

Section 3D

QAQC Plan

v1 January 2009



MEADOWBANK GOLD PROJECT

Quality Assurance / Quality Control (QA/QC) Plan

In Accordance with Water License 2AM-MEA0815

Prepared by:
Agnico-Eagle Mines Limited – Meadowbank Division

Version 1
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EXECUTIVE SUMMARY

This document presents the Meadowbank Mine Quality Assurance / Quality Control (QA/QC) Plan, a requirement of the Meadowbank Type A Water License No. 2AM-MEA0815, specified under Part I, Condition 19:

The Licensee shall submit within six (6) months of Licence approval to an Analyst for approval, a Quality Assurance/ Quality Control Plan that includes requirements for independent third party sampling and analysis. This Plan shall be developed in accordance with the 1996 Quality Assurance (QA) and Quality Control (QC) Guidelines for Use by Class "A" (INAC).

This Plan also supports the following conditions of the Meadowbank Project Certificate No. 004, issued by the Nunavut Impact Review Board (NIRB):

Condition 6

All monitoring information collected pursuant to regulatory requirements for the Meadowbank Project shall contain the following information:

- a. The person(s) who performed the sampling or took the measurements including any accreditations;*
- b. The date, time and place of sampling or measurement, and weather conditions;*
- c. Date of analysis;*
- d. Name of the person(s) who performed the analysis including accreditations;*
- e. Analytical methods or techniques used; and*
- f. Results of any analysis.*

Condition 23

For the purposes of monitoring quality assurance and quality control ("QA/QC").... ensure that water quality monitoring performed at locations within receiving waters that allow for an assimilative capacity assessment of concern to regulators, be carried out by an independent contractor and submitted to an independent accredited lab for analysis, on a type and frequency basis as determined by the NWB. Results of analysis shall be provided to the NWB and NIRB's Monitoring Officer.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA0815, Part B, Item 16, the proposed implementation schedule for this Plan is outlined below.

This Plan will be immediately implemented (January 2009) subject to any modifications proposed by the Analyst or the NWB as a result of the review and approval process.

DISTRIBUTION LIST

AEM – Environment Superintendent

AEM – Environmental Coordinator

AEM – Environmental Technician

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	09/01/01			Comprehensive plan for Meadowbank Project

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SECTION 1 • INTRODUCTION

The Quality Assurance and Quality Control (QA/QC) program is designed to identify and minimize the impacts of potential sampling and analytical errors in the monitoring program. This Plan documents the QA/QC program for the Meadowbank Project required by Type A Water License 2AM-MEA0815. It has been developed in accordance with the Indian and Northern Affairs Canada (INAC) 1996 'Guidelines For Use By Class "A" Licensees in Meeting SNP Requirements And For Submission Of A QA/QC Plan', which includes the following definitions:

Quality Assurance: the system of activities designed to better ensure that quality control is done effectively, and

Quality Control: the use of established procedures to achieve standards of measurement for the three principal components of quality – precision, accuracy and reliability.

This QA/QC Plan sets out standard procedures for sample and data collection with respect to surface water and groundwater sampling in support of monitoring programs outlined in the *Water Quality and Flow Monitoring Plan*, *Groundwater Monitoring Plan* and *Aquatic Effects Management Plan (AEMP)*. The QA/QC plan will be reviewed annually and updated as required by the Environment Superintendent.

Section 2 includes procedures for field sample collection and handling, Section 3 outlines external and internal laboratory requirements and Section 4 sets out data verification procedures and regulatory reporting requirements.

SECTION 2 • FIELD SAMPLING

Sampling stations, frequency and parameters are set out in Type A Water License 2AM-MEA0815 Schedule I – Conditions Applying to General and Aquatic Effects Monitoring (Appendix A)¹. The following sections outline the standard procedures for collection and handling of all surface water and groundwater samples.

2.1 SAMPLING EQUIPMENT

New or clean laboratory-supplied containers are used for sample collection. The bottles are constructed of either polyethylene plastic or glass, dependent on the specific parameter being analyzed.

The YSI 556 MPS (multiprobe system) handheld instrument is used to collect pH, temperature, conductivity, dissolved oxygen and oxidation reduction potential (ORP) data as required. The instrument should be calibrated before each *sample event* to ensure high performance. Calibration procedures are set out by the YSI 556 Operation Manual.

Following purging, a portable low-flow double valved pump will be used to collect groundwater samples. A whale pump, Van Dorn sampler (i.e. Beta Bottle) or similar equipment will be used to collect water samples at depth from the surrounding lake receiving environments. Low Density Poly Ethylene (LDPE) tubing, filter apparatus, manual pump and ashless filter paper are used to filter water for specific analyses (i.e. dissolved metals, chlorophyll a) and/or for depth integrated sampling (ie chlorophyll a, phytoplankton or Biological Oxygen Demand).

2.2 SAMPLING METHODS AND HANDLING

2.2.1 Sample Identification

All samples are given a unique sample identification number based on a station identifier. To ensure there is no identifier duplication, each sampler will be given a set series of sample numbers prior to each sampling event to accommodate the required number of water samples, duplicates and blanks. The sample identification number, date and time will be maintained on the field sheet and once entered into the database, integrity functions will disallow the entry of a duplicate sample number.

All sample bottles will be identified with the station number, sample number, time and date of collection, initials of the sampler and parameters to be tested. This information will be marked on a label with a water resistant pen and affixed to the sample bottle.

¹ Refer to Water Quality Flow and Management Plan, Section 2.3 for more detailed description of station locations. The actual location of each sampling site will be marked with a highly visible stake with appropriate signage attached that will define the exact location of the collection point.

2.2.2 Surface Water Sampling

The bottles will be pre-labelled with the required sample identification. Surface grab samples will be collected by submerging the sample bottle to half depth of the stream, or for sumps, diversion ditches and piped discharge points, to below the surface of the water. Sample bottles are commonly provided by the lab. For parameters that require it, bottles are received pre-rinsed and pre-preserved or pre-rinsed with preservative containing vials that are added at the end of sampling. In the case that bottles are not pre-preserved, bottles will be rinsed three times with sample water before filling. When it applies, preservatives will be added after filling as directed by the laboratory; see section 2.2.4 for more detail on preservation.

Samples analyzed for dissolved metals and chlorophyll A are filtered through ashless filter paper at the time of collection.

2.2.3 Groundwater Sampling

Well Preparation for Sampling

At the time of purging and sampling the heat trace cables are activated to warm the well pipe. Once the new well has been warmed up the pneumatic valve inside the well pipe is deflated to allow groundwater to flow into the well pipe.

