Contents

For Monitoring Programs under

Alaska Pollutant Discharge Elimination System Permit AK0053341

Waste Management Permit 2018DB0001

Suitability

This Quality Assurance Plan is to be used as a guide for the collection, analysis, recording, and reporting of environmental data for monitoring programs under Alaska Pollutant Discharge Elimination System Permit (APDES) Permit AK0053341 and Waste Management Permit 2018DB0001.

Title and Approvals

Pogo Quality Assurance Plan for Monitoring Programs under APDES Permit AK0053341 and Waste Management Permit 2018DB0001.

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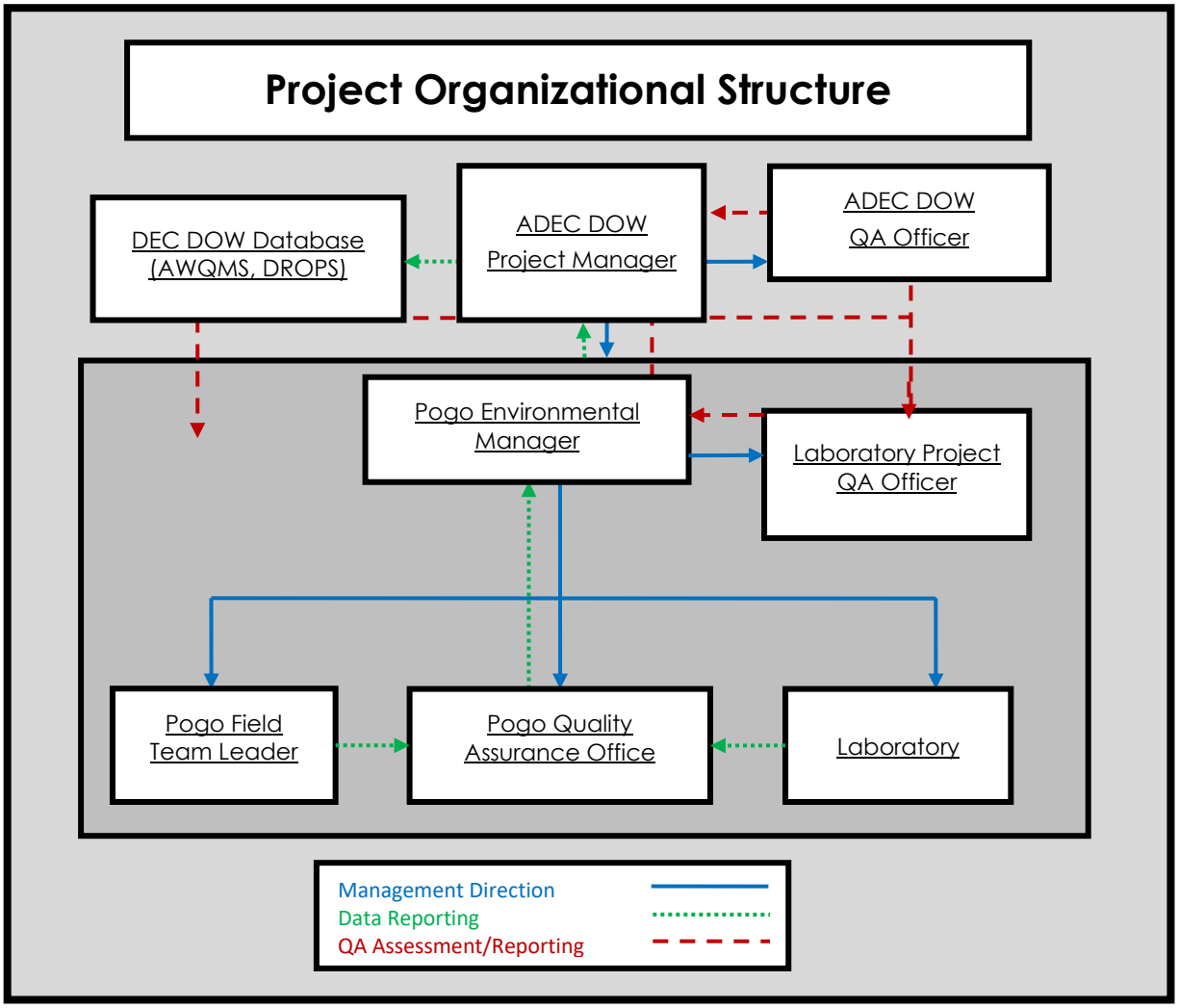
Project Organizational Responsibilities

POSITION TITLE	AGENCY OR COMPANY	DIVISION BRANCH/ SECTION	RESPONSIBILITIES
Environmental Superintendent	Pogo Mine	Environmental	Responsible for overall technical, financial and contractual management of the project and subsequent reporting of QA reviewed (validated and verified) data to DEC.
Environmental Coordinator	Pogo Mine	Environmental	Responsible for QA review and approval of plan and to ensure all monitoring complies with the QAPP specified criteria. This is accomplished through routine technical assessments of the sample collection, analysis and data reporting process. Assessments may include, but are not limited to on-site field audits, data audits, QA review of blind lab performance evaluation samples, lab audits, etc. These assessments are performed independent of overall project management.
Environmental Specialist & Environmental Technician	Pogo Mine	Environmental	Responsible for collecting and processing samples, creating records.
Laboratory Project Manager	Energy Laboratories Pollen Environmental TRE Environmental Eurofins TestAmerica Bioassay Laboratory ALS Chemex Eurofins Test America Laboratory SGS North America Inc Pogo Mine Assay Lab	Commercial Laboratory	Responsible for the overall review and approval of contracted laboratory analytical work, responding to sample result inquiries and method specific details. Responsible for QA/QC of laboratory analysis as specified in the QAPP and reviews and verifies the validity of sample data results as specified in the QAPP and appropriate EPA approved analytical methods. Verifies that lab deliverables meet QAPP specifications.
Laboratory Quality Assurance Officer	Energy Laboratories Pollen Environmental TRE Environmental Eurofins TestAmerica Bioassay Laboratory ALS Chemex Eurofins TestAmerica Laboratory Pogo Mine Assay Lab	Commercial Laboratory	Laboratory Quality Assurance Manager/Officer – Responsible for QA/QC of water quality laboratory analyses as specified in the QAPP. Along with Laboratory Manager, the Lab QA Officer reviews and verifies the validity of sample data results as specified in the QAPP and appropriate EPA approved analytical methods. Provides coordination and hosting of laboratory audits.
Project Manager	ADEC	Division of Water	Responsible for overall technical and contractual management of the project. For Permit related monitoring projects, responsible for ensuring permittee complies with permit required water quality monitoring as specified in the approved QAPP.
Water Quality Assurance Officer	ADEC	Division of Water	Responsible for QA review and approval of plan and oversight of QA activities ensuring collected data meets project's stated data quality goals.

Project Organizational Structure Flow Chart



Definitions and Acronyms

ACRONYM	NAME
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADNR	Alaska Department of Natural Resources
APDES	Alaska Pollutant Discharge Elimination System
APMA/AHEA	Alaska Placer Mine Application for Hardrock Exploration
ARD	Acid Rock Drainage
BMP	Best Management Practices
CA	Corrective Action
CFR	Code of Federal Regulations
CIP	Carbon-in-Pulp
COC	Chain of Custody
CWA	Clean Water Act
DI	Deionized
DMR	Discharge Monitoring Report
DMRQA	Discharge Monitoring Report Quality Assurance Study
DO	Dissolved Oxygen
DOT	Department of Transportation

ACRONYM	NAME
DOW	Division of Water (ADEC)
DQI	Data Quality Indicator
DQO	Data Quality Objective
DSTF	Drystack Tailing Facility
DTW	Depth to Water
EB	Equipment Blank
EDD	Electronic Data Delivery
EDMS	Environmental Data Management System
EPA	Environmental Protection Agency
FB	Field Blank
GPS	Global Positioning System
GWUDISW	Ground Water Under the Influence of Surface Water
JHA	Job Hazard Analysis
LIMS	Laboratory Information Management System
LQAO	Lab Quality Assurance Officer
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MDL	Method Detection Limit
ML	Minimum Limit
MQO	Measurement Quality Objective
MRL	Method Reporting Limit
MW	Monitoring Well
MWTP	Mine Water Treatment Plant
NP/AP	Neutralization Potential/Acid Potential
ORTW	Off-River Treatment Work
PHD	Pulse Height Analysis
POO	Plan of Operations
PQL	Practical Quantification Limit
PSI	Periodic Safety Inspection
PWSID	Public Water System Identification
PWTP	Potable Water Treatment Plant
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QAO	Quality Assurance Officer
RDP	Relative Percent Difference
RL	Reporting Level
RTP	Recycle Tailings Pond
SOC	Synthetic Organic Compounds
SWP	Safe Work Practice
STP	Sewage Treatment Plant
TB	Trip Blank
TCLP	Toxicity Characteristic Leaching Procedure
TWUA	Temporary Water Use Authorizations
USGS	United States Geological Survey
VOC	Volatile Organic Constituents
WAD	Weak Acid Dissociable
WET	Whole Effluent Toxicity
XRF	X-Ray Fluorescence Spectrometer

1. INTRODUCTION

Northern Star (Pogo) LLC is the operator of the Pogo gold mine, located 38 miles northeast of Delta Junction, Alaska (see Figure 1.1). Pogo's Plan of Operations (POO) outlines Pogo Mine activities through December 2022 and reflects site experience gained since operations began in 2005. Where appropriate, it builds upon the documents used for project permitting, as well as the 2023 Plan of Operations and the 2023 Reclamation and Closure Plan.

Pogo Mine is an underground mine that feeds gold ore to the mill at a rate of approximately 3,500 tons per day (tpd). The property produces approximately 300,000 ounces of gold annually.

