminum

Antimony
Arsenic
Barium
Beryllium
Bismuth
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead Lithium
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Strontium
Thallium
Tin
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Air (Inorganic)
Particulates - Air (223)
ED-TM-1140; modified from nioSH 0500/NIOSH 0600
GRAVIMETRIC
Particulates

Air (Inorganic)
Total Solids - Impinger (205)
ED-TM-1157; modified from EPA5
GRAVIMETRIC
Total Solids

Air (Organic)
Formaldehyde - Air (221)
ED-TM-1151; modified from TO-11A/NIOSH 2016
HPLC/UV - EXTRACTION
Formaldehyde

Air (Organic)
Gas - Compressed breathing Air (218)
ED-TM-1144; modified from ASTM D1946
GC/TCD
Nitrogen
Oxygen

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

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Air (Organic)
Hydrocarbons - Compressed Breathigng Air (217)
ED-TM-1142, ED-TM-1144; modified from EPA 18
- GC/FID
- Carbon Dioxide
- Carbon Monoxide
- Ethane
- Methane
- Total Volatile Hydrocarbons (C1-C16)

Air (Organic)
Isocyanates - Air Filter (220)
ED-TM-1145; modified from OSHA 42/OSHA 47
- HPLC - FLUORESCENCE
- 2,4/2,6-Toluene Diisocyanate (TDI)
- bis (Phenyl)methylene diisocyanate (MDI)
- Hexamethylene Diisocyanate (HDI)
- Isophorone Diisocyanate (IPDI)

Air (Organic)
VOC - Air (Gas Bag) (216)
ED-TM-1142; modified from EPA 018 AND EPA 25C
- GC/FID
- Benzene
- Ethylbenzene
- Non-methane organic carbons
- Toluene
- Xylenes

Oil (Organic)
Polychlorinated Biphenyls (PCB) - Oil (002)
ED-TM-1104; modified from EPA 8082 and ASTM D4059
- GC/ECD - EXTRACTION
- Aroclor 1016
- Aroclor 1221
- Aroclor 1232
- Aroclor 1242
- Aroclor 1248
- Aroclor 1254
- Aroclor 1260
- Aroclor 1262
- Aroclor 1268
- Total PCB

Paint
Lead - Paint (153)
ED-TM-1021, ED-TP-2018, NA-TP-2004; modified from EPA 200.2 and EPA 200.7
- ICP - DIGESTION
- Lead

Solids (Inorganic)
Ammonia - Soil (177)
ED-TM-1016, ED-TP-2019; modified from CSSS 15.2.1/SM 4500-NH3
- COLORIMETRIC (SATURATED PASTE)
- Ammonia

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Solids (Inorganic)
Anions - Soil (176)
ED-TP-2019, NA-TM-1001; modified from CSSS 15.2.1, EPA 300.1
ION CHROMATOGRAPHY (SATURATED PASTE)
Nitrate
Nitrite
Sulfate

Solids (Inorganic)
Asbestos (Bulk) - Solids (222)
ED-TM-1152; modified from EPA 600/R-93/116 AND NIOSH 9002
POLARIZED LIGHT MICROSCOPY
Bulk Asbestos

Solids (Inorganic)
Barium - Soil (172)
ED-TM-1021, ED-TP-2018, ISOP 158; modified from SSSA PART 3, 1996, PG 202, EPA 200.7
ICP - FUSION
Barium

Solids (Inorganic)
Barium (Extractable) - Soil (182)
ED-TM-1021, ED-TM-1051, ED-TP-2018; modified from BARITE WASTE GUIDELINES
ICP - EXTRACTION
Barium

Solids (Inorganic)
Chloride - Saturated Paste, Soil (168)
ED-TM-1032, ED-TP-2019; modified from CSSS 15.2.1/SM 4500 - CL E
COLORIMETRIC
Chloride

Solids (Inorganic)
Conductivity - Soil (156)
ED-TM-1004, ED-TP-2019; modified from CARTER CSSS 15.2.1, 15.3
SATURATED PASTE, METER
Conductivity

Solids (Inorganic)
Conductivity - Soil (157)
ED-TM-1004; modified from CARTER CSSS 15.3
1:2 EXTRACTION, METER
Conductivity

Solids (Inorganic)
Density - Soil (170)
ED-TM-1025; modified from ASTM D5057
GRAVIMETRIC
Density

Solids (Inorganic)
Grain Size - Soil (028)
ED-TM-1014; modified from ASTM D422-63
SIEVING
Grain Size

Solids (Inorganic)
Hexavalent Chromium - Soil (148)
ED-TM-1023; modified from EPA 3060A
IC-ALKALINE DIGESTION
Chromium

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Solids (Inorganic)
Hot Water Soluble Boron - Soil (145)
ED-TM-1021, ED-TM-1040, ED-TP-2018; modified from KEREN 1996 METHODS OF SOIL ANALYSIS
ICP - EXTRACTION
Boron

Solids (Inorganic)
Mercury - Soil (164)
NA-TM-1005, NA-TP-2004; modified from EPA 200.2 and EPA 245.1
COLD VAPOUR AA - DIGESTION
Mercury

Solids (Inorganic)
Metals - Soil (023)
NA-TM-1002, NA-TP-2004; modified from EPA 200.2 and EPA6020
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Sulfur
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Oil and Grease - Soil (029)
ED-TM-1131; modified from SM 5520
GRAVIMETRIC - EXTRACTION
Oil and Grease