Well Purging

The well is then purged to remove standing water inside the well and to induce the flow of fresh groundwater from the rock formation. Purging is done by lowering a portable double valve sampling pump (DVP) into the well pipe to approximately 10 to 20 meters above the top of the screened interval and activating the DVP. The pump is activated by pumping compressed air into a ¼" Low Density Polyethylene (LDPE) tubing attached to the DVP. The quality of the purged water is monitored for pH, electrical conductivity, temperature, water clarity and colour (visual observation) during this activity. A minimum of 3 well volumes (volume of water between the in-well packer and bottom of screened interval) are removed prior to sampling or until the monitored parameters stabilize (values remaining within 10% for three consecutive readings).

Groundwater Sampling

Groundwater is sampled immediately after purging by lowering the intake of the DVP tubing to 3 to 5 meters above the screened interval. The same DVP pump and tubing used for purging is used for sampling but utilizing compressed nitrogen gas to evacuate water that entered the sampler unit. Nitrogen gas is stable (inert) and avoids alteration of groundwater chemistry during sampling. Chemical parameters continue to be measured during sampling.

A groundwater sample is collected in clean, laboratory-supplied containers as per the instructions in the previous section. Samples analyzed for dissolved metals are filtered through a 45 µm inline filter.

Samples are collected in duplicate (See Section 2.2.5) and submitted as blind duplicates (using different reference numbers) to the analytical laboratory. Duplicate samples are analyzed for chloride and dissolved metals only.

Measurements of groundwater temperature, pH, electrical conductivity, total dissolved solids (TDS), and dissolved oxygen are obtained in the field during purging and sampling. Measurements are recorded for future reference and to check against laboratory data.

The following procedures are followed to provide data quality control on the samples:

- Measurement of field parameters at selected intervals until stable readings (within 10% of each other);
- Minimization of the exposure of the sampled water to the atmosphere;
- Use of compressed, inert gas (nitrogen) to evacuate water for sample collection;
- In-situ measurement of sensitive chemical parameters (pH, conductivity, dissolved oxygen, alkalinity, where applicable); and
- Abiding by sample preservation methods (refrigeration and use of preservatives where needed); and specified holding times.

Bottles are labelled with required information.

2.2.4 Preservation

Preservatives, if required, are added to sample bottles after filling, as directed by the analytical laboratory. Table 2.1 summarizes the minimum sample volumes, preservation and holding times for each analyte. This information was provided by Maxxam Analytics.

Table 2.1: Summary of Sampling Requirements

Parameter	Minimum Volume (ml)	Bottle Type	Preservation	Holding Time
pH	250	250 mL, glass or plastic, filled to the top	4°C	Analyze immediately
Conductivity	125	250 mL, glass or plastic	4°C	28 days
Hardness	250	250 mL plastic, filled to the top	4°C, HNO ₃	6 months
Oil and Grease (total)	1000	1 L amber glass	4°C, H ₂ SO ₄	28 days
Turbidity	125	250 mL, glass or plastic	4°C	48 hours
Total Dissolved Solids (TDS)	125	250 mL glass	4°C	7 days
Total Suspended Solids (TSS)	125	250 mL glass	4°C	7 days

Total Alkalinity	250	250 mL, glass or plastic, filled to the top	4°C	14 days
Bicarbonate Alkalinity	250	250 mL, glass or plastic, filled to the top	4°C	14 days
Carbonate Alkalinity	250	250 mL, glass or plastic, filled to the top	4°C	14 days
Total Cyanide	125	250 mL, glass or plastic	4°C, NaOH	14 days
Free Cyanide	125	250 mL, glass or plastic	4°C, NaOH	14 days
Benzene, Toluene, Ethylbenzene & Xylene (BTEX)	40 (per vial)	3 X 40 mL, glass, filled to the top	4°C	7 days
Total Petroleum Hydrocarbons (TPH)	1000	1L, glass	4°C, H ₂ SO ₄	28 days
<u>Total Metals (ICP-MS)</u> (Aluminum, Antimony, Arsenic, Boron, Barium, Beryllium, Cadmium, Cobalt, Copper, Chromium, Iron, Lithium, Manganese, Mercury, Molybdenum, Nickel, Lead, Selenium, Tin, Strontium, Titanium, Thallium, Uranium, Vanadium, Zinc, Potassium, Magnesium, Sodium)	125	250 mL plastic	4°C, HNO ₃	6 months
<u>Dissolved Metals</u> (Aluminum, Antimony, Arsenic, Boron, Barium, Beryllium, Cadmium, Cobalt, Copper, Chromium, Iron, Lithium, Manganese, Mercury, Molybdenum, Nickel, Lead, Selenium, Tin, Strontium, Titanium, Thallium, Uranium, Vanadium, Zinc)	125	250 mL plastic	4°C, Filtered on-site, HNO ₃	6 months
Ammonia-nitrogen	250	250 mL, glass or plastic, filled to the top	4°C, H ₂ SO ₄	28 days
Total kjeldahl nitrogen	250	250 mL, glass or plastic, filled to the top	4°C, H ₂ SO ₄	28 days
Nitrate nitrogen	125	250 mL, glass or plastic	4°C	48 hours
Nitrite nitrogen	125	250 mL, glass or plastic	4°C	48 hours
Ortho-phosphate	125	250 mL, glass or plastic	4°C	14 days
Total phosphorous	125	250 mL, glass or plastic	4°C, H ₂ SO ₄	28 days

Total organic carbon	125	250 mL glass	4°C, H ₂ SO ₄	28 days
Dissolved organic carbon	125	250 mL glass	4°C, H ₂ SO ₄	28 days
Chloride	125	250 mL, glass or plastic	4°C	28 days
Fluoride	125	250 mL plastic	4°C	28 days
Sulphate	125	250 mL, glass or plastic	4°C	28 days
Radium 226	500	1L plastic	4°C, HNO ₃	1 month
Reactive Silica	250	500 mL, plastic	4°C	28 days

2.2.5 Field Duplicates and Blanks

It is recommended that one field duplicate, one filter blank and one field blank be used for a) each 10 samples or b) each sampling event as shown in Table 2.2. Field duplicates and filter blanks are collected and handled concurrently and in the same manner as the other samples in the field. Field blanks are samples of distilled water handled concurrently and in the same manner as the other samples in the field.

Table 2.2: Quality Control Sample Frequency

Sampling Site	QA/QC Sampling Frequency
CM Program	
Attenuation ponds	1 field duplicate, 1 field blank and 1 filter blank per month during open water season
Mine facilities - operations	1 field duplicate, 1 field blank and 1 filter blank biannually
Mine facilities - closure	1 field duplicate, 1 field blank and 1 filter blank biannually
Mine facilities - post-closure	1 field duplicate, 1 field blank and 1 filter blank per year
Seep water chemistry	1 field duplicate, 1 field blank and 1 filter blank per 10 samples
Groundwater chemistry	1 field duplicate, 1 field blank and 1 filter blank per groundwater sampling event
Receiving water chemistry	Blind field duplicates, laboratory and field blanks, sediment cleaning swipes, laboratory matrix spike duplicates per 10 samples (AEMP)
EM Program	
Each event	One field duplicate per 10 samples

The duplicate samples are given sample identification numbers and included in the sample stream. The indication of the sample as a duplicate is maintained in the data records at site.