The mine consists of the following major elements:

- Underground cut-and-fill mining with conveyor access for transfer of ore to the surface;
- Surface gold mill for gold recovery through gravity concentration, flotation and cyanide leaching;
- Tailings preparation facilities, including cyanide detoxification and filtration, to produce paste backfill for the underground mine workings and dewatered tailings material suitable for placement in a Drystack facility on the surface;
- Drystack tailings facility (DSTF) to dispose the dewatered tailings materials and waste rocks and the recycle tailings pond (RTP) to collect the seepage and runoff water from the DSTF;
- An upper camp and lower camp with recreation and catering facilities for each;
- Transmission line along the Shaw Creek Hillside route, and on-site electrical distribution system;
- 49-mile all-season road constructed along the Shaw Creek Hillside route; and
- A water management system that maximizes recycling and treats all waters affected by the project in accordance with applicable federal and state legislation.

The Pogo Mine property consists of 1,250 state mining claims covering an area approximately 51,140 acres. The Pogo and Faith claims occur in the following townships and ranges of the Fairbanks Meridian:

- T6S, R14E, sections 1-4, 9-15, 22-25, and 36
- T5S, R14E, sections 13-16, 21-28, and 33-36
- T5S, R15E, sections 18-20, and 28-36
- T6S, R15E, sections 1-34
- T5S, R16E, sections 31
- T6S, R16E, sections 6-7, and 18-19

The Pogo upland Mining lease occupies the following sections of T5S, R14E of the Fairbanks Meridian:

- Sections 22, 23, 25, 26, 27, 34, 35, and 36. The Upland Mining Lease covers 2,320 acres within the Pogo claim block.

The Pogo Claims, Faith Claim and Pogo Upland Mining Lease are located on Big Delta B-2 USGS Quadrangle Map (Figure 1.1, Location and Access, Pogo Mine).

The primary study area for the QAPP includes the Liese Creek valley and a 15-mile segment of the upper Goodpaster River above and below the confluence with Liese Creek (Figure 1.2, Water Monitoring Stations). Individual, detailed site descriptions/characterizations are maintained in the electronic Environmental Data Management System (EDMS).

The QAPP was updated using the Alaska Department of Environmental Conservation (ADEC) requirements and Environmental Protection Agency (EPA) guidance. The QAPP is required by Pogo's Alaska Pollutant Discharge Elimination System (APDES) permit AK0053341, Section 1.6 for discharge of treated water to the Goodpaster River. It is also required by the ADEC Waste Management Permit 2018DB0001.

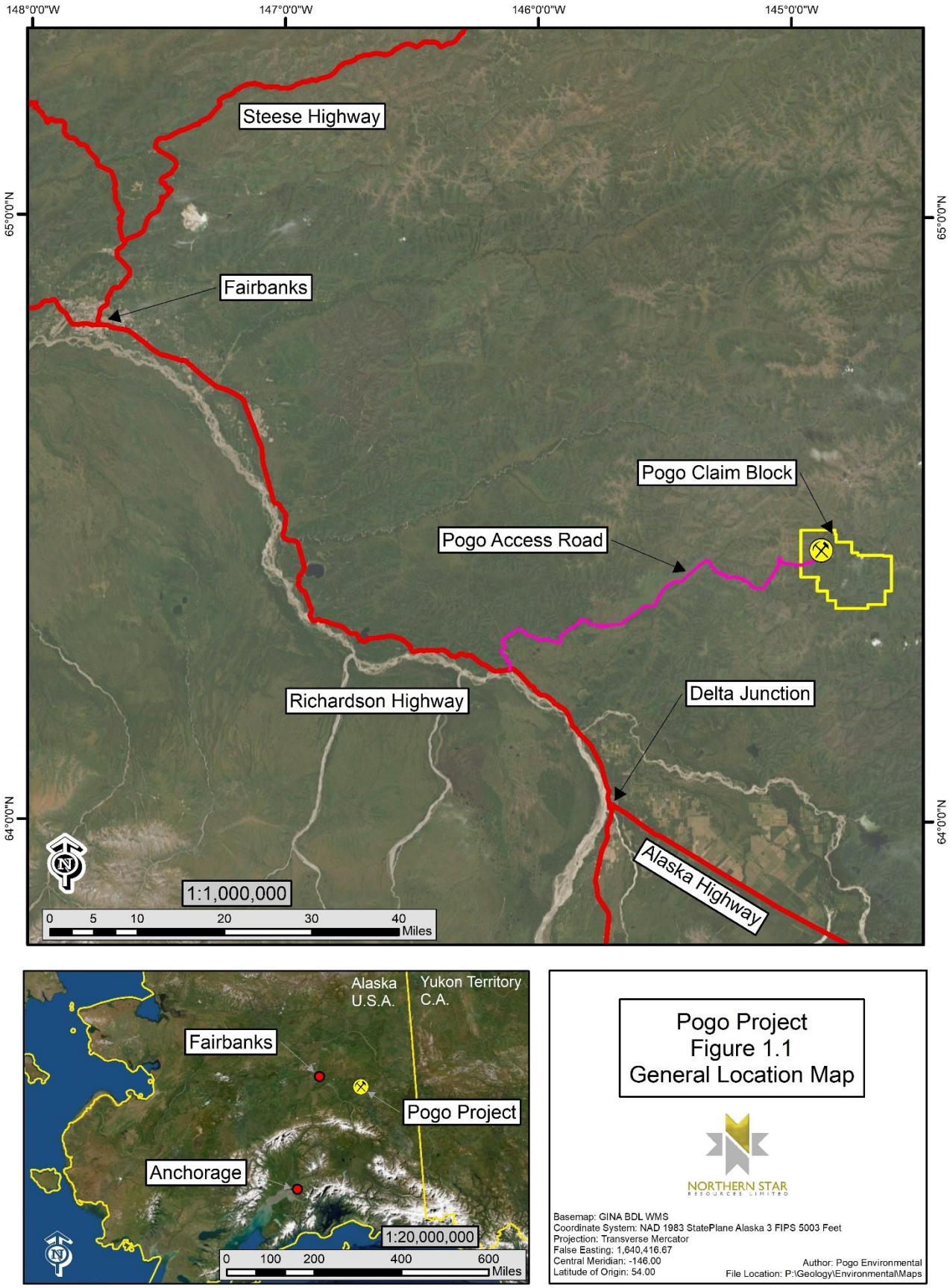


Figure 1.1: Location and Access, Pogo Mine

Figure 1.2
Monitoring Locations
Pogo Mine

Coordinate Sytem: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Jeremiah Drewel, Environmental Coordinator

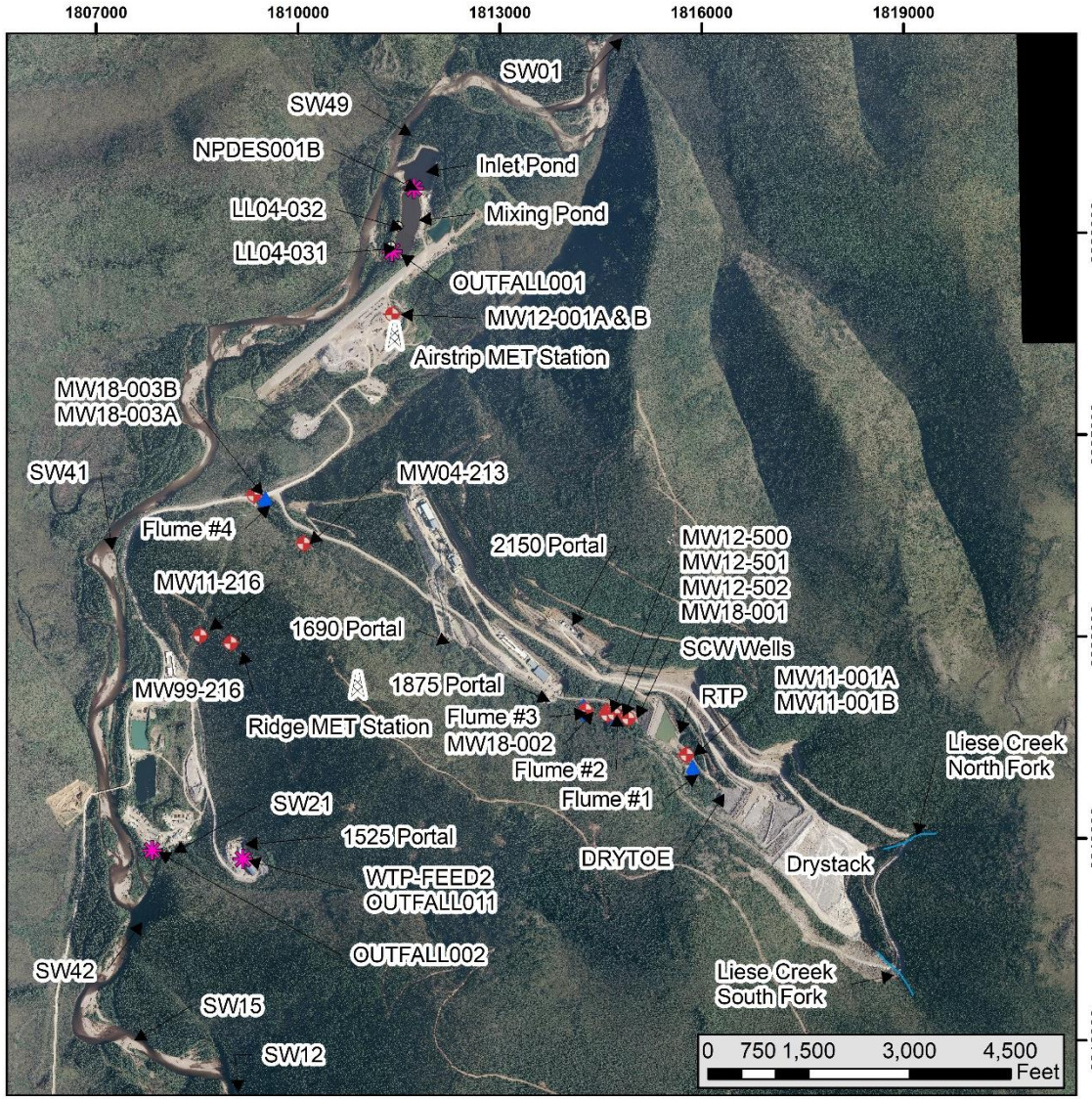


Figure 1.2: Water Monitoring Stations

2. PROJECT MANAGEMENT

2.1 Problem Definition and Background

The primary goal of Northern Star (Pogo) LLC's Quality Assurance Plan (QAPP) is to define procedures that assure the quality and integrity of the collected samples, the representativeness of the results, the sensitivity, precision and accuracy of the analyses, and the completeness of the data. These defined procedures include administrative, sampling, field preparedness, safety, data validation and documentation. This document was developed with guidance from the following: EPA Requirements for Quality Assurance Plans, EPA QA/R-5 (EPA, 2001) and Guidance for Quality Assurance Plans, EPA QA/G-5 (EPA, 2002b). A description of the facilities and details of the sampling design is provided in the Pogo Mine Monitoring Plan (Pogo, January 2022).