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Solids (Inorganic)
Hot Water Soluble Boron - Soil (145)
ED-TM-1021, ED-TM-1040, ED-TP-2018; modified from KEREN 1996 METHODS OF SOIL ANALYSIS
ICP - EXTRACTION
Boron

Solids (Inorganic)
Mercury - Soil (164)
NA-TM-1005, NA-TP-2004; modified from EPA 200.2 and EPA 245.1
COLD VAPOUR AA - DIGESTION
Mercury

Solids (Inorganic)
Metals - Soil (023)
NA-TM-1002, NA-TP-2004; modified from EPA 200.2 and EPA6020
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Sulfur
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Oil and Grease - Soil (029)
ED-TM-1131; modified from SM 5520
GRAVIMETRIC - EXTRACTION
Oil and Grease

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The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

Solids (Inorganic)
Hot Water Soluble Boron - Soil (145)
ED-TM-1021, ED-TM-1040, ED-TP-2018; modified from KEREN 1996 METHODS OF SOIL ANALYSIS
ICP - EXTRACTION
Boron

Solids (Inorganic)
Mercury - Soil (164)
NA-TM-1005, NA-TP-2004; modified from EPA 200.2 and EPA 245.1
COLD VAPOUR AA - DIGESTION
Mercury

Solids (Inorganic)
Metals - Soil (023)
NA-TM-1002, NA-TP-2004; modified from EPA 200.2 and EPA6020
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Sulfur
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Oil and Grease - Soil (029)
ED-TM-1131; modified from SM 5520
GRAVIMETRIC - EXTRACTION
Oil and Grease

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2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol
3-Methylphenol (m-Cresol)
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methylphenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
4-Nitrophenol
4,6-Dinitro-2-methylphenol
Pentachlorophenol
Phenol

Solids (Organic)
Polychlorinated Biphenyls (PCB) - Soil (097)
ED-TM-1103; modified from EPA 3550 and EPA 8082
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Solids (Organic)
Sulfolane - Soil (204)
ED-TM-1115; modified from EPA 3540 AND EPA 1625
GC/MS - EXTRACTION
Sulfolane

Solids (Organic)
Volatile Organic Compounds (VOC) - Soil (167)
ED-TM-1111, NA-TM-1102; modified from EPA 5021 and EPA 8260
GC/MS - HEADSPACE/EXTRACTION
1,1-Dichloroethane
1,1-dichloroethylene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
1,2-dichlorobenzene
1,2-dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene

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The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-dichlorobenzene
2-Chlorotoluene
2-Hexanone
2,2-Dichloropropane
4-Chlorotoluene
Acetone (2-Propanone)
Acrylonitrile
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon Disulphide
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
cis-1,4-Dichloro-2-Butene
Dibromomethane
Dichlorodifluoromethane
Dichloromethane
Ethyl Alcohol
Ethyl Methacrylate
Ethylbenzene
Ethylene Dibromide
Hexachlorobutadiene
Isopropylbenzene
m/p-xylene
Methyl Ethyl Ketone
Methyl Iodide
Methyl isobutyl Ketone
n-butylbenzene
n-propylbenzene
Naphthalene
o-xylene
p-Isopropyltoluene
sec-butylbenzene
Styrene
tert-butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trans-1,4-Dichloro-2-Butene

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride

Swab (Inorganic)
Mercury - Swabs (211)
ED-TP-2004, NA-TM-1005; modified from EPA 3050 B AND EPA 245.1
COLD VAPOUR AA - DIGESTION
Mercury

Swab (Inorganic)
Metals - Swabs (201)
ED-TP-2004, NA-TM-1002; modified from EPA 200.2 & EPA 6020
ICP/MS - EXTRACTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Strontium
Tin
Vanadium
Zinc

Swab (Organic)
Polychorinated Biphenyls (PCB) - Swabs (202)
ED-TM-1102; modified from EPA 3550 AND EPA 8082
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCBs

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Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride

Swab (Inorganic)
Mercury - Swabs (211)
ED-TP-2004, NA-TM-1005; modified from EPA 3050 B AND EPA 245.1
COLD VAPOUR AA - DIGESTION
Mercury

Swab (Inorganic)
Metals - Swabs (201)
ED-TP-2004, NA-TM-1002; modified from EPA 200.2 & EPA 6020
ICP/MS - EXTRACTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Strontium
Tin
Vanadium
Zinc

Swab (Organic)
Polychorinated Biphenyls (PCB) - Swabs (202)
ED-TM-1102; modified from EPA 3550 AND EPA 8082
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCBs

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Waste (Inorganic)
Metals - TCLP Leachate - Waste (141)
NA-TM-1002, NA-TM-1700; EPA 1311 (LEACH) and modified from EPA 6020 (ANALYSIS)
ICP/MS - TCLP
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Nickel
Selenium
Silver
Thallium
Uranium
Vanadium
Zinc
Zirconium

Waste (Inorganic)
Specific Gravity - Waste (174)
ED-TM-1025; modified from ASTM D5057
GRAVIMETRIC
Specific Gravity

Waste (Organic)
BTEX - TCLP Leachate - Waste (135)
ED-TP-2005, NA-TM-1103; EPA 1311 (LEACH) and modified from EPA 8260B (ANALYSIS)
GC/MS - TCLP
Benzene
Ethylbenzene
m/p - xylene
o-xylene
Toluene