2.3 SAMPLE TRANSPORT

All water samples are stored in coolers with ice packs and preserved as specified by the laboratory. Samples are shipped to the external laboratory as soon as sampling is completed via chartered aircraft and dedicated ground transportation to ensure arrival in a safe and timely manner.

A Chain of Custody form with the following information is completed for every shipment of samples:

- Company name and sampler's name;
- Sample identification number;
- Time and date of sampling;
- Presence and type of preservative and whether the sample was filtered or not;
- Requested analytical parameters for each bottle;
- Time and date of shipping; and
- Analytical laboratory address and contact person.

One copy of the form is included with the shipment and one copy remains at the mine site for reference.

SECTION 3 • LABORATORY ANALYSIS

3.1 EXTERNAL LABORATORY

Maxxam Analytics (Maxxam) is located in Montreal and as of December 2008 performs the required environmental analyses for the Meadowbank Project. Maxxam is ISO/IEC Standard 17025 accredited by the Standards Council of Canada; details of their accreditation are included in Appendix B.

3.2 INTERNAL LABORATORY

As of December 2008, the assay lab at the Meadowbank site is under construction. The on-site laboratory will seek accreditation and this process is expected to be completed in the next 2-3 years.

SECTION 4 • DATA REQUIREMENTS

4.1 DATA COLLECTION

A database of all water sampling data will be maintained at the Meadowbank site, starting in the first quarter of 2009. The database has been designed based on the sample stations in the compliance monitoring program of 2AM-MEA0815 Schedule I and the various discharge limits designated in the license. The database functionality includes event scheduling, trend analysis and flagging out of compliance samples, all to enhance the effectiveness of the QA/QC program.

The following data is collected for each sample in the field and will be entered into the database by the sampler for the corresponding sampling station:

- a. Sample Identification Number;
- b. Name of sampler;
- c. The date and time of sampling or measurement and weather conditions; and
- d. Physical characteristics (pH, temperature etc.), if required.

The database will generate a hardcopy and electronic chain of custody form as discussed in Section 2.3.

Upon receipt of sample results from the laboratory, the data will be input to the database and matched on sample identification number, such that the record also includes the following data for each sample:

- e. Analytical methods or techniques used;
- f. Date of analysis;
- g. Name of the person(s) / laboratory that performed the analysis; and
- h. Results of any analysis.

4.2 DATA VERIFICATION

Upon reception of analytical results, the blank and duplicate analyses will be verified for potential contamination and accuracy, respectively. Results will be interpreted and recommended actions taken as stipulated in the Maxxam laboratory "Environmental QAQC Interpretation Guide", presented in Appendix C.

4.3 EXCEEDENCE REPORTING

Any measured concentration at a sample station exceeding a regulated discharge criterion stipulated in Water License 2AM-MEA0815 or the Metal Mining Effluent Regulations (MMER) will be reported to the NWB and INAC water inspector within 30 days of the receipt of the analysis. In addition, results of the action plan will be reported and, where necessary, mitigation options identified within 90 days after receipt of the analyses.

Appendix A

Water License 2AM-MEA0815 Schedule I

Table 1: Monitoring Group

Table 2: Monitoring Program

Schedule I - Conditions Applying to General and Aquatics Effects Monitoring

TABLE 1 - MONITORING GROUP

Group	Parameters
1	pH, turbidity, hardness, alkalinity, ammonia, aluminum, arsenic, barium, cadmium, chloride, chromium, copper, fluoride, iron, lead, manganese, mercury, molybdenum, nickel, nitrate, selenium, silver, sulphate, thallium, zinc,
2	pH, turbidity, total dissolved solids (TDS), alkalinity, ammonia, arsenic, copper, lead, nickel, zinc,
3	pH, alkalinity, turbidity, hardness, ammonia nitrogen, nitrate, nitrite, chloride, fluoride, sulphate, TDS, total and free cyanide for wells in ground water flow path of the tailings storage facility . Dissolved Metals: aluminum, arsenic, barium, cadmium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium and zinc.
4	Total and Dissolved metals: aluminum, antimony, arsenic, boron, barium, beryllium, cadmium, copper, chromium, iron, lithium, manganese, mercury, molybdenum, nickel, lead, selenium, tin, strontium, titanium, thallium, uranium, vanadium and zinc; Nutrients: Ammonia-nitrogen, total kjeldahl nitrogen, nitrate nitrogen, nitrite-nitrogen, ortho-phosphate, total phosphorous, total organic carbon, total dissolved organic carbon and reactive silica; Conventional Parameters: bicarbonate alkalinity, chloride, carbonate alkalinity, conductivity, hardness, calcium, potassium, magnesium, sodium, sulphate, pH, total alkalinity, TDS, and TSS
5	MMER parameters (total cyanide, arsenic, copper, lead, nickel, zinc, radium 226, total suspended solids, pH), sulphate and turbidity
6 *	pH, TSS, Electrical Conductivity, Total Ammonia, Total Arsenic, Total Trace Metals as determined by a standard ICP Scan (to include at a minimum, the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn), Oil and Grease, TPH (Total Petroleum Hydrocarbons), and BTEX (Benzene, Toluene, Ethylbenzene and Xylene)
7 *	Total Arsenic, Total Copper, Total Lead, Total Nickel, TSS, Ammonia, Cyanide, Benzene, Toluene, Ethylbenzene, Lead, Oil & Grease, pH
MMER	total cyanide, arsenic, copper, lead, nickel, zinc, radium 226, total suspended solids, pH, effluent volumes and flow rate of discharge, acute toxicity, Daphnia Magna and environmental effects monitoring (EEM).
Full Suite	Group 4, Total Petroleum Hydrocarbons, Turbidity

* Groups 6 and 7 are referenced from 8BC-MEA0709

TABLE 2 – MONITORING PROGRAM

Station	Description	Phase	Monitoring Parameters	Frequency
Mine Site				
ST-DC-1 to TBD	Monitoring stations during Dike Construction as defined in Final Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D Item 11	Construction	As defined in Final Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D Item 11	As defined in Final Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D Item 11
ST-DD-1 to TBD	Monitoring stations during Dike Dewatering as defined in Final referred to in Part D Item 11	Construction	As defined in Final Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D Item 11	As defined in Final Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D Item 11
ST-1	Water Intake for camp and mill	Construction, early operation, late operation, closure	Volume (m ³)	Monthly
ST-2	Reclaim Water Intake	Construction, early operation, late operation, closure	Volume (m ³)	Monthly
ST-3	Water Intake for Emulsion Plant	Construction, early operation, late operation, closure	Volume (m ³)	Monthly
ST-4	Water reclaimed from Tailings Storage Facility	Early operation, late operation, closure	Volume (m ³)	Monthly
ST-5	Portage Area (east) diversion ditch	Early operation, late operation, closure	Group 5, Aluminum	Monthly during open water
ST-6	Portage Area (west) diversion ditch	Early operation, late operation, closure	Group 5, Aluminum	Monthly during open water
ST-7	Vault Area diversion ditch	Early operation, late operation, closure	Group 5, Aluminum	Monthly during open water
ST-9	Portage Attenuation Pond prior to discharge through Third Portage Lake Outfall Diffuser	Early operation	Full Suite	Prior to discharge and Weekly during discharge
			Volume (m ³)	Daily during periods of discharge
			Acute Lethality	Once prior to discharge and Monthly thereafter