This QAPP verifies that appropriate data are collected to: (1) determine if permit limitations are exceeded, where applicable, and (2) establish proper collection, handling, and preparation of samples without contamination.

The monitoring programs described in the QAPP are designed to monitor activities from:

- The discharge of treated mine drainage and excess precipitation to the Goodpaster River;
- The discharge of treated domestic wastewater to the Goodpaster River; and
- The disposal of mine tailings, development rock and other solid wastes from the gold recovery facility to the Drystack Tailings Facility (DSTF) and the mine underground workings.

A summary of the programs described in the QAPP is presented in Table 2.1.

This QAPP also includes detailed sampling procedures in Sections 3 - 7.

This document will be periodically reviewed and updated by site personnel to reflect actual site conditions and permit monitoring requirements as needed.

Table 2.1: Monitoring Program Summary

AREA	PROGRAM MANAGER	QAPP SECTION	PROGRAM	PERMIT REFERENCE	ANALYTICAL LABORATORY
Effluent	Environmental Manager	18.0 Effluent Monitoring Program	Effluent Monitoring (OUTFALL001, OUTFALL011, and NPDES001B)	AK0053341 (1.3, 1.4)	Energy
	Environmental Manager	18.0 Effluent Monitoring Program	Effluent Monitoring (OUTFALL002 and Influent (STP002))	AK0053341 (1.5)	Pollen/Energy
	Environmental Manager	19.0 Whole Effluent Toxicity Program	Whole Effluent Toxicity Testing (OUTFALL001)	AK0053341 (1.3)	TRE/TestAmerica Bioassay
Surface Water	Environmental Manager	15.0 Surface Water Monitoring Program	Receiving Water (SW01, SW15, SW41, SW42, SW49)	AK0053341 (1.8)	Energy
	Environmental Manager	16.0 Fish Tissue Monitoring Program	Fish Tissue (SW01, SW12)	AK0053341 (1.7)	TA-Tacoma
Groundwater	Environmental Manager	17.0 Groundwater Monitoring Program	Detection Monitoring (RTP – MW12-500, MW12-501, MW12-502)	2018DB0001 (1.1.4, 1.2.6, 1.6.4)	Energy
	Environmental Manager	17.0 Groundwater Monitoring Program	Trend Monitoring (MW04-213*, MW11-216, LT99-009, MW99-216, MW18-001, MW18-002, MW18-003A, MW18-003B *MW04-213 is decommissioned as of 10/01/2019, MW18-003A and MW18-003B have replaced it.	2018DB0001 (1.6.4)	Energy
	Environmental Manager	17.0 Groundwater Monitoring Program	ORTW Groundwater (LL04-031, LL04-032)	2018DB0001 Pogo Mine Monitoring Plan	Energy
Process Control	Mill Manager	10.0 Fluid Management Program	Water Balance (fluid management)	2018DB0001(1.6.2.4)	NA
	Mill Manager	14.0 CIP Tailings Monitoring Program	CIP Tails (PC001, cyanide)	2018DB0001 (1.2.3/1.6.2.3)	Pogo Onsite Assay Laboratory
	Environmental Manager	13.0 Development Rock Segregation	Development Rock	2018DB0001 (1.2.1/1.5.2.6)	ALS Global
	Environmental Manager	12.0 Flotation Tailings Interstitial Water Program	Flotation Tailing Interstitial Water	2018DB0001(1.2.1/1.5.2.6)	Energy
	Environmental Manager	11.0 DSTF Geochemistry Program	DSTF Geochemistry (tailings and development rock placed in DSTF)	2018DB0001 (1.2.1/1.5.2.6)	ALS Global
Visual Monitoring	Environmental Manager	9.0 Visual Monitoring Plan	Facility Inspection	2018DB0001 (1.6.2.1)	NA
	Maintenance Manager	9.1 Biological Visual Survey Program	Biological Visual Survey	2018DB0001 (1.5.2.5)	NA
Hydrology	Environmental Manager	3.3 Hydrology Characterization	Hydrology Data Collection	NA	NA

2.2 Project/Task Organization

Figure 2.2.1: Task Organization Flow Chart

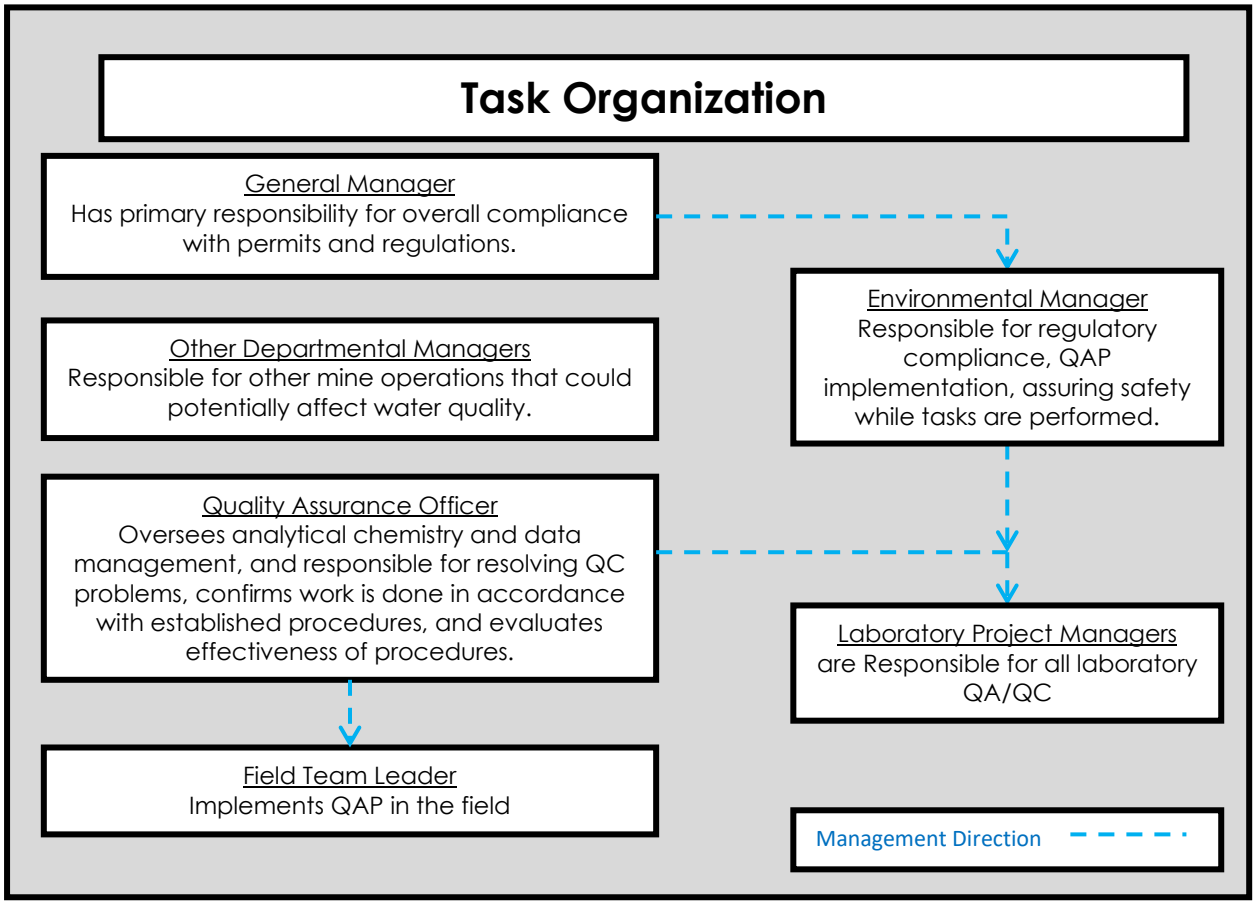


Table 2.2.2: Project Team

ROLE	POSITION	NAME	EMAIL	PHONE	ORGANIZATION
General Manager	General Manager	Michael Eckert	meckert@nsrltd.com	(907) 895-2834	Northern Star (Pogo) LLC
Department Managers	Environmental Manager	Russell Gossett	rgossett@nsrltd.com	(907) 895-2831	Northern Star (Pogo) LLC
	Processing Manager	Mark Pliska	mpliska@nsrltd.com	(907) 895-2751	
	Mine Manager	Sam Nethery	snethery@nsrltd.com	(907) 895-2746	
Quality Assurance Officer (QAO)	Senior Environmental Coordinator	James Meyers	jmeyers@nsrltd.com	(907) 895-2879	Northern Star (Pogo) LLC
Field Team Leaders	Environmental Coordinator	Nathan Kehoe	nkehoe@nsrltd.com	(907) 895-2760	

ROLE	POSITION	NAME	EMAIL	PHONE	ORGANIZATION
Contract Laboratory	Project Manager	Jon Hager	jhager@energylab.com	(877) 472-0711	Energy Laboratories, 3161 E. Lyndale Ave., Helena MT 59604
Contract Laboratory	Project Manager	Jarrod Pollen	jerry@pollenenv.com	(907) 479-8368	Pollen Environmental 3039 Davis Rd Suite A Fairbanks, Alaska 99709
Contract Laboratory	Project Manager	Rami B. Naddy, Ph.D.	Naddyrb.tre@gmail.com	(970) 416-0916	TRE Environmental Strategies, LLC 100 Racquette Drive, Unit A, Fort Collins, CO 80524
Contract Laboratory	Project Manager	Brett Muckey	brett.muckey@Eurofinset.com	(541) 243-0976	Eurofins TestAmerica Bioassay Laboratory 1100 NE Circle Boulevard, Suite 310, Corvallis Oregon 97330
Contract Laboratory	Project Manager	Matthew Hanson	Matthew.Hanson@ALSGlobal.com	(907) 452-2188	ALS Fairbanks 1060 Bush Street, Fairbanks, AK 99709
Contract Laboratory	Project Manager	Sheri Cruz	sheri.cruz@eurofinset.com	(253) 248-4960	Eurofins FGS Laboratories Inc. 5755 8th Street East, Tacoma WA 98424