Water (Inorganic)
Acidity - Water (206)
ED-TM-1049; modified from APHA 2310
TITRATION
Acidity

Water (Inorganic)
Acidity - Water (212)
ED-TM-1049; modified from APHA 2310
TITRATION - POTENTIOMETRIC
Acidity

Water (Inorganic)
Alkalinity - Water (004)
ED-TM-1026; modified from SM 2320 B
TITRIMETRIC
Alkalinity (pH 4.5)
Alkalinity (pH 8.3)

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Water (Inorganic)
Ammonia - Water (178)
ED-TM-1016; modified from SM 4500 NH3
COLORIMETRIC
Ammonia

Water (Inorganic)
Ammonia - Water (213)
ED-TM-1024; modified from EPA METHOD 350.1
COLORIMETRIC
Ammonia

Water (Inorganic)
Anions - Water (005)
NA-TM-1001; modified from EPA 300.1
ION CHROMATOGRAPHY
Bromide
Chloride
Fluoride
Nitrate
Nitrite
Sulfate

Water (Inorganic)
Biochemical Oxygen Demand (BOD) - Water (013)
ED-TM-1007, ED-TM-1037; modified from SM 5210B
D.O. METER
BOD (5 day)
BODu (ultimate)
CBOD (5 day)

Water (Inorganic)
Carbon - Water (118)
ED-TM-1002; modified from SM 5310 B
IR - COMBUSTION
Inorganic Carbon
Organic Carbon
Total Carbon (TC)

Water (Inorganic)
Chemical Oxygen Demand (COD) - Water (051)
ED-TM-1009; modified from SM 5220 D
COLORIMETRIC - DIGESTION
COD

Water (Inorganic)
Chlorine - Water (123)
ISOP 134; modified from SM 4500 CL-A,F,G
COLORIMETRIC
Free Chlorine
Total Chlorine

Water (Inorganic)
Colour - Water (152)
ED-TM-1038; modified from SM 2120 A, C
SPECTROPHOTOMETRIC
True Colour

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Water (Inorganic)
Colour (Automated) - Water (199)
ED-TM-1052; modified from SM 2120 A, C
COLORIMETRIC
True Colour

Water (Inorganic)
Conductivity - Water (006)
ED-TM-1026; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity (25˚C)

Water (Inorganic)
Dissolved Metals - Water (007)
NA-TM-1002, NA-TP-2002; modified from EPA 6020
ICP/MS
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Iron
Lead Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

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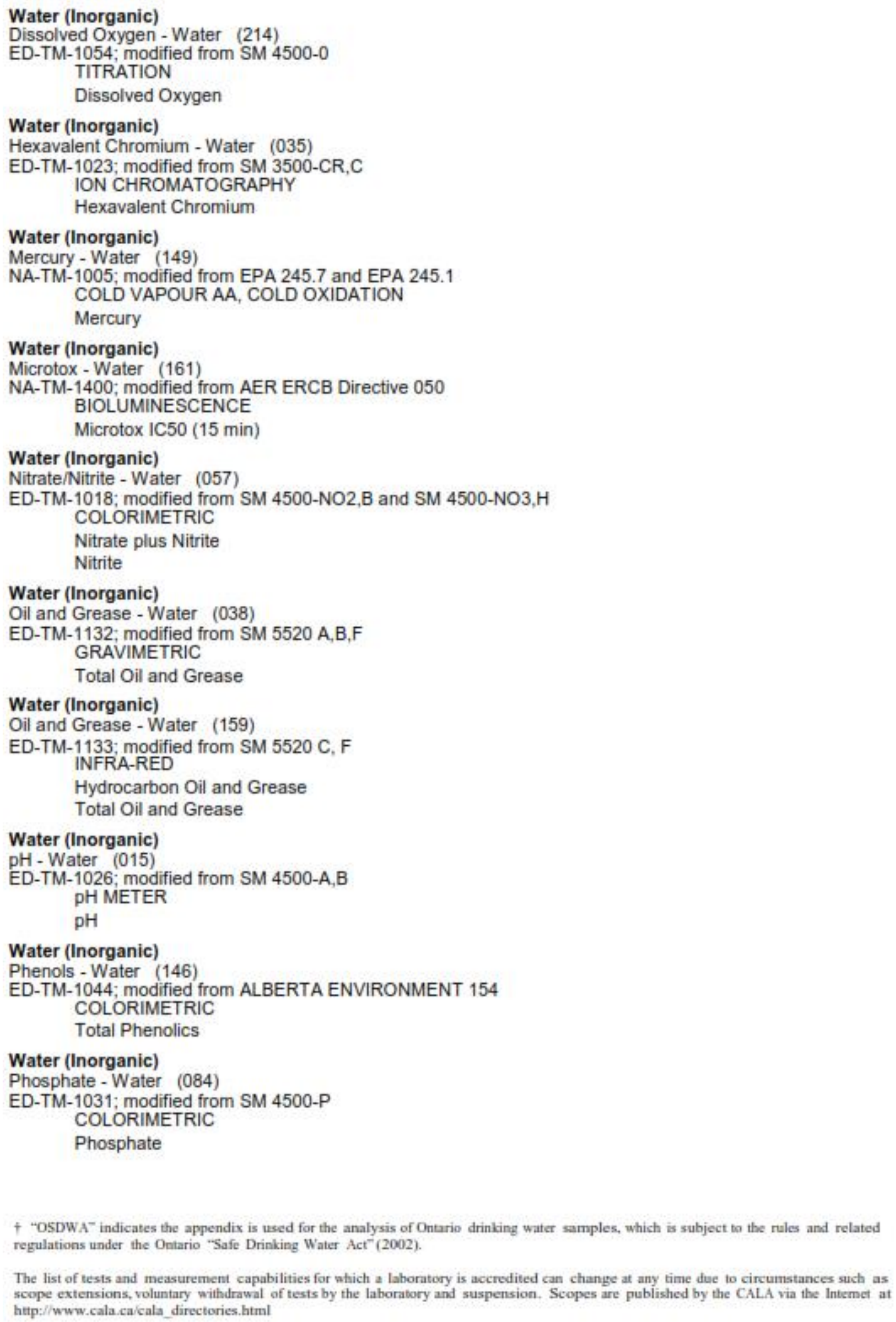