ST-10	Vault Attenuation Pond prior to discharge through Wally Lake Outfall Diffuser	Late operation	Full Suite	Prior to discharge and Weekly during discharge
			Volume (m ³)	Daily during periods of discharge
			Acute Lethality	Once prior to discharge and Monthly thereafter
ST-11	Tailings Storage Facility	Post closure	MMER, Ammonia-Nitrogen, Nitrate-Nitrogen, Nitrite-Nitrogen	Annually during open water
ST-12	Portage/ Goose Pit Lake	Post closure	Full Suite	Annually during open water season
ST-13	Vault Pit Lake	Post closure	Full Suite	Annually during open water
ST-14 (TEH-11)	Discharge to the land from Landfarm sump at mine site	Pre-development, Construction, early operation, late operation, closure	Benzene, Toluene, Ethylbenzene, Lead, Oil & Grease	Prior to discharge and Weekly during discharge
			Volume (m ³)	Daily during periods of discharge
ST-15	Vault non-contact diversion ditch	Early operation, late operation, closure	Group 5, Aluminum	Monthly during open water
ST-16	Portage Rock Storage Facility	Early operation	Group 3	Bi-annually during open water
			Total Metals	Once Annually immediately following spring freshet
		Late operation	Group 2	Monthly during open water
		Closure	Group 3	Bi-annually during open water
			Total Metals	Once Annually immediately following spring freshet
ST-17**	North Portage Pit Sump	Early operation	Group 2	Monthly during open water
			Group 3	Bi-annually during open water
			Volume (m ³)	Daily during periods of discharge
	Portage Pit Lake	Late operation	Group 4	Monthly during open water
		Closure	Group 3	Bi-annually during open water
ST-18	Portage Attenuation Pond	Early operation	Group 2	Monthly during open water

			Group 3	Bi-annually during open water
ST-19**	Third Portage Pit Sump	Early operations	Group 2	Monthly during open water
			Group 3	Bi-annually during open water
			Volume	Daily during periods of discharge
	Third Portage Pit Lake	Late operations	Group 4	Monthly during open water
ST-20	Goose Island Pit Sump	Early operations	Group 2	Monthly during open water
			Group 3	Bi-annually during open water
			Volume	Daily during periods of discharge
	Goose Island Pit Lake	Late operations	Group 4	Monthly during open water
		Closure	Group 3	Bi-annually during open water
ST-21	Tailings Reclaim Pond	Early operation (south of central dike)	Group 3, Cyanide	Monthly during open water
			Total Metals	Once Annually immediately following spring freshet
		Late operation (north of central dike)	Group 3, Cyanide	Bi-annually during open water
			Total Metals	Once Annually immediately following spring freshet
ST-22	Tailings Storage Facility	Late operation	Group 3, Cyanide	Bi-annually during open water
			Total Metals	Once Annually immediately following spring freshet
		Closure (drainage runoff)	Group 3, Cyanide	Bi-annually during open water
			Total Metals	Once Annually immediately following spring freshet
ST-23	Vault Pit Sump	Late operations	Group 2	Monthly during open water
			Group 3	Bi-annually during open water
			Volume (m ³)	Daily during periods of discharge
ST-24***	Vault Rock Storage Facility	Late operation	Group 2	Monthly during open water

			Group 3	Bi-annually during open water
			Total Metals	Once annually immediately following spring freshet
		Closure (east ditch) ST-24-A	Group 3	Monthly during open water
			Total Metals	Once Annually immediately following spring freshet
		Closure (west ditch) ST-24-B	Group 3	Monthly during open water
			Total Metals	Once Annually immediately following spring freshet
ST-25	Vault Attenuation Pond	Late operation	Group 2	Monthly during open water
			Total Metals	Once Annually immediately following spring freshet
			Group 3	Bi-annually during open water
ST-26	Vault Pit Lake	Closure	Group 4	Monthly during open water (flooding)
			Group 3	Quarterly (fully flooded)
ST-S-1 to TBD	Seeps (to be determined)	Construction	Group 3	Monthly during open water
		Early operations, late operations, closure	Group 1	Monthly or as found
ST-GW-1 to TBD	Groundwater wells (to be determined)	Construction, Early operations, late operations, closure	Group 3	Annually
ST-AEMP-1 to TBD	Receiving AEMP	Construction, Early operations, late operations, closure	Group 4	Monthly during open water season all AEMP stations. Monthly throughout year at a smaller number of locations (through ice)
ST-MMER-1 to TBD	Vault and Portage effluent outfall	Early and late operations	MMER	Weekly during open water
8BC-TEH0809				
ST-27 and ST-28 (TEH-1 & TEH-2)	Water Intake for camp and concrete batch plant purposes	Pre-development, Construction	Volume for each purpose (m ³)	Monthly

ST-29 and ST-30 (TEH-3 & TEH-4)	Water, if any, accumulated in north and south pre-development zones	Pre-development	pH, Turbidity	Weekly
			Metals using an ICP-Metals 36 element scan, Total Ammonia, Nitrate, Sulphate	Monthly
ST-31 and ST-32 (TEH-5 & TEH-6)	Water pumped from north and south pre-development zones to Contact Water Collection System	Pre-development	pH, Turbidity	Daily during periods of pumping
ST-33 and ST-34 (TEH-7 & TEH-8)	Contact Water Collection System Lakes #1 and #2	Pre-development, Construction	pH, Turbidity, Metals using an ICP-Metals 36 element scan, Total Ammonia, Nitrate, Sulphate	Weekly during periods of pumping from the pre-development pits
ST-35 (TEH-9)	Discharge from Lake #1 of Contact Water Collection System (Stormwater Management Pond) to Second Portage Lake	Pre-development, Construction	pH, TSS, T-Al, BOD ₅ , Fecal Coliforms, T-As, T-Cu, T-CN, T-Pb, T-Ni, T-Zn, T-Radium ₂₂₆	Once prior to discharge and Weekly during periods of discharge
			Acute Lethality	Once prior to discharge and Monthly thereafter
			Volume (m3)	Daily during periods of discharge
	In addition, if discharge from Bulk Fuel Storage Facility directed to Lake #1		Benzene, Lead, Toluene, Ethylbenzene, Oil & Grease	Once prior to discharge and Weekly during periods of discharge
ST-36 (TEH-10)	Discharge from Lake #2 of Contact Water Collection System to Second Portage Lake	Pre-development, Construction	pH, TSS, T-As, T-Cu, T-CN, T-Pb, T-Ni, T-Zn, T-Radium ₂₂₆	Once prior to discharge and Weekly during periods of discharge
			Acute Lethality	Once prior to discharge and Monthly thereafter
			Volume (m3)	Daily during periods of discharge
8BC-MEA0709				
ST-37 (MEA-1)	Water sample location at Baker Lake in close proximity to the construction facilities	Pre-development, construction, early operation, late operation, closure	Group 6	Annually
ST-38 (MEA-2)	East Contact Water Pond located in the south-east corner of the lay-down area	Pre-development, construction, early operation, late operation, closure	Group 6 & 7	Prior to discharge or transfer of Effluent
			Volume (m3)	Monthly