The organizational structure was designed to provide project control and proper quality assurance/quality control (QA/QC) for the field investigation. The roles for individuals involved in the project are provided in Table 2.2.2. The responsibilities associated with each role are outlined below:

POSITION	RESPONSIBILITIES
General Manager	Has overall responsibility for compliance with existing permits as well as state and federal regulations related to Water Quality.
Department Managers	Are responsible for coordinating with the Environmental Superintendent to protect water quality, meet compliance requirements and ensure safe access to sampling areas.
Environmental Manager	Reports to the General Manager and works directly with other Departmental Managers as needed. The Environmental Superintendent assists project personnel in planning, coordinating, and controlling technical aspects of the project. They are responsible for monitoring the quality of the technical and managerial aspects of the project, implementing the QAPP, implementing corrective measures, and maintaining communication with regulatory authority.
Quality Assurance Officer (QAO)	Oversees analytical chemistry and data management activities and communicates directly with the Field Team Leader to coordinate field sampling activities. They are responsible for QC of the analytical chemistry and data management documentation, and resolves problems that may occur with laboratories, field activities, and sampling activities in accordance with the QAPP. They work directly with the Environmental Manager. The QAO ensures that personnel assigned to the project are trained on the requirements of the QAPP. They also review and verify nonconformance and corrective action reports and conduct periodic quality assurance audits. The QAO has authority to halt work performed in accordance with the QAPP in case of nonconformance or if minor problems are not corrected in a timely manner. The QAO is also responsible for maintaining all documentation required by the QAPP.

POSITION	RESPONSIBILITIES
Field Team Leader	Supervises site activities and is responsible for the implementation of the QAPP in the field. The Field Team Leader reports to the applicable Environmental Manager and communicates with the field staff and the Laboratory QAO. The Field Team Leader oversees scheduling field activities. They also oversee day-to-day activities including field measurements and data collection activities to check that they are conducted in accordance with the QAPP. They are responsible for documentation, packaging, and shipment of samples to the analytical laboratory
Laboratory Quality Assurance Officers (LQAOs)	Ensure that appropriate procedures are followed in accordance with each laboratory's Quality Assurance Plan. The laboratory QAO is responsible for: 1) Ensuring that the laboratory analyses and associated analytical methods are consistent with approved analytical methods and meet the accuracy, precision and sensitivity required by the ADEC and Pogo's permits; 2) Ensuring that their equipment is properly calibrated as specified in the manufacturer's guidelines and approved analytical methods; 3) Reviewing and validating all data and calculations in conformance with EPA and ADEC guidelines and the approved analytical method; 4) Preparing and transmitting the laboratory report; 5) Maintaining raw data including any worksheets, notebooks, sample tracking records, instrument logs, calibration records and quality control reports consistent with the laboratory's Quality Assurance Plan and the laboratory's document retention policy; and 6) Identifying and reporting any nonconformance and taking corrective action to address the nonconformance.

2.3 Project / Task Description

Refer to the Pogo Mine Monitoring Plan (Pogo, January 2022) for a detailed description and schedule for all monitoring activities. Measurements and associated QA/QC goals, procedures, and timetables for collecting the measurements are discussed below.

2.4 Quality Objectives and Criteria

The QAPP defines data quality objectives (DQOs) and measurement quality objectives (MQOs). After completion of the DQO process, MQOs are developed as criteria for data verification.

2.4.1 Data Quality Objectives

The objective of this project is to monitor water quality changes in surface and groundwater that may occur as a result of mining activities or discharges from the facility. It is also to monitor the processes associated with Pogo Mine Facilities. Based on the project objective, the primary data quality objectives of this project are as follows:

- Provide procedures for quality control beginning with sample collection and proceeding through data interpretation;
- Provide procedures to ensure that data are of known or acceptable precision, accuracy, representativeness, completeness, and comparability;
- Collect samples in accordance with relevant sampling methodologies;
- Obtain effluent data representative of operations and identify changes in effluent characteristics due to process variations;
- Properly package and ship samples to contract laboratory;
- Ensure that contract laboratories analyze samples using strict QC procedures as outlined in the *EPA Guidance for Analytical Methodologies*;
- Ensure that contract laboratories scrutinize and qualify data under their QA/QC program; and
- Submit data, fully validated, to the ADEC, EPA, or other stakeholders as required

2.4.2 Measurement Quality Objectives

MEASUREMENT	DEFINITION
Detectability	is the ability of the analytical method to reliably measure an analyte concentration above background levels. Detectability is determined using the Method Detection Limit (MDL) and the Practical Quantification Limit (PQL), Method Reporting Limit (MRL) or Reporting Limit (RL). MDL indicates the minimum value at which an instrument is able to discern the presence of the targeted analyte, but without certainty as to the accuracy of the measured value. PQL, MRL, or RL is the minimum value that can be reported with confidence and is usually a multiple of the MDL.
Precision	Is the ability of a measurement to be consistently reproduced. For the purposes of this plan, precision is the degree of agreement among repeated measurements of the same parameter and is expressed as the relative percent difference between two measurements. Precision will be calculated from replicated pairs with both results greater than the MRL using the formula: $Precision = RPD = \frac{A-B}{(A+B)/2} * 100$ Where: RPD = Relative Percent Difference A = Primary Sample B = Replicate Field Sample or Laboratory Duplicate Sample
Accuracy	Is the degree to which a measurement conforms to the correct value. For the purposes of this plan, accuracy will be determined using any of the following: instrument calibrations, various QC checks (e.g., sample split measurements, laboratory control sample recoveries, matrix spike (MS) recoveries, MS duplicates (MSDs), continuing calibration verification checks, internal standards, sample blank measurements (field and lab blanks), external standards, and performance audit samples. Accuracy will usually be assessed using the formula: $Accuracy = \frac{Measured\ Value}{True\ Value} * 100$ When sample spike recoveries are used to evaluate accuracy, accuracy will be assessed using the formula: $Accuracy = \frac{Measured\ Concentration\ of\ Spiked\ Sample - Sample\ Concentration}{Concentration\ of\ Spike\ Added\ to\ Sample} * 100$
Completeness	Is a measure of the percentage of valid samples collected and analyzed to yield sufficient information to make statistically defensible decisions. Project completeness will be determined for each parameter using the formula: $Completeness = \frac{T-(1+NC)}{T} * 100$ Where: T = Total number of expected sample measurements I = Number of invalid (rejected) sample measurements NC= Number of sample measurements not collected The completeness goal for this project will be 90 percent for each analytical parameter for the entire year
Comparability	Is a measure that indicates how data can be compared to other data sets. Comparability shall be established by referencing methods as specified in federal and/or state regulatory and guidance documents/methods for the parameters to be sampled and measured. All methods employed will be EPA CWA and ADEC Water Quality Standards methods. For a complete list of analytical methods used for data analysis at Pogo, please see Sections 11 - 20.

2.5 Assessment, Oversight, Response Action and Reports

2.5.1 Assessment and Oversight

All field measurements and analytical results are systematically checked for errors throughout the entire process from sample collection to reporting to ADEC. In addition, the QAO periodically conducts audits to ensure that the Field Team Leaders are performing the sampling and data collection in conformance with the requirements of the QAPP. The QAO periodically monitors contract laboratory performance by submitting split samples, blind audit samples and by sending duplicate samples to multiple laboratories (also refer to Table 8.5.1 DMR-QA Study General Reporting Schedule).

Data which are found to be invalid is flagged "AX" in EDMS which removes it from the active database. Invalid data exists when accuracy and precision requirements are not met, or when analysis, sampling and operating problems or reporting errors are present. Other examples are a non-representative sample, mislabelling of containers, and sampling the wrong location. When samples are not received by the contract laboratory within the allowable holding time or when they are improperly preserved, they are qualified by the laboratories and the qualified data is kept active in the database. See Section 8 for more detailed description of data validation.

In the case of missing samples, or broken sample containers, the sample will be collected again, if possible. Recollected samples that can be done within the permit sample frequency requirements will not be considered "missed" samples. Any missing or destroyed samples that cannot be recollected within the permit sample frequency requirements will be noted in the database and reported to ADEC.

When field equipment is used to collect field parameters, the specific probe used for the measurement is indicated on the sampling field data sheet. If field equipment is found to be inoperable or functioning outside the acceptable performance limits, it will be repaired or replaced prior to continued use. Data collected from any instrument immediately prior to the repair or replacement will be identified as questionable and appropriate actions will be taken including repeating measurements or resampled, if appropriate.

2.5.2 Responsible Actions

If any nonconformance with the QAPP is identified, the QAO will take steps to immediately address the nonconformance. The QAO also has the primary responsibility for designing and approving a response action plan to correct any nonconformance. When appropriate, a response action plan will contain the following:

- The nature of the nonconformance;
- The response actions needed to correct the nonconformance;
- Whether or not there is a deficiency in the QAPP and if a revision to the QAPP is necessary;
- The steps needed to implement the response action;
- Who is responsible for implementing the response action and revising the QAPP if appropriate;
- A timeline to implement the response action; and
- A post- implementation review.

If a nonconformance is identified by the contract laboratories, the contract laboratories will correct the nonconformance consistent with their applicable Quality Assurance Plans. Within the laboratory, response actions may involve a review of the calculations, check of the instrument maintenance and operation, review of analytical techniques and methodology, re-calibration of equipment, and reanalysis of quality control and field samples.

2.5.3 Reports

The QAO will periodically review and update the QAPP at least annually, or as required.

The QAO is responsible for ensuring that the Program Managers and Project Manager are informed of any nonconformance with the QAPP, any response actions necessary to correct the noncompliance, the completion of the response actions and any updates to the QAPP.

The Environmental Manager is responsible to ensure that any response actions to address nonconformance with the QAPP are timely completed and that appropriate resources are available. It is also the responsibility of the Program Manager and Project Manager to ensure that all appropriate staff read and comply with the QAPP and that the QAPP is regularly reviewed.