Water (Inorganic)
Dissolved Oxygen - Water (214)
ED-TM-1054; modified from SM 4500-0
TITRATION
Dissolved Oxygen

Water (Inorganic)
Hexavalent Chromium - Water (035)
ED-TM-1023; modified from SM 3500-CR,C
ION CHROMATOGRAPHY
Hexavalent Chromium

Water (Inorganic)
Mercury - Water (149)
NA-TM-1005; modified from EPA 245.7 and EPA 245.1
COLD VAPOUR AA, COLD OXIDATION
Mercury

Water (Inorganic)
Microtox - Water (161)
NA-TM-1400; modified from AER ERCB Directive 050
BIOLUMINESCENCE
Microtox IC50 (15 min)

Water (Inorganic)
Nitrate/Nitrite - Water (057)
ED-TM-1018; modified from SM 4500-NO2,B and SM 4500-NO3,H
COLORIMETRIC
Nitrate plus Nitrite
Nitrite

Water (Inorganic)
Oil and Grease - Water (038)
ED-TM-1132; modified from SM 5520 A,B,F
GRAVIMETRIC
Total Oil and Grease

Water (Inorganic)
Oil and Grease - Water (159)
ED-TM-1133; modified from SM 5520 C, F
INFRA-RED
Hydrocarbon Oil and Grease
Total Oil and Grease

Water (Inorganic)
pH - Water (015)
ED-TM-1026; modified from SM 4500-A,B
pH METER
pH

Water (Inorganic)
Phenols - Water (146)
ED-TM-1044; modified from ALBERTA ENVIRONMENT 154
COLORIMETRIC
Total Phenolics

Water (Inorganic)
Phosphate - Water (084)
ED-TM-1031; modified from SM 4500-P
COLORIMETRIC
Phosphate

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Water (Inorganic)
Phosphates (Low) - Water (183)
ED-TM-1018; modified from SM 4500-P
COLORIMETRIC - TECHNICON
Phosphate

Water (Inorganic)
Phosphorus - Water (011)
ED-TM-1031; modified from SM 4500-P,B,E
COLORIMETRIC - DIGESTION
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Phosphorus - Water (119)
ED-TM-1031, ED-TP-2006; modified from SM 4500-A B, E
COLORIMETRIC
Inorganic Phosphorus

Water (Inorganic)
Phosphorus - Water (184)
ED-TM-1019; modified from SM 4500, P, B, E
COLORIMETRIC - TECHNICON
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Reactive Silica - Water (200)
ED-TM-1053; modified from SM 4500-SIO2 A, E
COLORIMETRIC
Reactive Silica

Water (Inorganic)
Solids - Water (012)
ED-TM-1005; modified from SM 2540 A, B, C, D, E
GRAVIMETRIC
Fixed Suspended Solids
Total Dissolved Solids
Total Suspended Solids
Volatile Suspended Solids

Water (Inorganic)
Sulfide - Water (033)
ED-TM-1001; modified from SM 4500-S2 A, D,E
COLORIMETRIC
Sulfide

Water (Inorganic)
Total Kjeldahl Nitrogen (TKN) - Water (010)
ED-TM-1017, ED-TP-2021; modified from EPA 351.2
COLORIMETRIC - DIGESTION
Dissolved Kjeldahl Nitrogen
Total Kjeldahl Nitrogen

Water (Inorganic)
Total Metals - Water (082)
NA-TM-1002, NA-TP-2001; modified from EPA 6020 and SM 3030 E
ICP/MS - DIGESTION
Aluminum
Antimony

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Water (Inorganic)
Phosphates (Low) - Water (183)
ED-TM-1018; modified from SM 4500-P
COLORIMETRIC - TECHNICON
Phosphate

Water (Inorganic)
Phosphorus - Water (011)
ED-TM-1031; modified from SM 4500-P,B,E
COLORIMETRIC - DIGESTION
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Phosphorus - Water (119)
ED-TM-1031, ED-TP-2006; modified from SM 4500-A B, E
COLORIMETRIC
Inorganic Phosphorus

Water (Inorganic)
Phosphorus - Water (184)
ED-TM-1019; modified from SM 4500, P, B, E
COLORIMETRIC - TECHNICON
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Reactive Silica - Water (200)
ED-TM-1053; modified from SM 4500-SIO2 A, E
COLORIMETRIC
Reactive Silica