ST-39 (MEA-3)	West Contact Collection Pond located in the south-west corner of the lay-down area	Pre-development, construction, early operation, late operation, closure	Group 6 & 7	Prior to discharge or transfer of Effluent
			Volume (m3)	Monthly
ST-40 (MEA-4)	Secondary containment sump at the Bulk Fuel Storage Facility	Pre-development, construction, early operation, late operation, closure	Group 6 & 7	Prior to discharge or transfer of Effluent
ST-41 (MEA-5)	Water sample location at the ammonium nitrate storage area	Pre-development, construction, early operation, late operation, closure	Group 7	Prior to discharge or transfer of Effluent
ST-42 (MEA-6)	Water sample location at the explosive storage area	Pre-development, construction, early operation, late operation, closure	Group 7	Prior to discharge or transfer of Effluent

** ST-17 and ST-19 in Closure become one sampling point

*** During Closure, two contact water monitoring points will be assigned to the Vault Storage Facility at ST-24

Appendix B

Maxxam Analytics – Accreditation Details

CERTIFICATE OF ACCREDITATION



Standards Council of Canada
Conseil canadien des normes

CERTIFICAT D'ACCREDITATION

MAXXAM ANALYTIQUE

889 Montée de Liesse, Saint-Laurent, Québec

having been assessed by the Standards Council of Canada (SCC) and found to conform with the requirements of ISO/IEC 17025:2005 (CAN-P-4E) and the conditions for accreditation established by SCC is hereby recognized as an

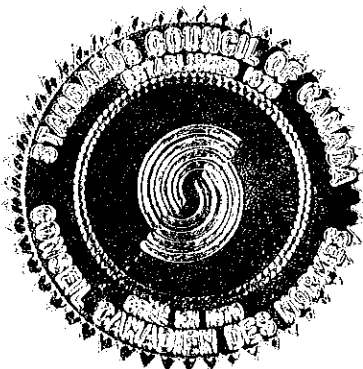
ACCREDITED TESTING LABORATORY

for the specific tests or types of tests listed in the scope of accreditation approved by SCC and found on the SCC website at www.scc.ca.

ayant fait l'objet d'une évaluation réalisée par le Conseil canadien des normes (CCN) et été jugé conforme aux exigences énoncées dans ISO/CEI 17025:2005 (CAN-P-4E) et aux conditions liées à l'accréditation établies par le CCN, est, en vertu du présent certificat, reconnu comme étant un

LABORATOIRE D'ESSAIS ACCRÉDITÉ

pour les essais ou types d'essais énumérés dans la portée d'accréditation approuvée par le CCN et figurant dans le site Web du CCN à www.ccn.ca.



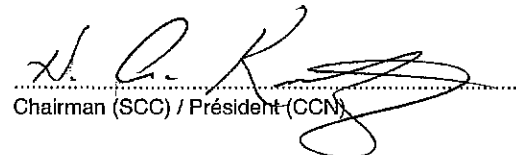
This accreditation is the formal recognition of the technical competence of the laboratory, for the approved scope. In addition, this laboratory has demonstrated that they operate a quality management system (refer to the SCC website for the joint ISO-ILAC-IAF Communiqué dated 2005-06-18).

Accredited laboratory number.: / Numéro de laboratoire accrédité : 120

Accreditation date: / Date d'accréditation : 1993-06-08

Issued on: / Délivré le : 2008-09-09

Expiry date: / Date d'expiration : 2013-06-08


Chairman (SCC) / Président (CCN)

Cette accréditation est la reconnaissance officielle de la compétence technique du laboratoire pour la portée d'accréditation approuvée. Ce laboratoire a également prouvé qu'il gère un système de management de la qualité (voir le site Web du CCN pour le communiqué commun ISO-ILAC-IAF daté du 18 juin 2005).

SCOPE OF ACCREDITATION

MAXXAM ANALYTIQUE
889 Montée de Liesse
Saint-Laurent, QC
H4T 1P5

Accredited Laboratory No. 120

(Conforms with requirements of CAN-P-1585, CAN-P-1587, CAN-P-4E (ISO/IEC 17025:2005))

CONTACT: Mme. Amelie Roy
TEL: 514-448-9001 ext.268
FAX: (514) 448-9199
EMAIL: Amelie.Roy@maxxamanalytics.com

CLIENTS SERVED: All interested parties

FIELDS OF TESTING: Biological, Chemical/Physical

PROGRAM SPECIALTY AREA: Agriculture and Food Products (AFP), Environmental

ISSUED ON: 2008-11-12

VALID TO: 2013-06-08

ANIMAL AND PLANTS (AGRICULTURE)

Foods and Edible Products: (Human and Animal Consumption)

(Dairy Produce; Feeds; Meat and Edible Meat Offal)

(Microbiology)