2.6 Training Requirements

Field Team Leaders receive extensive on-the-job instruction and training in proper sampling techniques based on EPA protocols. Employee training is completed through the INX database, which provides documents, SWPs, and skills necessary for specific roles and activities.

Wastewater Treatment and Potable Water System Operators are certified by the State of Alaska for their assigned duties.

The Quality Assurance Officer is responsible for the implementation and adherence to the QAPP. They are also responsible for the proper training of the Field Team Leader/Environmental Specialist/Technician in sample collection, handling and shipping.

Pogo requires that all contract laboratories analyzing data for the monitoring program have current EPA certification. They must also participate in the previous year's DMR QA Study. This ensures that the laboratory can meet the testing and evaluation guidelines requirements and standards of the EPA.

3. FIELD PLANNING AND MOBILIZATION

3.1 Field Trip Planning

Implement the following general steps during the field planning and mobilization process, as applicable:

1) Determine the number of people required to complete the sampling activities within the allotted time frame. For safety and efficiency in remote locations, a field team should consist of at least two people.
2) Identify sampling team members and develop a detailed itinerary and schedule:
   - Sample from the least contaminated to the most contaminated sampling point;
   - Sample from downstream to upstream in flowing water;
   - Ensure that at least one trained, experienced individual is part of each team;
   - Review procedures and any associated documents (sampling plan, permit, etc.);
   - Review project/site files for unusual procedures or site peculiarities; and
   - Review the safety plan and discuss contingencies (weather, broken equipment, site access, etc.).
3) Before leaving for the field, notify at least two people of your itinerary.
4) If a helicopter, snow machine, or boat is used, a Job Hazard Analysis (JHA) is recommended.
5) Assemble any needed maps, directions and site descriptions.
6) Identify the number of sampling points, and for each sampling point:
   - Determine the matrices that will be sampled;
   - Identify the specific analyses to be performed per matrix;
   - Identify the sampling equipment needs;
   - Determine the number and types of sample containers;
   - Determine the types of preservatives that will be needed;
   - Determine what field measurements must be taken; and
   - Identify transportation mode to reach each location (helicopter, truck, etc.).

3.2 Equipment and Supply Preparation

Prepare equipment and supplies as needed.

3.2.1 Sampling Equipment

Assemble all equipment and prepare as follows:

1) Inspect equipment for cracks, breaks, and other signs of wear, if necessary, repair any equipment and document the repairs in appropriate maintenance logs;
2) Clean any equipment that was not protected from the environment (stored on dusty shelves);
3) Decontaminate equipment by cleaning thoroughly and rinsing with DI water;
4) Clean all transport ice chests and water transport containers; and
5) Check to make sure fuel and battery powered pumps are working.

Store all dedicated equipment (except dedicated pump systems or dedicated drop pipes) in a controlled environment. If possible, store equipment in an area that is located away from the sampling site. If equipment other than dedicated pumps or dedicated drop pipes is stored in monitoring wells, suspend the equipment above the well water. Secure the monitoring well in order to prevent tampering between sampling events.

3.2.2 Field Instruments

Assemble all field instruments and prepare as follows:

1) Inspect instruments for damage, repair and/or replace parts as necessary, and document in appropriate maintenance logs;
2) Assemble the appropriate calibration standards and supplies;
3) Determine the accuracy of the instruments by either performing an initial calibration or checking the calibration before leaving the base of operations; and
4) Document the calibration.

3.2.3 Documentation

Assemble field record supplies such as field forms, waterproof pens, clipboard, camera, and Global Positioning System (GPS) unit, if needed.

3.2.4 Sample Containers

Assemble the appropriate types of sample containers obtained from the contract laboratory. Sample containers are provided by the analytical laboratory. All sample containers are received pre-cleaned and, depending on the laboratory, some contain preservatives already added in the correct ratio, and some require addition of preservatives directly after collection.

3.2.5 Preservatives

Assemble preservation supplies provided by the laboratory. Discard any expired solution and obtain fresh solution.

3.2.6 Field Decontamination Supplies

Assemble field decontamination supplies. Discard any old de-ionized (DI) water. Clean containers and prepare fresh solutions.

3.2.7 Shipping Supplies

Assemble shipping supplies such as coolers and ice packs, chain of custody forms, shipping labels, tape, and custody seals.

3.2.8 Vehicles

Make sure vehicle maintenance is up to date. Perform pre-shift inspection.

3.2.9 Safety Equipment

Assemble any needed safety equipment such as: handheld radio, rubber gloves, rubber boots (if needed), respirator (if required), first aid kit, drinking water, bear spray, GPS "SPOT" Tracker, and JHA (if required).

4. GENERAL SAMPLING PROCEDURES

This section presents sample collection methodology and sample custody requirements.

4.1 Sampling Process Design

The sampling location and frequency is described in the Pogo Mine Monitoring Plan (Pogo, January 2022) and the ADEC APDES Permit (AK0053341) and Waste Management Permit (2018DB0001).

4.2 Sample Collection

Include the following documentation for sample collection, sample handling and field-testing activities.

4.2.1 Sample Identification Requirements

Label or tag each sample container with the sample ID. This includes, at a minimum: name of site, date and time sample was collected, and preservative if used. Some labs prefer the name or initials of sampler on bottle as well. However, this is also documented on the COC.

Attach the label or tag so that it does not contact any portion of the sample that is removed or poured from the container.

Record the sample ID on field data sheets, COCs, and any other documentation associated with the specific sample container.

4.2.2 General Requirements for Sampling Documentation

Record the following information for all sampling:

- Name of person(s) that collected the sample.
- Date and time of arrival onsite
- Profile name, or a description of the number and types of sample containers and preservatives
- Description of sampling methodology by reference to the appropriate SWP
- Date and time of sample collection. Indicate hours and minutes, use 24-hour clock time, and note the exact time of collection for sample containers (all samples collected under the same location and sample ID should use the same date and time)
- Ambient field conditions such as weather, activities nearby, etc.
- Detailed description of sample location (e.g., monitoring well identification number, outfall number, station number, etc.).
- Unique sample ID for each sample container and parameters to be analyzed.
- Matrix sampled.

Field-testing measurement data, to include the following:

- Project name;
- Date and time of measurement or test;
- Detailed description of sample or monitor location (e.g., monitoring well identification number, outfall number, station number or other description);
- Parameter measured;
- Value in appropriate reporting units;
- Name of person(s) performing the measurement(s);
- Unique identification of the specific field instrument unit(s) used;
- Calibration records for field-testing equipment;
- Profiles or individual analyses to be ordered;
- Type of purging and sampling equipment used.
- Type, number, collection location and collection sequence of quality control samples;
- Number of grab or subsamples and amount of each in any composite samples. Record location for each grab sample in a composite sample; and
- Signature(s) or initials of sampler(s).

4.3 General Sampling Procedures

4.3.1 Sample Containers

When collecting aqueous samples in an intermediate container (such as dipping bottle or 5-gallon bucket), intermediate container must be certified clean. Alternatively, intermediate containers may be cleaned with formal decontamination procedures. All intermediate containers should be rinsed with a portion of the sample water before taking the actual sample. Certified sample containers from the contract laboratory do not need to be rinsed. Do not rinse sample containers with pre-measured preservatives.

4.4 Contamination Prevention and Sample Collection Order

4.4.1 Contamination Prevention

Collect the ambient or background samples first and store them in separate ice chests or shipping containers. Collect samples in flowing water from downstream to upstream. Do not store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same ice chest or shipping container with other environmental samples. Isolate these sample containers by sealing them in separate, untreated plastic bags immediately after collecting, preserving, labeling, etc. Use a clean, untreated plastic bag to line the ice chest or shipping container.

4.4.2 Special Considerations for Low Level Mercury

If low level mercury (Hg) samples are required, ultra clean procedures are used to ensure samples meet QC criteria. The contract laboratory provides low level Hg bottles that have been verified as clean by the laboratory. Low level Hg bottles must be shipped and stored in two sealed resealable bags, with one sealed bag sealed inside the second bag. When collecting a low-level Hg sample, the sampler follows all procedures specified by the EPA methodology. EPA Methods 245.7 and 1631E specify that samplers should make every effort to minimize the duration in which the sample bottle is exposed to open air, special Hg free sampling gloves should be worn, and particular effort should be made to keep the low level Hg bottle and resealable-bags clean and free of dust, dirt, or water.

4.4.3 Sample Collection Order

Unless field conditions dictate other sampling regimens, collect samples in the following order: Volatile Organics and Volatile Inorganics, Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil & Grease, Total Metals, Dissolved Metals, Inorganic Nonmetallic, Physical and Aggregate Properties, and Biologicals, Radionuclides, and Microbiological.

If the pump used to collect groundwater samples cannot be used to collect volatile or extractable organics, then collect all other parameters, withdraw the pump and tubing, and collect the volatile and extractable organics.

4.4.4 Protective Gloves

Gloves serve a dual purpose to: (1) protect the sample collector from potential exposure to sample constituents and (2) minimize accidental contamination of samples by the collector.

Always wear protective gloves (latex, nitrile, etc.) when conducting sampling activities. Wear gloves while handling sample containers and do not let gloves come into contact with the sample or with the interior or lip of the sample container.

Use clean, new, un-powdered and disposable gloves. Latex or nitrile gloves are recommended; however, other types of gloves may be used as long as the glove materials can not contaminate the sample or if internal safety protocols require greater protection. The powder in powdered gloves can contribute significant contamination and it is not recommended unless it can be demonstrated that the powder does not interfere with the sample analysis.

Change gloves: (1) after preliminary activities such as pump placement; (2) after collecting all the samples at a single sampling point; or (3) if torn or used to handle extremely dirty or highly contaminated surfaces. Properly dispose of all used gloves.