Water (Inorganic)
Solids - Water (012)
ED-TM-1005; modified from SM 2540 A, B, C, D, E
GRAVIMETRIC
Fixed Suspended Solids
Total Dissolved Solids
Total Suspended Solids
Volatile Suspended Solids

Water (Inorganic)
Sulfide - Water (033)
ED-TM-1001; modified from SM 4500-S2 A, D,E
COLORIMETRIC
Sulfide

Water (Inorganic)
Total Kjeldahl Nitrogen (TKN) - Water (010)
ED-TM-1017, ED-TP-2021; modified from EPA 351.2
COLORIMETRIC - DIGESTION
Dissolved Kjeldahl Nitrogen
Total Kjeldahl Nitrogen

Water (Inorganic)
Total Metals - Water (082)
NA-TM-1002, NA-TP-2001; modified from EPA 6020 and SM 3030 E
ICP/MS - DIGESTION
Aluminum
Antimony

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Water (Microbiology)
Heterotrophic Plate Count (HPC) - Water (198)
NA-TM-1300; modified from SM 9215 E
- MOST PROBABLE NUMBER (QUANTI-TRAY)
  - Heterotrophic Plate Count (HPC)

Water (Organic)
Alkanolamines - Water (209)
ED-TM-1155; modified from "QUANTITATIVE ANALYSIS OF AMINO ACIDS" T. NASHOLM, G. SANDLBERG AND A. ERICSSON. J. CHROMATOGRAM. 396:225-236 (1987)
- HPLC - EXTRACTION
  - DEA (Diethanolamine)
  - DIPA (Diisopropanolamine)
  - MEA (Monoethanolamine)
  - MIPA (Monoisopropanolamine)

Water (Organic)
Base Neutral Extractables - Water (117)
ED-TM-1124; modified from EPA 3510 and EPA 8270
- GC/MS - EXTRACTION
  - 1,2,3-Trichlorobenzene
  - 1,2,4-Trichlorobenzene
  - 2-Chloronaphthalene
  - 2,4-Dinitrotoluene
  - 2,6-Dinitrotoluene
  - Hexachlorobenzene
  - Hexachlorobutadiene
  - Hexachlorocyclopentadiene
  - Hexachloroethane
  - Pentachlorobenzene

Water (Organic)
Chlorophenols - Water (019)
ED-TM-1108; modified from EPA 1653 and ALBERTA ENVIRONMENT 130.0
- GC/MS - EXTRACTION
  - 2-Chlorophenol
  - 2-Chlorosyringaldehyde
  - 2,4,5-Trichlorophenol
  - 2,6-Dichlorophenol
  - 2,6-Dichlorosyringaldehyde
  - 3,4-Dichlorocatechol
  - 3,4-Dichloroguaiacol
  - 3,4,5-Trichlorocatechol
  - 3,4,5-Trichloroguaiacol
  - 3,4,5-Trichloroveratrole
  - 3,4,6-Trichlorocatechol
  - 3,4,6-Trichloroguaiacol
  - 3,5-Dichlorocatechol
  - 3,6-Dichlorocatechol
  - 4-Chlorocatechol
  - 4-Chloroguaiacol
  - 4-Chlorophenol
  - 4,5-Dichlorocatechol
  - 4,5-Dichloroguaiacol
  - 4,5-Dichloroveratrole
  - 4,5,6-Trichloroguaiacol

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4,5,6-Trichlorosyringol
4,6-Dichloroguaiacol
5-Chlorovanillin
5,6-Dichlorovanillin
6-Chlorovanillin
Tetrachlorocatechol
Tetrachloroguaiacol
Tetrachloroveratrole
Trichlorotrimethoxybenzene

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (075)
NA-TM-1110; modified from EPA 3511
GC/FID - EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50
TEH (C11-C30)

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (165)
NA-TM-1103; modified from EPA 5021 and EPA 8260
GC/FID - HEADSPACE
F1: C6-C10
VH: C6-C10

Water (Organic)
Phenols - Water (076)
ED-TM-1114; modified from EPA 8270 and EPA 3510
GC/MS - EXTRACTION
2-Chlorophenol
2-Methylphenol (o-Cresol)
2-Nitrophenol
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4 & 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4,5-Trichlorophenol
2,4,6-trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol
3-Methylphenol (m-Cresol)
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methylphenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
4-Nitrophenol
4,6-Dinitro-2-methylphenol

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Pentachlorophenol
Phenol

Water (Organic)
Polychlorinated Biphenyls (PCB) - Water (096)
ED-TM-1136; modified from EPA 3510 and EPA 8082
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Water (Organic)
Resin and Fatty Acids - Water (020)
ED-TM-1106; modified from ALBERTA ENVIRONMENT 129.0
GC/MS - EXTRACTION
12-Chlorodehydroabietic Acid
12,14-Dichlorodehydroabietic Acid
14-Chlorodehydroabietic Acid
9,10-Dichlorostearic Acid
Abietic Acid
Arachidic Acid
Dehydroabietic Acid
Isopimaric Acid
Levopimaric Acid
Linoleic Acid
Linolenic Acid
Myristic Acid
Neoabietic Acid
Oleic Acid
Palmitic Acid
Palustric Acid
Pimaric Acid
Sandaracopimaric Acid
Stearic Acid