MFHPB-18	Determination of the Aerobic Colony Count in Foods (Maxxam STL SOP-00193)
MFHPB-19	Enumeration of Coliforms, Faecal Coliforms and E. Coli in Foods using the MPN Method (Maxxam STL SOP-00198)
MFHPB-20	Enumeration of Salmonella from Foods (Maxxam STL SOP-00200)
MFHPB-21	Enumeration of Staphylococcus aureus in Foods (Maxxam STL SOP-00202)
MFHPB-22	Enumeration of Yeasts and Molds in Foods (Maxxam STL SOP-00223)
MFHPB-30	Isolation and Identification of Listeria monocytogenes from all Foods and Environmental Samples (Maxxam STL SOP-00209)
MFHPB-31	Enumeration of Coliforms in Foods Using Violet Red Bile Agar (Maxxam STL SOP-00195)
MFHPB-34	Enumeration of E. coli and Coliforms in Food Products and Food Ingredients Using 3MTM Petrifilm™ E. coli Count Plates (Maxxam STL SOP-00194)
MFLP-21	Enumeration of Staphylococcus aureus in Foods and Environmental Samples Using 3MTM Petrifilm™ Staph Express Count (STX) Plates (Maxxam STL SOP-00217)
MFLP-28	The Qualicon BAX® System Method for the Detection of Listeria species and Listeria monocytogenes in a Variety of Food (Maxxam STL SOP-00219)
MFLP-29	The Qualicon BAX® System Method for the Detection of Salmonella in a Variety of Food and Environmental Samples (Maxxam STL SOP-00220)
MFLP-30	Detection of E. coli O157:H7 by BAX System; based on 'The DuPont Qualicon BAX System Method for the Detection of E. coli O157:H7 in Raw Beef and Fruit Juice', Health Protection Branch. Ottawa. MFLP-30. May 2003 (Maxxam STL SOP-00218)
MFLP-74	Enumeration of Listeria monocytogenes in Food (Maxxam STL SOP-00203)
Performing the Swab STOP Tests for Antibiotic Tests (On Premises) for Antibiotic Residues, U.S.D.A.	Analysis of Antibiotics in Food by STOP (Swab Test on Premises) (Maxxam STL SOP-00213)
STL SOP-00194, Based on MFHPB-34	Enumeration of Total Coliforms and Escherichia Coli Using Petrifilm
STL SOP-00220 based on MFLP-29	Detection of Salmonella by the BAX system
USDA-FSIS MLG 4.03	FSIS Procedure for the Isolation and Identification of Salmonella from Meat, Poultry and Egg Products (Maxxam STL SOP-00221)
USDA-FSIS MLG 4C.02	FSIS Procedure for the Use of the BAX System PCR Assay for Screening Salmonella in Raw Meat, Carcass Sponge Samples, Whole Bird Rinses, Ready-To-Eat Meat and Poultry Products, and Pasteurized Egg Products (Maxxam STL SOP-00222)

Meat and Edible Meat Offal

MA.200–Hg 1.0

Determination of Mercury in Water and Soil and Wipes and Meat and Vegetables and Fish by cold vapor AA spectroscopy. (Maxxam STL SOP–00042)

ENVIRONMENTAL AND OCCUPATIONAL HEALTH AND SAFETY

Environmental

Soil/Sediment

(BTEX – Soil)

MA 400–COV 1.1 and MA 403–COV 1.1

Analysis of VOC in water and soils by purge and trap GCMS (Maxxam STL SOP–00145)

Benzene

Ethylbenzene

m/p–xylene

o–xylene

Toluene

(Metals – Soil)

MA.200–Mét 1.1 & EPA SW846 Perkin Elmer Elan 6100 and Elan 9000 ICPMS (Maxxam STL 6020 WI–00012)

Aluminum

Antimony

Arsenic

Barium

Beryllium

Bismuth

Boron

Cadmium

Calcium

Chromium

Cobalt

Copper

Iron

Lead

Lithium

Magnesium

Manganese

Molybdenum

Nickel

Potassium

Selenium

Silicon
Silver
Sodium
Strontium
Tellurium
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Water (Inorganic)

(Dissolved Metals – Water)

MA.200–Mét 1.1 & EPA 200.7
Revision 4.4 & EPA 3050B &
IRSST Method I–INO–051,
Révision: 8

Acids digestion of metals by ICP or ICP–MS spectroscopy
(Maxxam STL SOP–00006)

Bismuth
Dissolved Aluminum
Dissolved Barium
Dissolved Beryllium
Dissolved Boron
Dissolved Cadmium
Dissolved Calcium
Dissolved Chromium
Dissolved Cobalt
Dissolved Copper
Dissolved Iron
Dissolved Lead
Dissolved Magnesium
Dissolved Manganese
Dissolved Molybdenum
Dissolved Nickel
Dissolved Silver
Dissolved Strontium
Dissolved Thallium
Dissolved Tin
Dissolved Titanium
Dissolved Uranium
Dissolved Vanadium
Dissolved Zinc

Lithium
Potassium
Silicon
Sodium
Tellurium
Thallium
Thorium
Tungsten
Zirconium

(Totals Metals – Water)

MA.200–Mét 1.1 & EPA 200.7
Revision 4.4 & EPA 3050B &
IRSST Method I–INO–051,
Révision: 8

Acids digestion of metals by ICP or ICP–MS spectroscopy
(Maxxam STL SOP–00006)

Total Antimony
Total Arsenic
Total Selenium

Water (Organic)

(BTEX – Water)

MA–400–COV 1.1 and MA
403–COV 1.1

Analysis of VOC in water and soils by purge and trap GCMS
(Maxxam STL SOP–00145)

(Nitroaromatics and Nitramines – Water)

EPA 8330B

Analysis of Explosives compounds in Water by HPLC/UV
(Maxxam STL SOP–00156)

1,3 Dinitrobenzene (m–dinitrobenzene)

1,3,5–trinitrobenzene

2, Amino–4,6–Dinitrotoluene

2,4,6–Trinitrotoluene

2,4–Dinitrotoluene

2,6–Dinitrotoluene

2–nitrotoluene

3–nitrotoluene

4–Amino–2,6–dinitrotoluene

4–nitrotoluene

Hexahydro‘,3,5 trinitro‘,3,5 triazine (RDX)

Methyl‘,4,6 trinitrophenylnitramine (Tetryl)

Nitrobenzene

Octahydro‘,3,5,7 tetranitro‘,3,5,7 tetrazocine (HMX)

Notes:

CAN-P-1587: Guidelines for the Accreditation of Agricultural and Food Products Testing Laboratories

CAN-P-1585: Guidelines for Accreditation of Environmental Testing Laboratories

CAN-P-4E (ISO/IEC 17025): General Requirements for the Competence of Testing and Calibration Laboratories (ISO/IEC 17025–2005)

CFIA: Canadian Food Inspection Agency

EPA: Environmental Protection Agency, U.S.