4.5 Preservation and Storage

Samples are stored at < 6° C or < 42.8° F in the refrigerator at the Environmental Lab in a manner that ensures that they cannot freeze. Preservative, container and holding time requirements are specific for each analyte and are in accordance with 40 CFR Part 136, EPA and ADEC requirements. When samples are stored in the Environmental lab refrigerator for more than 24 hours, refrigerator temperature must be recorded to ensure sample temperature compliance. Temperature of refrigerator is checked visually on an interior thermometer whenever sampling events occur to assure temperature remains within the desired range. An automatic, battery-operated data logger for temperature is downloaded weekly, and checked for anomalies. Any unusually high temperatures are checked to see if they coincide with the storage of collected samples. Downloading and data management procedures are on SharePoint and can be found using their SharePoint ID# in Section 21 - Related Documents, Water Meter Calibration SWP.

Samples are preserved to prevent chemical, physical and/or biological processes from changing the actual concentration of an analyte present at the time of sampling. In order to preserve sample integrity until the time of analysis, various preservatives are added to the sample depending on the type of analysis required. Some of the commonly used preservatives are:

- Nitric Acid;
- Sodium Hydroxide;
- Sulfuric Acid;
- Hydrochloric Acid;
- Methanol; and
- Zinc Acetate

Personal protective gear such as safety glasses and latex/nitrile gloves will be worn when opening sample bottles.

Preservation protocols specify immediate preservation. "Immediate" is defined as "within 15 minutes of sample collection." Some analytical laboratories provide pre-preserved sample bottles for use with on-site sample collection. Other laboratories include preservatives in separate containers (with color coded lids) for field preservation. Twenty-four hour composite water samples are the exception to the "15-minute" criterion.

Samples are stored under the direct control of the Environmental Department until relinquished to the shipper. Samples are shipped to the laboratory in insulated coolers with sufficient ice packs to maintain sample temperatures at < 6° C. A temperature blank is placed in each cooler shipped so temperature can be confirmed by the contract laboratory. The contract laboratory will measure temperature upon receipt of samples using a thermometer readable to 3 significant digits and will report the temperature to no fewer than 2 significant digits. The laboratory will also confirm that samples did not freeze during shipment.

4.6 Sample Custody

4.6.1 Chain of Custody

Chain of Custody (COC) procedures are used to demonstrate that the samples and/or sample containers are handled and transferred in such a manner to eliminate possible tampering. Use the following procedures to document and track all time periods and the physical possession and/or storage of sample containers and samples from point of origin through the final analytical result and sample disposal.

When COC is used, samples must be: (1) in the actual possession of a person who is authorized to handle the samples (e.g., sample collector, laboratory technician); (2) in the view of the same person after being in their physical possession; (3) secured by the same person to prevent tampering; or (4) stored in a designated secure area. Unoccupied hotel or motel rooms are not considered secure storage unless the containers are secured with custody seals or tamper-indicating tape.

Use a COC form to document sample transfers. Other records and forms may be used to document internal activities. Limit the number of people who physically handle the sample.

COC begins when the cleaned sample containers are dispatched to the field. The person who relinquishes the prepared sample kits or containers and the individual who receives the sample kits or containers must sign the COC form unless the same party provides the containers and collects the samples. All parties handling the sample are responsible for sample custody (i.e. relinquishing and receiving) and documentation except when the samples or sampling kits are relinquished to a common carrier. Laboratory specific COC forms, sample labels, and sample logs may be substituted if the laboratory forms document the same information as Pogo forms.

4.6.2 Shipping Samples under COC

Complete all relevant information on the COC form: (1) sampling site name and location; (2) number of coolers; (3) number of pages of COC; (4) date, time, and depth of sample collection; (5) unique field identification code for each sample source and each sample container; (6) names of person(s) collecting samples; (6) signatures of all transferors and transferees; (7) time of day and calendar date of all custody transfers; (8) clear indication of number of sample containers; (9) required analyses by approved method number or other description; (10) common carrier usage; and (11) sample container/preservation kit documentation, if applicable.

The COC form must have a place to document the date, time and person who prepared the shipping container for shipment, and the name of the common carrier. The person who seals the samples in the shipping containers must be the last person to sign the COC form.

Place the forms in a sealed water-proof bag and place in the shipping container with the samples. Seal the shipping container with custody seals or tamper-proof tape so that any tampering can be clearly seen by the individual who receives the samples. Note: The common carrier does not sign COC forms but the COC form must identify the common carrier (when used).

4.6.3 Delivering Samples to the Laboratory

Pogo personnel sign the COC's and seal the COC in the sample coolers prior to shipment offsite. The coolers are transported to the analytical laboratory via Pogo personnel, courier services, and/or commercial air transportation.

4.6.4 Chain of Custody Seals

Use tamper-indicating tape or custody seals on all shipping containers that are used to transfer or transport shipping containers and samples. Place the seal so the transport container cannot be opened without breaking the seal.

4.7 Instrument Equipment Testing Inspection and Maintenance

Section 7.0 provides field testing and measurement details.

4.7.1 Testing and Maintenance

Preventive maintenance activities are necessary to ensure that the equipment can be used to obtain accurate results and to avoid unusable or broken equipment while in the field. Equipment is properly maintained when: (1) it functions accurately during mobilization; and (2) it is not a source of sample contamination (e.g., dust, cross-contamination).

All field staff are responsible for regular cleaning, inspection, and maintenance of their assigned equipment. All equipment should be visually inspected daily for damage or dirt and repaired or cleaned if needed before use. Refer to instruction manuals for manufacturer's recommendations for inspection, maintenance, and repair.

4.7.2 Inspection and Calibration

All field meters must be inspected and calibrated at the beginning of each day used. Field staff should record calibration information on the appropriate form, including sampler(s) name, date/time of initial calibration, meter number, and date of last probe/battery replacement. A copy of Pogo's field instrument calibration forms are provided in Pogo's Water Meter Calibration SWP. Refer to the manufacturers' instruction manuals for specific calibration procedures. Standards should be selected so that they bracket the range of measurements expected that day.

Instruments have internal "Acceptance Criteria" (see Table 4.7.2.1) and if the instrument falls within the acceptable range, it will accept a calibration by exiting calibration menu. If the instrument does not calibrate it displays "Out of Range" or "Calibration Failed" and is re-calibrated. A post-calibration check will be performed to ensure proper calibration. The instrument will be re-calibrated if measurements do not meet the numeric acceptance criteria provided in Table 4.7.2.1. If re-calibration fails, field maintenance (probe replacement, cleaning etc.) may be performed if feasible. If calibration cannot be achieved the instrument is returned to a manufacturer's representative for repair or replacement.

Meters should also be recalibrated if any of the following occur: physical shock to meter; dissolved oxygen (DO) membrane is touched, fouled, or dries out; unusual (high or low for the particular site) or erratic readings, or excessive drift; extreme readings (e.g., extremely acidic or basic pH; DO saturation >120%); or measurements are outside of the range for which the meter was calibrated. Refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Water Meter Calibration SWP.

Table 4.7.2.1: Field Equipment Calibration Numeric Acceptance Criteria

EQUIPMENT INSTRUMENT	PROCEDURE	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	SWP/ REFERENCE
YSI Professional Plus	pH 4.01	Place probe in 4.01 buffer and reading should be ±0.5 or between 3.96 and 4.06.	Recalibrate / Replace sensor	Environmental Specialist or Technician	Water Meter Calibration SWP
	pH 10.1	Place probe in 10.01 buffer and reading should be ±0.5 or between 9.96 and 10.06.	Recalibrate / Replace sensor	Environmental Specialist or Technician	Water Meter Calibration SWP
	Temperature	± 0.5°C	Send to Manufacturer's Rep for Repair	Environmental Specialist or Technician	Water Meter Calibration SWP
	Specific Conductance	Gain Between 1.0 +/- 0.09	Recalibrate / Replace sensor	Environmental Specialist or Technician	Water Meter Calibration SWP
	Dissolved Oxygen	Gain Between 0.7 +/- 1.5	Replace sensor	Environmental Specialist or Technician	Water Meter Calibration SWP
Hach 2100Q Turbidimeter	Turbidity	± 1 NTU of 10NTU standard	Recalibrate	Environmental Specialist or Technician	Water Meter Calibration SWP

4.7.3 Decontamination of Field Equipment

Decontamination is the cleaning process used to remove contaminants from equipment. Sample-wetted equipment is decontaminated after sample collection at each station, preferably before the equipment dries. Decontamination is conducted in clean and protected environments (in field area, vehicle, or chamber) as is appropriate to the equipment being cleaned. If this is not possible, the equipment is at least flushed and rinsed, preferably with a low-phosphate detergent, followed by a clean water (DI) rinse, before it is temporarily stored for thorough cleaning at a later date and before it is reused to collect samples.

Depth-to-Water Meter probes (approximately the last 12'' of probe) are decontaminated between use in groundwater wells. A solution of a low-phosphate soap (Alconox) mixed with water (in a spray bottle or other container) is used to clean the probe, after which it is rinsed thoroughly with DI water before being used in a different well.

To verify that decontamination is adequate, equipment blanks are prepared at selected stations if required (see section 5.2.1 Equipment Blanks).

4.7.4 SWP Master Reference List

A binder with a printed copy of this QAPP and all applicable SWPs (Section 21 - Related Documents) will be available in the Environmental Field Lab at all times. This hardcopy collection of SWPs are updated as needed by the Environmental Specialist or Technician. All current SWPs will be available on the Pogo document control system, Northern Star Intranet via Microsoft SharePoint. See Table 4.7.2.2 Master List of Standard Operating Procedures Associated with QAPP.

Table 4.7.2.2: Master List of Safe Work Procedures Associated with QAPP Located in SharePoint

Document Name	Document Number
APDES Outfall Sample Collection SWP	PGO-ENV-038-SWP
DSTF Piezometer Data Downloading & Compiling Manual	PGO-ENV-002-SWP
Drinking Water Lead and Copper Sample Collection SWP	PGO-ENV-035-SWP
Field Hydrological Data Collection - Instrument Maintenance SWP	PGO-ENV-009-SWP
Fish Tissue Sample Collection SWP	PGO-ENV-036-SWP
Flotation Tailings Geochemistry and Interstitial Water (PC003) Sample Collection SWP	PGO-ENV-040-SWP
Mineralized Waste Rock (Red Rock) PC002 Geochemistry Sample Collection SWP	PGO-ENV-034-SWP
Monitoring Well Sample Collection SWP	PGO-ENV-033-SWP
Snow Survey SWP	PGO-ENV-032-SWP
Surface Water Sampling on the Goodpaster River SWP	PGO-ENV-030-SWP
Waste Rock Characterization SWP	PGO-ENV-042-SWP
Water Meter Calibration SWP	PGO-ENV-037-SWP
Whole Effluent Toxicity (WET) Test Sample Collection SWP	PGO-ENV-031-SWP
Pogo Assay Laboratory Quality Assurance Plan	PGO-PRO-ALA-062-PLA

5. QUALITY CONTROL

This section describes field and laboratory quality control samples. These samples are intended to provide information needed to evaluate method performance during sample collection and analysis and to determine whether subsequent analytical results meet project DQOs.