Water (Organic)
Resin and Fatty Acids - Water (132)
ED-TM-1106; modified from ALBERTA ENVIRONMENT 129.0
GC/MS - EXTRACTION (RFA-Low ED)
12-Chlorodehydroabietic acid
12,14-Dichlorodehydroabietic acid
14-Chlorodehydroabietic acid
9,10-Dichlorostearic acid
Abietic acid
Arachidic acid
Dehydroabietic Acid
Isopimaric acid
Levopimaric acid
Linoleic Acid

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Linolenic Acid
Myristic acid
Neoabietic acid
Oleic Acid
Palmitic Acid
Palustric acid
Pimaric acid
Sandaracopimaric acid
Stearic Acid

Water (Organic)
Sulfolane - Water (203)
ED-TM-1115; modified from EPA 3510 AND EPA 1625
GC/MS - EXTRACTION
Sulfolane

Water (Organic)
Volatile Organic Compounds (VOC) - Water (166)
NA-TM-1102; modified from EPA 5021 and EPA 8260
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-dichloroethylene
1,1-dichloropropene
1,1,1-Trichloroethane
1,1,1,2-tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-dibromo-3-chloropropane
1,2-dichlorobenzene
1,2-dichloroethane
1,2-Dichloropropane
1,2,3-trichlorobenzene
1,2,3-Trichloropropane
1,2,4-trichlorobenzene
1,2,4-trimethylbenzene
1,3-Dichlorobenzene
1,3-dichloropropane
1,3,5-trimethylbenzene
1,4-dichlorobenzene
2-chlorotoluene
2-Hexanone
2,2-dichloropropane
4-chlorotoluene
Acetone (2-Propanone)
Acrylonitrile
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon Disulphide
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane

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Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
cis-1,4-Dichloro-2-Butene
Dibromomethane
Dichlorodifluoromethane
Dichloromethane
Ethyl Alcohol
Ethyl Methacrylate
Ethylbenzene
Ethylene Dibromide
hexachlorobutadiene
Isopropylbenzene
m/p-xylene
Methyl Ethyl Ketone
Methyl Iodide
Methyl isobutyl Ketone
n-butylbenzene
n-propylbenzene
naphthalene
o-xylene
p-isopropyltoluene
Sec-butylbenzene
Styrene
Tert-butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trans-1,4-Dichloro-2-Butene
Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride

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QUALITY ASSURANCE AND QUALITY CONTROL PLAN

MODULE A: 2AM-DOH1323 (DORIS)

CONFORMITY TABLE

Licence	Part	Item	Topic	Report Section
	B	7.	The Licensee shall update for submission to the Board for review as required under the relevant sections in the Amended Licence, the following management plans: a. Quality Assurance and Quality Control Plan	This plan
	J	4.	Water quality monitoring shall be carried out in accordance with the Quality Assurance/Quality Control Plan, approved by an Analyst and submitted to the Board as per Part K, Item 2.	This plan
		5.	The Licensee, in consultation with an Inspector, shall establish the locations and GPS coordinates for all monitoring stations referred to in Schedule J.	Table A1 and Figure A1
		9.	All analyses shall be conducted as described in the most recent edition of “Standard Methods for the Examination of Water and Wastewater” or by other such methods approved by an Analyst.	Sections 2 and 3
		10.	All compliance analyses shall be performed in an accredited laboratory according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	Section 5
	K	1.	The Board is in receipt of the plan HOPE BAY MINING LTD., Quality Assurance and Quality Control Plan, 2AM-DOH0713, 2BB-BOS0712, 2BE-HOP1222, HB-QA-ENV-MP-001, November 2012 (REV 7.1) that was found to be acceptable to an Analyst by letter dated November 22, 2012.	N/A
		2.	The Licensee shall submit to the Board for review, at least three (3) months prior to Operations, a Quality Assurance / Quality Control Plan that includes a cover letter from the accredited laboratory confirming approval of the Plan for analyses to be performed under this Licence. The QA/QC Plan shall be prepared and updated as needed in accordance with and in consultation with the accredited laboratory conducting the analyses. This Plan shall be developed in accordance with current Standard Methods and the 1996 Quality Assurance (QA) and Quality Control (QC) Guidelines for Use by Class “A” (INAC).	This report
		3.	The Licensee shall annually review the approved QA/QC Plan and modify the Plan as necessary. Proposed changes shall be submitted to an Accredited Laboratory for approval.	Section 1.4

A1. INTRODUCTION

The Type A Water Licence No. 2AM-DOH1323 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program.

A2. SNP SAMPLING STATIONS

Table A1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the Surveillance Network Program for water licence 2AM-DOH1323. The location of each sampling point is illustrated in Figure A1 below.

Table A1. 2AM-DOH1323 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
ST-1	Sedimentation Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-2	Pollution Control Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-3	Discharge from Non-hazardous Landfill pollution control sump	Construction, Care and Maintenance, Operation, Closure	G, MT and Total Ammonia-N, Total Sulphate, Total and Free CN, Total Oil and Grease	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-4	Discharge from Landfarm sump	Construction, Operation, Care and Maintenance, Closure	G, HC, total Ammonium, total Lead	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-5	Discharge from the Plant Site Fuel Storage and Containment Area Sump	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-6a and ST-6b	Discharge from the Roberts Bay Fuel Storage and Containment Area Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-7	Freshwater pumped from Doris Lake	Construction, Operation, Care and Maintenance, and Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl	Monthly during periods pumping
			D	Monthly during periods of pumping
			Cl-*a*	Annually
ST-7a	Freshwater pumped from the Windy Lake freshwater intake	Construction, Operation, Care and Maintenance, Closure	G, N1, N2, MT and, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, T-Ca, and Total Oil and Grease	Monthly during periods of pumping
			B	