P-RE: Agriculture Canada Method

PCP: Pentachlorophenol

USDA: U.S. Department of Agriculture

P. Paladino, P. Eng., Director, Conformity Assessment

Date: 2008–11–12

Number of Scope Listings: 25

SCC 1003–15/198

Partner File #0

Partner: SCC

Appendix C

Maxxam Analytics Environmental QA/QC Interpretation Guide

ENVIRONMENTAL QA/QC INTERPRETATION GUIDE

LABORATORY QA/QC SAMPLE TYPE	FREQUENCY (1)	PURPOSE	APPLICATION	RECOMMENDED ALERT CRITERIA ^(4,5)	RECOMMENDED ACTION
<u>Method Blank</u> A laboratory control sample which is free of the target parameters and of any substance which may interfere with that analysis. A method blank is processed through the entire analytical method including any extraction, digestion or any other preparation procedure.	1 in 20 samples or 1 per batch.	Monitors laboratory background levels of target analytes and laboratory artifacts.	Used for most analytical parameters.	Any detected levels above reporting limits (2 x RDL) or greater than 5X method detection limit (MDL) ⁽²⁾	Repeat the analysis for all samples in the batch if unacceptable concentrations of target analytes are identified in the method blank. The laboratory may report elevated RDL values if project/regulatory criteria are not exceeded.
<u>Blank Spike</u> A laboratory control sample free of the target analytes or interferences is fortified with a known concentration of target analytes. The blank spike is processed through the entire analytical method including any extraction, digestion or any other preparation procedure. Results are expressed as a percentage recovery.	1 in 20 samples.	Monitors analyte recovery and potential loss during the preparation procedures. It also serves to validate the calibration of the instrumentation or technique.	Used for most analytical parameters.	Metals 80-120% (Water) 75-125% (soil) VOCs/C ₆ -C ₁₀ HC 70-130% (Water) 60-140% (soil) Extractable HC 30-130% (Water) 30-130% (soil) Volatile Gases 50-150% (Water) 30-150% (soil) General Chem. 80-120% (Water) 75-125% (soil) BNAs 10-130% (water) 10-130% (soil) PAHs 30-130% (Water) 30-130% (soil)	Repeat the analysis for all samples in the batch if blank spike recoveries are outside in-house control limits.
<u>Matrix Spike</u> A second aliquot from a randomly chosen sample is fortified with a known concentration of target analytes. The sample is processed through the entire analytical method. Results are expressed as a percentage recovery.	1 in 20 samples ⁽³⁾	Evaluates any “matrix effects” that may exist in a sample due to its composition that may effect the recovery of analytes. An example is the presence of peat in soils which tends to adsorb analytes such as benzene resulting in a poor matrix	Used for most analytical procedures. Matrix spike alert criteria do not apply if the native analyte concentration is greater than 1/2 the matrix spike target concentration.	Metals 80-120% (Water) 75-125% (soil) VOCs/C ₆ -C ₁₀ HC 70-130% (Water) 60-140% (soil) Extractable HC 30-130% (Water) 30-130% (soil) Volatile Gases 50-150% (Water) 30-150% (soil) General Chem. 80-120% (Water) 75-125% (soil) BNAs 10-130% (water) 10-130% (soil) PAHs 30-130% (Water) 30-130% (soil)	Repeat the analysis or qualify the data appropriately.

ENVIRONMENTAL QA/QC INTERPRETATION GUIDE

LABORATORY QA/QC SAMPLE TYPE	FREQUENCY (1)	PURPOSE	APPLICATION	RECOMMENDED ALERT CRITERIA ^(4,5)		RECOMMENDED ACTION
		spike recovery.				
<u>Laboratory Duplicate (RPD)</u> A second aliquot from a randomly chosen sample within an analytical batch processed through the entire analytical method. Laboratory duplicates are expressed as the Relative Percent Difference (RPD) between the two results.	1 in 20 samples.	Evaluates analytical precision and sample homogeneity.	Applicable for all analytical parameters but the RPD calculation is only applicable when both concentrations are > 5X RDL.	Metals (25% Water; 35% soil) VOCs/C ₆ -C ₁₀ HC (40% water; 50% soil) Volatile Gases (50% water; 60% soil) General Chemistry (25% water; 35% soil) Other Organics (40% water; 50% soil)		Repeat affected sample. If still not acceptable, inspect for homogeneity. Only repeat a third time if analytical error is suspected.
<u>Certified Reference Material (CRM)</u> Purchased samples which have been certified by a recognized agency to contain specified levels of selected constituents, when measured by specified standard procedures. Results are expressed as a percentage of the design value.	1 in 20 samples ⁽³⁾	Used for validating the performance of a method including precision, extraction/digestion efficiency.	Applicable for all analytical parameters where CRMs are commercially available.	Metals 80-120% (Water) 75-125% (soil) VOCs/C ₆ -C ₁₀ HC 70-130% (Water) 60-140% (soil) Volatile Gases 50-150% (Water) 30-150% (soil) General Chem. 80-120% (Water) 75-125% (soil) BNAs 10-130% (water) 10-130% (soil) Other Organics 70-130% (Water) 30-130% (soil)		Repeat the analysis for all samples in the batch.
<u>Surrogate Recovery</u> Surrogates are deuterated analogues or compounds not normally found in nature but have chemical and physical behaviour similar to the analytes of interest. Known surrogate concentrations are added to samples prior to analysis and recoveries are calculated and expressed as a percentage.	Every organic analysis, included in every sample and standard.	Monitors the efficiency of organic extractions, instrument performance and provides within-run quality control.	Applicable for all analytical parameters determined by Gas Chromatography or HPLC techniques.	VOCs/C ₆ -C ₁₀ HC 70-130% (Water) 60-140% (soil) Extractable HC 30-130% (Water) 30-130% (soil) BNAs 30-130% (water) 30-130% (soil) PAHs 30-130% (Water) 30-130% (soil)		Repeat the analysis or qualify data if there is a marginal exceedence that has no impact on the data as determined by a Department Manager/Supervisor.

Footnotes:

(1) Maxxam's standard QC frequency is presented; however specific monitoring programs may have project specific QC requirements.

(2) Regulatory limits vary depending on soil porosity. Coarse/ fine classification based upon 75µm fraction is available upon request.

(3) Matrix Spike or a certified reference material are included in batch sizes of 20 samples or less; not necessarily both (if insufficient sample is submitted for a matrix spike a CRM may be substituted).

(4) It is acceptable to approve matrix spikes for multi-scan parameters if less than 10% of the recoveries fail and these compounds are not detected in samples within the batch or a 0% recovery obtained

(5) Acceptance limits are based on Maxxam in-house method control limits and may differ from those published by EPA. These are recommended alert criteria, but results outside these limits may be deemed acceptable on a case by case basis. These criteria should be considered general guidance only and some labs may have more stringent limits than what is specified in the above table.