5.1 Field Quality Control Requirements

5.1.1 Scope & Applicability

Field quality control measures monitor the sampling event to ensure that the collected samples are representative of the sample source and that the field-collected data have stated limits of precision and accuracy.

1. Field-collected blanks must demonstrate that the collected samples have not been contaminated during sampling, transport, or storage.
2. Field Measurement Quality Controls must demonstrate that the instrument was properly calibrated and that it maintained an acceptable level of calibration during use.

5.1.2 Equipment & Supplies

De-ionized (DI) water for blanks must be obtained from the contract laboratory. The contract laboratory will provide volumes of water sufficiently pure to serve as field blanks when QC criteria require blanks to be collected. The Field Team Leader shall be responsible for ensuring that the appropriate quantity and purity of DI is ordered and delivered from the contract laboratory.

When requested, the contract laboratory shall be responsible for providing DI water appropriate for low-level analytes, in particular for Hg, Cu, and VOA analysis.

5.1.3 Procedures

When collected, analyze all quality control samples for the same parameters as the associated samples using identical methods and MRLs.

Preserve, transport, document and handle all quality control samples as if they were samples. Once collected, they must remain with the sample set until the laboratory has received them. Except for trip blanks, prepare all quality control samples on-site in the field during sample collection. Trip blanks are not required, but must be collected and analyzed if the analytical test method requires them.

Table 5.1.3.1 provides field quality control samples for various matrices. More detailed duplicate and field blank scheduling is presented in sections 11 - 20 of this QAPP.

Table 5.1.3.1: General Field Quality Control Samples by Matrix

QC SAMPLE	MATRIX	FREQUENCY OF COLLECTION
Duplicate	Water	Collect at a minimum ten percent of each reported test result (i.e. for each sample container submitted). Collect at least one field duplicate for each reported test result combination each year.
	Development Rock	Collect at a minimum four percent of each reported test result (i.e. for each sample container submitted). Collect at least one field duplicate for each reported test result each year.
Blank	Water	Collect at a minimum ten percent of each test result for cyanide and metals (including major cations). Collect at least one blank (excluding trip blanks) for each reported test result for cyanide and metals each year. Collect field-cleaned equipment blanks if any sample equipment decontamination is performed in the field. If decontamination is not performed in the field, collect pre-cleaned equipment blanks if the equipment is not certified clean by the vendor or the laboratory providing the equipment. Collect field blanks if no equipment except the sample container is used to collect the samples or if the sampling equipment is certified clean by the vendor or the laboratory providing the equipment.
	Soil, Sediment	Collect at a minimum ten percent of each test result for cyanide and metals. Collect at least one blank (excluding trip blanks) for each reported test result for cyanide and metals each year. Collect field-cleaned equipment blanks if any sample equipment decontamination is performed in the field. If decontamination is not performed in the field, collect pre-cleaned equipment blanks if the equipment is not certified clean by the vendor or the laboratory providing the equipment.
	Development Rock	Collect at least one blank (excluding trip blanks) for each reported test result for metals each year. Collect field-cleaned equipment blanks if any sample equipment decontamination is performed in the field. If decontamination is not performed in the field, collect pre-cleaned equipment blanks if the equipment is not certified clean by the vendor or the laboratory providing the equipment.
	Fish Tissue	If the sample container consists of a Ziploc-type bag, field blanks will be submitted each sampling round and will consist of the sample container filled with distilled/de-ionized water.

QC SAMPLE	MATRIX	FREQUENCY OF COLLECTION
Split	Water	Collect as necessary for determining variability between laboratories.
Replicate	Fish Tissue	Collect at a minimum ten individual fish at each station
Laboratory QC	Fish Tissue	Collect at a minimum five additional fish per station for laboratory QA/QC.

5.2 Quality Control Blanks

When applicable, collect blanks for the following parameter groups and tests: volatile organics; extractable organics; metals; trace metals; inorganic metallics; radionuclides; petroleum hydrocarbons and oil & grease; volatile inorganics; and aggregate organics except Biochemical Oxygen Demand.

Blanks are not required for: microbiological (all types); toxicity; field parameters such as pH, specific conductance, residual chlorine, temperature, dissolved oxygen, ORP and salinity; radon; algal growth potential; biological community; physical and aggregate properties; and biochemical oxygen demand.

5.2.1 Equipment Blanks (EB)

Field-Cleaned equipment blanks are collected on equipment that is decontaminated in the field, usually between sampling sites. If the equipment has been certified clean by the vendor or the laboratory providing the equipment, equipment blanks aren't necessary.

Collect field-cleaned equipment blanks if any sample equipment decontamination is performed in the field (i.e., between sampling points) during the middle to end of a sampling trip. Do not prepare field-cleaned equipment blanks after leaving the sampling site.

Annual surface water equipment blanks are collected from dipping bottles after decontamination of collection bottle between one sampling site. This process verifies efficacy of the triple rinse process. Alternately, new, laboratory clean bottles may be used at every site for every sampling event, after which no equipment blanks are required. Another alternative is to have a dedicated dipping bottle used only at one site that is triple rinsed between sampling events. This application also does not require an equipment blank.

Ground water wells with dedicated pumps, or dedicated foot valves/tubing, do not require equipment blanks.

5.2.2 Field Blanks (FB)

Field blanks are collected if no equipment except the sample container is used to collect the samples or if the sampling equipment is certified clean by the vendor or the laboratory providing the equipment.

Field blanks are used to monitor on-site sampling environment, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions. Prepare field blanks by pouring analyte-free water into sample containers for each parameter set to be collected. Field blanks are not required if equipment blanks are collected.

5.2.3 Trip Blanks (TB)

Trip blanks are used to monitor sample container cleaning, the suitability of sample preservatives and analyte-free water, and both sample transport and storage conditions. These blanks are applicable if samples are to be analyzed for volatile constituents (volatile organics, methyl mercury, etc.). The laboratory providing the volatile organic constituent (VOC) vials provides the trip blanks by filling one or more VOC vials with analyte-free water. The trip blanks are prepared without air bubbles. Place a set of trip blanks in each transport container used to ship/store empty VOC vials. They must remain with the VOC vials during the sampling episode and must be transported to the analyzing laboratory in the same shipping or transport container(s) as the VOC samples.

Trip blanks must be opened only by the laboratory after the blank and associated samples have been received for analysis.

5.3 Field Duplicates

Field duplicates are designed to measure the variability in the sampling process. Collect duplicates by repeating (simultaneously or in rapid succession) the entire sample acquisition technique that was used to obtain the first sample. Collect, preserve, transport and document duplicates in the same manner as the samples. These samples are not considered laboratory duplicates.

If collected, analyze field duplicates for the same parameters as the associated samples using the same methods and MRLs. When possible, collect duplicate samples from sampling locations where concentrations are measurable. Vary the sampling location each duplicate round.

5.4 Split Samples

Split samples may be used as a means of determining compliance, as an added measure of quality control, or for monitoring laboratory performance. Unlike duplicate samples that measure the variability of both the sample collection and laboratory procedures, split samples measure only the variability between laboratories. Therefore, the split samples must be subsamples of the same parent sample and every attempt must be made to ensure sample homogeneity.

Pogo will submit a selection of split samples to at least one other qualified alternative laboratory annually, as a cross-check for accuracy. At least three samples will be collected with various analytical profiles, *i.e.* surface water, groundwater, effluent etc. for each annual sampling event.

WAD cyanide split samples, from the CIP (Carbon-in-Pulp) stock tank (PC001), will also be collected at least annually, and then sent off site to be analyzed by a contract laboratory using a standard EPA approved method. This will assure that the Pogo Assay Lab obtains results comparable to generally acceptable methods for WAD cyanide analysis.

When split samples are incorporated as an added quality control measure, all the logistics of collecting the samples, the supplier(s) of the preservatives and containers, the analytical method(s) should be decided ahead of time. The resulting data from each lab should not show a statistically significance difference of more than 5%; if this does occur, further sampling and investigation may be required to assure laboratory accuracy.

5.4.1 Water

Collect split samples for water in one of two ways:

- Mix the sample in a large, appropriately pre-cleaned, intermediate vessel (a churn splitter is recommended). This method shall not be used if volatile or extractable organics, oil and grease or total petroleum hydrocarbons are of interest. While continuing to thoroughly mix the sample, pour it into the appropriate sample containers.
- Alternatively, fill the sample containers from consecutive sample volumes from the same sampling device. If the sampling device does not hold enough sample to fill the sample containers, use the following procedure: fill the first container with half of the sample, and pour the remaining sample into the second container; obtain an additional sample, pour the first half into the second container, and pour the remaining portion into the first container; continue until both containers are filled.

5.4.2 Soils, Sediments, Chemical Wastes and Sludges

Collecting split samples for these matrices is not recommended because a true split sample in these matrices is not possible.

5.5 Sample Frequency

Specific field QC sample minimum frequency requirements are described in the following sections.

5.5.1 Field Duplicates

Collect at a minimum ten percent of each sample profile/matrix combination (e.g., quarterly water treatment plant samples, surface water samples). Collect at least one field duplicate for each sample profile/matrix combination each year. Collect during the sampling trip that includes the first sample of every ten (or less) samples collected.

5.5.2 Blanks

Collect at a minimum ten percent of each reported test result/matrix combination. Collect at least one blank (excluding trip blanks) for each reported test result/matrix combination each year. Collect during the sampling trip that includes the first sample of every ten (or less) samples collected.