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
			D	
ST-8	Discharge from Wastewater Treatment Plant bio-membrane	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when discharge to the Tundra, Annually when discharge to the TIA
			Location of discharge	Monthly during periods of discharge
			D	Daily during periods of discharge
ST-9	Runoff from Wastewater Treatment Plant discharge - downstream of wastewater treatment plant discharge point and just prior to flow entering Doris Lake	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when discharged to the tundra
ST-10	Site Runoff from Sediment Controls	Construction, Operations, Closure	TSS or Turbidity (following development and approval of a site-specific TSS-Turbidity)	Daily during periods of discharge
ST-11	Reagent and Cyanide Storage Facility Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC , MT, Total Ammonia, Total and Free Cyanide, and D	Annually
ST-12	Doris Lake	Operation, Closure	Water Level	Monthly
			Ice Thickness	Annually in April
ST-13	Pollution Control Pond associated to Pad U	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
TL-1	TIA at the Reclaim Pipeline	Operation, Care and Maintenance, Closure, Post Closure (for up to nine (9) years after cessation of mining)	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr,T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, HC, FC	Monthly during Operations, Closure and Post Closure. Annually during Care and Maintenance.
			Dissolved Oxygen and Redox Potential	Annually
			Acute Lethality	Annually during Post-Closure
			B	Annually
TL-2	Doris Outflow Creek - upstream (at the flow monitoring station adjacent to the bridge)	Closure, Post Closure (for up to nine (9) years after cessation of mining)	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Oil and Grease	Annually during Care and Maintenance Annually for 2 years prior to Post-Closure, and during Post-Closure, Increase to three times per year (under ice, freshet, and pre-freeze up), two years prior to breach of the North Dam.
		Operation	D	Daily upon commencement of mining in or beneath the Doris Lake Talik.

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
TL-3	Doris Outflow Creek (~80m downstream of the base of the waterfall)	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Total Oil and Grease	Inactive
			D	
TL-4	TIA Discharge End-of-Pipe	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226	Inactive
			Acute Lethality	
			B	
			D	
TL-5	Effluent from Process Plant (tailings slurry/ water)	Operations	G, N1, MT, and Free CN, Total CN, WAD CN, Sulphate, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, and Total Metals by ICP-MS	Quarterly
			Cyanate and Thiocyanate	
TL-6	Tailings Discharged into TIA (Solid Component) taken from a valve in the mill at the discharge end of the mill tailings pumps	Operations	Tonnage of dry tailings solids	Monthly during periods of discharge
			MT and T-Cd, T-Cr, T-Hg, T-Mo, T-Se, Total Inorganic Carbon and Total Metals by ICP-MS (must include Sulphur)	Sampled on a weekly basis with analyses carried out monthly on a composite sample of the TL-6 weekly samples
TL-7	Detoxified tailings sent underground as backfill	Operations	Dry tonnage of detoxified tailings sent underground; WAD CN, Total Inorganic Carbon, Total Metals by ICP-MS (including Sulphur), Moisture content of backfill trucked underground	Monthly
			Cyanate and Thiocyanate	Quarterly
TL-8	Reclaim water pumped from TIA to Mill Process water tank taken from a valve at the discharge end of the reclaim water pump	Inactive		Inactive
TL-9	Detox tailings reactor tank (650-TK-565)	Operations	Continuous automated monitoring. Should the automatic monitor used to carry out this measurement be out of service manual samples from the detox filter feed pumps (650-PU-567/568) will be used to verify process operations.	

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
TL-10	Water Column in deepest portion of Tail Lake and at a location away from the TIA Reclaim water floating pump house, sampled at surface, mid- depth and near bottom.	Inactive		Inactive
TL-11	Seepage from underground backfilled stopes	Operations	Visual inspection for seepage. If seepage present parameters to be monitored include N1 and pH, EC, Trace metals by ICP-MS, Alkalinity, Acidity, Sulphate, Total and WAD CN	Survey Twice annually
TL-12	Mine Water Discharge Point	Operations during continuous pumping	Chloride, TDS and nitrate	Weekly
			Total Ammonia, Nitrate, Nitrite, pH, EC, ICPMS Metals, alkalinity, sulphate, TSS, major ions and Total and WAD Cyanide	Monthly
			D	Daily during periods of discharge

Figure A1. 2AM-DOH1323 Sample Stations Locations

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

MODULE B: 2BE-HOP1222 (WINDY)

CONFORMITY TABLE

Licence	Part	Item	Topic	Report Section
2BE-HOP1222	J	14.	The Licensee shall implement the Hope Bay Mining Limited, Quality Assurance and Quality Control Plan R5, for the Windy Lake Camp and the Patch Lake Fuel Farm Area, dated December 31, 2010, prepared in accordance with the INAC document "Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field, 1996" approved by an Analyst on July 4, 2011.	
		15.	The Licensee shall annually review the approved Quality Assurance/Quality Control plan and modify it as necessary. Proposed modifications shall be submitted to an Analyst for approval.	Section 1.4
		16.	The approved Quality Assurance/Quality Control Plan shall be submitted to the Board for review and implemented as approved by an Analyst.	This plan
		17.	All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater, or by such other methods approved by the Board.	Sections 2 and 3
		18.	All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	Section 5

B1. INTRODUCTION

The Type B Water Licence No. 2BE-HOP1222 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program. Windy Camp and the Patch Lake Laydown facility are no longer in use; therefore, sampling stations associated with camp operations and fuel storage facility are not being used or monitored. There are currently no active sampling stations at Windy Camp or Patch Lake. Water drawn from Windy Lake for domestic use at Doris Camp is monitored under the 2AM-DOH1323 Licence SNP Station ST-7A.