ENVIRONMENTAL QA/QC INTERPRETATION GUIDE

FIELD QA/QC SAMPLE TYPE	FREQUENCY (1)	PURPOSE	APPLICATION	RECOMMENDED ALERT CRITERIA ^(4,5)	RECOMMENDED ACTION
<u>Blind Duplicate</u> A second sample is collected at the same time and location in separate containers. Samples are homogenized where possible (ie alternate filling of sample and duplicate for waters and bowl mixing for soils). Samples are submitted to the laboratory without identifying them as duplicates. VOCs in soil should not be homogenized.	1 per submission.	Evaluates analytical precision, field precision and sample homogeneity.	Useful for most parameters. Has limited use for samples that cannot be homogenized (ie VOCs in soil). RPD calculation is only applicable when concentrations are > 5X RDL.	Metals (50% Water; 100% soil) VOCs/C ₆ -C ₁₀ HC (80% water; 100% soil) Volatile Gases (80% water; 100% soil) General Chemistry (50% water; 100% soil) Other Organics (80% water; 100% soil)	Evaluate laboratory QC, homogenization procedures and field collection technique. Contact the laboratory as soon as possible.
<u>Trip Blank</u> A sample of analyte free media (supplied by the laboratory) taken to the site and returned to the laboratory unopened. The laboratory prepares the trip blank .A duplicate of the trip blank prepared at the same time is retained at the laboratory in a contaminant free location.	1 per VOC water project.	Identifies any potential cross-contamination that may occur from other samples, ambient conditions, or other sources that samples may be exposed.	Volatile organics in water.	Any concentrations above (2 x RDL) or (5 x MDL).	Analyze the laboratory trip blank duplicate retained by the laboratory.
<u>Trip Spike</u> A sample prepared by the laboratory that is fortified with a known concentration of target analytes. This sample is shipped along with containers and is to be taken into the field, but returned unopened to the laboratory. Analysis is conducted and recoveries are reported expressed as a percentage.	1 per VOC water monitoring program.	Monitors the breakdown or loss of analytes during the sampling process. Holding time, and temperature effects on concentration	Usually volatile organics in water. May be applied to other analyses	70 – 130 % recovery for all VOCs except the dissolved gases (ie vinyl chloride), which the recommended acceptable range is 60-140%.	Review storage conditions, temperatures of samples upon receipt and holding time.

ENVIRONMENTAL QA/QC INTERPRETATION GUIDE

FIELD QA/QC SAMPLE TYPE	FREQUENCY ⁽¹⁾	PURPOSE	APPLICATION	RECOMMENDED ALERT CRITERIA ^(4,5)	RECOMMENDED ACTION
		can be accessed.			
<u>Field Blank</u> A sample of analyte free media (supplied by the laboratory) taken to the site, opened and exposed to the ambient air.	1 per VOC water monitoring program.	Monitors any potential contamination that may impact samples due to ambient air conditions.	Applicable for most parameters.	Any concentrations above (2 x RDL) or (5 x MDL).	Evaluate any “hits” found in the sample that were also found in the field blank.
<u>Blind Known</u> A purchased CRM (see above) or a sample previously analyzed by an accredited laboratory multiple times is submitted to the laboratory blind.	1 per remediation or large project.	Evaluates laboratory accuracy and precision.	Ideal for long holding time tests such as metals in soil. Submission of the same blind known multiple times during a large project provides excellent monitoring of the laboratory precision and accuracy.	Metals 80-120% (Water) 75-125% (soil) VOCs/C ₆ -C ₁₀ HC 70-130% (Water) 60-140% (soil) Volatile Gases 50-150% (Water) 30-150% (soil) General Chem. 80-120% (Water) 75-125% (soil) BNAs 10-130% (water) 10-130% (soil) Other Organics 70-130% (Water) 30-130% (soil)	Contact the laboratory.
<u>Interlaboratory Duplicate</u> A second sample is collected at the same time and location in separate containers. Samples are homogenized where possible (ie alternate filling of sample and duplicate for waters and bowl mixing for soils). One sample is submitted to third party laboratory.	1 per remediation or large project.	Evaluates appropriateness of the analytical method, precision and accuracy between two laboratories.	Suitable for parameters that can be homogenized and adequate split samples can be obtained. RPD calculation is only applicable when concentrations are > 5X RDL.	Metals (50% Water; 100% soil) VOCs/C ₆ -C ₁₀ HC (80% water; 100% soil) Volatile Gases (80% water; 100% soil) General Chemistry (50% water; 100% soil) Other Organics (80% water; 100% soil)	Evaluate laboratory QC and homogenization procedures. Contact the laboratory and compare methods between the two laboratories.
<u>Equipment Blank</u> An aliquot of analyte free water is exposed to any field apparatus (ie well materials, tubing, field filter) and then collected in appropriate	1 per GW submission.	Evaluates “artifacts” or cross contamination from field equipment.	Suitable for water samples for most analytes.	Any concentrations above (2 x RDL) or (5 x MDL).	Evaluate any “hits” found in the sample that were also found in the equipment blank.

ENVIRONMENTAL QA/QC INTERPRETATION GUIDE

FIELD QA/QC SAMPLE TYPE	FREQUENCY (1)	PURPOSE	APPLICATION	RECOMMENDED ALERT CRITERIA ^(4,5)	RECOMMENDED ACTION
containers for the parameters of interest.					

Useful Calculations and Analytical Relationships:

Relative Percent Difference:
$$\frac{(\text{sample result} - \text{duplicate result}) \times 100}{(\text{sample result} + \text{duplicate result}) / 2}$$

Sodium Absorption Ratio:
$$\frac{[\text{Na}^+]}{(([\text{Ca}^{2+}] + [\text{Mg}^{2+}]) / 2)^{0.5}}$$

Total Hardness (as mg/L as CaCO₃) = Ca (mg/L) x 2.497 + Mg (mg/L) x 4.118

Organic Nitrogen: TKN – NH₃-N

Unionized Ammonia: $f = 1 / (10^{\text{pKa} - \text{pH}} + 1)$
where f is the fraction of NH₃ of the NH₃ + NH₄ result and pKa = 0.09018 + 2729.92/T, where T = ambient water temperature in Kelvin (K = deg C + 273.16)

Theoretical Total Dissolved Solids: 0.6 – 0.9 X field or lab measured conductivity roughly will estimate your TDS in mg/L

Ion Balance:
$$\frac{(\text{Anion Sum} - \text{Cation Sum}) \times 100}{(\text{Anion Sum} + \text{Cation Sum})}$$

where Anion Sum = (ALK_{tot} x 0.02) + (Cl⁻ x 0.0282) + (SO₄²⁻ x 0.0208) + (NO₃⁻ as N x 0.0714) ---- Note: Fluoride can also be included but doesn't usually contribute much.

and Cation Sum = ([Ca] x 0.0499) + ([Mg] x 0.0823) + ([Na] x 0.0435) + ([K] x 0.0256) + (1000/10^{pH}) ----Note: Ammonia as N and Fe can also be included.

The resulting % difference should not exceed 5% or |(Anion Sum) - (Cation Sum)| ≤ 0.2 meq/L.

ENVIRONMENTAL QA/QC INTERPRETATION GUIDE

Method Detection Limit (MDL): the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. It is determined from several replicate analyses of a sample in a given matrix containing the analyte, by putting each aliquot through the entire process that samples would undergo, including all preparation steps (e.g., digestion, extraction)

Reporting Limit (RDL): the lowest concentration that can be reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions. The RDL is generally 1 to 10 times the MDL where regulatory criteria permit. By setting a reporting limit 1 to 10 times the statistical MDL, **more confidence is achieved, particularly for low level data.**