B2. SNP SAMPLING STATIONS

Table B1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the Surveillance Network Program for water licence 2BE-HOP1222. The location of each sampling point is illustrated in Figure B1 below.

Table B1. 2BE-HOP1222 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
HOP-1	Raw water supply intake at Windy Lake	B, G, Oil and Grease	Monthly (when in use for Doris)
		D	Daily during periods of pumping
HOP-2*	WWTF effluent discharge at the surge tank prior to being pumped over the ridge east of the Windy Camp Facilities	G, B, MT, Oil and Grease	Monthly
		D	Daily during periods of discharge
HOP-3*	WWTF effluent at a point of entry into Windy lake	G, B, Oil and Grease	Monthly
		Acute Lethality	Annually
		D	Daily during periods of discharge
HOP-4*	Effluent from the Landfarm Treatment Facility pumped to the WWTF surge tank	B, G, Oil and Grease	Once before any discharge, daily when discharging onto the tundra
		D	Daily during periods of discharge
HOP-5*	Effluent from the Bulk Fuel Storage Facility located at the Windy Camp, prior to release	G, MT, HC, TPH, PAH, Nitrate, Nitrite, Total Phenols, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-6*	Effluent from the Bulk Fuel Storage Facility located at the Patch Lake location, prior to release to a location approved by an Inspector	G, MT, HC, Oil and Grease Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-7A, B and D	Discharge from Quarries A, B and D respectively	G, N1, MT, Total Sulphate, Alkalinity, Oil and Grease, Electrical Conductivity and Reduction potential (Eh)	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-8*	Effluent from the Bulk Fuel Storage Facility located at the new Windy Camp location, prior to release to a location approved by an Inspector	G, MT, HC, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
Drill Sites	Under-ice sampling before and after drilling	G, MT, Electrical Conductivity, Oil and Grease	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

*Station not in use at this time

Figure B1. 2BE-HOP1222 Sample Stations Locations

TMAC RESOURCES

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

MODULE C: 2BB-BOS1217 (BOSTON)

CONFORMITY TABLE

Licence	Part	Item	Topic	Report Section
2BB-BOS1217	J	15.	The Licensee shall submit to an analyst for approval, within three (3) months of the issuance of the Licence, a revised Quality Assurance and Quality Control Plan. The plan shall include analysis of field blanks and certified reference material, and replicate sampling in order to assess accuracy, precision and field contamination.	
		16.	The Licensee shall annually review the approved Quality Assurance/Quality Control plan of Part J, Item 15 and modify it as necessary. Proposed modifications shall be submitted to an Analyst for approval.	Section 1.4
		17.	All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater, or by such other methods approved by the Board.	Sections 2 and 3
		18.	All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	Section 5

C1. INTRODUCTION

The Type B Water Licence No. 2BB-BOS1217 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program.

C2. SNP SAMPLING STATIONS

Table C1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the Surveillance Network Program for water licence 2BB-BOS1217. The location of each sampling point is illustrated in Figure C1 below.

Table C1. 2BB-BOS1217 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
BOS-1*	Raw water supply intake at Aimaokatalok (Spyder) Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
BOS-2	Containment Pond discharge	G, T-Arsenic, T-Copper, T-Lead, T-Nickel, T-Zinc, Oil and Grease	Prior to discharge, weekly during periods of discharge, and once near the end of discharge
		D	Daily during periods of discharge
BOS-3*	Sewage Disposal Facility final discharge	B, G, Oil and Grease	Monthly
		D	Daily during periods of discharge
BOS-4*	Treated sewage effluent point prior to entry into Aimaokatalok (Spyder) Lake	B, G, Oil and Grease	Once before any discharge, daily when discharging onto the tundra
		Acute Lethality	Annually
BOS-5	Effluent from the Bulk Fuel Storage Facility prior to release to a location approved by an Inspector	G, MT, HC, T-Mercury, Total Petroleum Hydrocarbons, PAH, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium, Nitrate-Nitrite, Electrical Conductivity	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
BOS-6	Effluent from the Landfarm Treatment Facility prior to release	G, MT, HC, T-Mercury, Total Petroleum Hydrocarbons, PAH, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium, Nitrate-Nitrite, Electrical Conductivity	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
BOS-7*	Landfill leachate (seepage from former waste pit)	G, MT, HC, T-Mercury, Total Petroleum Hydrocarbons, PAH, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium, Nitrate-Nitrite, Electrical Conductivity	During periods of observed flow
BOS-8	Waste Rock and Ore Storage Pad	G, ICP-MS, HC, Electrical Conductivity, Total Ammonia, Sulphate	Initially during spring thaw and monthly during periods of observed flow
Drill Sites	Under-ice sampling before and after drilling	G, ICP-MS, T-Arsenic, T-Mercury, Electrical Conductivity, Total Ammonia, Sulphate	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

*Station not in use at this time

Figure A1. 2BE-HOP1222 Sample Stations Locations