To claim that a positive result is due to external contamination sources during sample collection, transport or analysis, then at least one field collected blank (excludes trip blanks) must have been collected at the same time the samples were collected and analysed with the same sample set.

If the results of a blank are positive, collect another blank under the same conditions during the next sample round and repeat until the problem is identified and solved.

5.6 Laboratory Quality Control

5.6.1 Scope and Applicability

EPA certified laboratories are required for compliance analysis. A copy of the contract lab's QAPP can be obtained upon request. Laboratory quality control samples are analysed with each batch of samples submitted to Pogo's contract laboratory. Quality control requirements involve monitoring sample preparation, measurement, analysis, and reporting within the laboratory and consist of the following checks:

- Method Blank
- Reagent Blank
- Storage Blank
- Instrument Blank
- Lab Duplicate
- Lab Matrix Spike
- Matrix Spike Duplicate
- Surrogates
- Lab Control Sample
- Calibration Checks
- MRL Checks
- Internal Standards

Generally acceptance criteria for quality control samples are method specific. The corrective actions and criteria listed in the tables below generally apply. However, there may be analyte-specific control limits or somewhat different corrective actions that may apply in specific cases. For instance, if a method blank is out of limits but all associated samples are non-detects for the analytes impacted, and all other QC is in control, corrective action may not be required. Such cases are normally discussed in the Case Narrative provided with the report. The quality assurance criteria can be found in Appendix B.

6. GENERAL DOCUMENTATION PROCEDURES

The QAO is responsible for maintaining all documentation required by the QAPP.

6.1 Universal Documentation Requirements

Ensure that the history of a sample is clearly evident in the retained records and can be independently reconstructed.

6.1.1 Criteria for All Documents

Keep all original hardcopy data and or electronic records (i.e. Word documents, Excel spreadsheets, EDMS database etc.) for auditing purposes. These forms, or access to electronic information, shall remain accessible on-site.

Record enough information so that clarifications, interpretations, or explanations of the data are not required from the originator of the documentation.

Clearly indicate the nature and intent of all documentation and all record entries.

Refer to SWPs and other documents by the complete name, reference or publication number, and revision number and revision date for the cited document, when applicable.

Retain copies of all revisions of all cited documents as part of the documentation archives.

6.1.2 Procedures

Sign or initial and date all documentation entries made to paper, digital/electronic or other records, clearly indicating the reason where applicable (e.g., "sampled by"; "released by"; "prepared by"; "reviewed by").

Employ straightforward archiving of records to facilitate documentation tracking and retrieval of all current and archived records for purposes of inspection, verification and historical reconstruction of all procedures and measurement data.

Keep copies or originals of all documentation stored on site, including documentation sent to or received from external parties. All documentation kept for a minimum of five years.

Use indelible ink for all paper documentation.

Do not erase or obliterate entry errors on paper records. Make corrections by marking a line through the error so that it is still legible. Initial or sign and date the marked error and its correction. Indicate where and if other changes to the entry have been made.

Utilize software that allows tracking of users and data edits, if feasible. Software that prompts the user to double-check edits before execution is also preferred.

Link reports, field data, data summaries or other versions of data to the original sample data.

6.1.3 Documentation Storage Requirements

Keep all documentation archives for a minimum of five years after the date of project completion or permit cycle unless a longer period is specified in an order or permit. All documents are stored on site.

Store media such as photographs, photographic negatives, microfilm, videotape, etc. under protection from deterioration.

6.2 Electronic Documentation

6.2.1 Retention of Automatic Data Recording Products

For data not directly read from the instrument display and manually recorded, retain all products or outputs from automatic data recording devices, such as strip chart recorders, integrators, data loggers, field measurement devices, computers, etc. Store records in electronic, magnetic, optical or paper form, as necessary.

Retain all original, raw output data. Ensure archiving of these data prior to subsequent reduction or other manipulation of the data.

Identify output records as to purpose, analysis date and time, field sample identification number, data source, or instrumentation used to make the measurement.

6.2.2 Electronic Data Security

Control levels of access to electronic data systems as required to maintain system security and to prevent unauthorized editing of data.

Do not alter raw instrumentation data or original manual data records in any fashion without retention of the original raw data and renaming the data record.

Maintain secure computer networks and appropriate virus protection as warranted for each system design.

6.2.3 Electronic Data Storage

Store all electronic, magnetic and optical media for easy retrieval of records.

Ensure that all records can be printed to paper if needed for audit or verification purposes.

If it is anticipated that the documentation archive will become unreadable due to obsolescence of a particular storage technology, retain a paper archive of the data or transfer to other suitable media.

Back up all data at a copy rate commensurate with the level of vulnerability of the data. Consider replicating all original data as soon as possible after origination.

6.2.4 Software Verification

Ensure that any software used to perform automatic calculations conforms to required formulas or protocols. Document all software problems and their resolution. Record the date, responsible personnel and relevant technical details. Note all software changes, updates and installations. File associated service records supplied by vendors or other service personnel.

6.2.5 Protection of Equipment and Storage Media

Protect computers, instrumentation, peripheral devices and storage media from deteriorating conditions such as temperature, humidity, magnetic fields, spillage or other hazards.

6.3 Sample Documentation

Each sample will be documented to ensure that each analytical result belongs to a uniquely identified sample and to indicate the quality of that result.

6.4 Sample Shipping

If shipping transmittal forms are placed in the transport containers with the samples, place the forms in a waterproof enclosure and seal.

For common carrier shipping, seal transport containers securely with strapping tape or other means to prevent lids from accidentally opening. Keep all shipping bills from common carriers with archived transmittal records.

6.5 Sample Handling and Custody

Written documentation of sample custody from the time of sample collection through the generation of data by analysis of that sample is recognized as a vital aspect of an environmental study. The chain-of-custody of

the physical sample and its corresponding documentation will be maintained throughout the handling of the sample.

6.6 Field Records & Documentation

Field observations and findings are documented on the various forms referenced in SWPs related to the sampling event (Section 21 - Related Documents). Only indelible ink should be used to record entries on field forms (no pencil). Field notes include water quality measurements, sampling times, sampler name, sampling conditions, weather conditions, and any other unusual circumstance.

At a minimum the following type of information needs to be recorded:

- Sample dates and times;
- Sampler name;
- ID number for the field meters used;
- Instrument readings;
- Site locations;
- Weather and other conditions such as ice thickness;
- Unusual circumstances such as turbid water, low or high flow, discoloration, etc, and
- If any photos were taken

Documentation of field observations is necessary to provide a record of data and observations to enable participants to reconstruct events that occurred during sampling and to refresh the memory of samplers if called upon to testify during legal proceedings. Notes should be made in real-time and not after returning from the field. All entries should be initialed and dated. Correct mistakes by drawing a single line through the text and initialing the deletion. Do not erase or cover with liquid paper. Do not leave sections blank on forms.

If a sample was not collected during a scheduled sampling event, (due to frozen conditions, a dry well, pump or other equipment problems) it is noted on the field data sheet in the comments box or other applicable area. All unsuccessful sampling events are entered into EDMS via a drop-down box of common reason for failure or, alternately, explanations can be entered in the "comments" portion of the screen.

6.7 Field Equipment Maintenance, Calibration, and Reagent Documentation

6.7.1 Documentation of Equipment Maintenance

Follow the manufacturer's suggested maintenance activities and document all maintenance. Assign each specific instrument with a unique description or code for each instrument unit employed. This may include a manufacturer name, model number, serial number, inventory number, etc. Label each unit accordingly.

Document the following information for each piece of instrumentation: identity (unique identifier code) and description (including software if used); manufacturer's name, model number, and serial number (if applicable); calibration checks or other tasks that demonstrate that the equipment performs as expected; manufacturer's operating and maintenance instructions; written preventive maintenance schedule that includes the activity, and the frequency of each activity; and date(s) of any preventive maintenance, repairs, malfunctions, etc., and name of person(s) performing the task(s), see Pogo's Water Meter Maintenance SWP referenced in Section 21 - Related Documents for calibration and maintenance forms.

Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures and solution or parts replacement for instrument probes. Include the calendar date for the procedures performed. Record names of personnel performing the maintenance or repair tasks. Describe any malfunctions necessitating repair or service.

Retain vendor service records for all affected instruments. Record the following for rented equipment: rental date(s) and equipment type and model or inventory number or other description. Retain a copy of the manufacturer's operating and maintenance instructions.

6.7.2 Field Calibration Documentation

Field instrument calibration must be performed on a regular basis and calibration records must be kept on the field sheets, field logs or in a separate calibration log. The records must indicate the calibration method (or SWP), and the type of standard(s) (including the concentrations) that were used. Record each calibration check (initial, continuing or final) in the permanent field records (or calibration logs).

At a minimum, these records must include: date, time and location of each calibration check; individual performing the check; results of each check, including the concentration/type of standard, expected reading, and the actual reading; whether instrument calibrated correctly or failed acceptance criteria; readings associated with a failed check; and corrective actions associated with failed check (such as recalibration, removal from use, etc.).

6.7.3 Reagent and Standards Documentation

Maintain documentation on calibration standards (e.g., buffers) and other reagents. At a minimum, note expiration dates (on the bottle label), and date of first use (on the standard container).

Observe and follow the expiration dates. If month and year are listed as the expiration date the reagent is considered expired on the first day on the month listed. If any standard or chemical is used after the expiration date, there must be documentation showing that the reagent is providing an acceptable response.

If reagents or standards are prepared from stock chemicals, they must be analytical reagent grade or better. Some reagents or standards may specify "primary standard". In such cases, purchase only the specified grade. Do not substitute an analytical grade chemical.

7. FIELD TESTING AND MEASUREMENT

This section outlines procedures to conduct field measurements commonly associated with sampling activities. They include the parameters that are directly measured in-situ or in a field sample by means of direct-reading instruments or remotely operated meters.

7.1 Inspection / Acceptance of Supplies and Consumables

The consumables that will be used during field operations include decontamination fluids, water for rinsate, blank preparation, tubing, and filters. No material will be used beyond the manufacturers' suggested expiration date.

Decontamination fluids will be visually inspected for gross contamination and considered usable if no visible contamination is present. If contamination is visible, the fluids will be discarded and replaced.

Water used for preparation of equipment blanks and ambient blanks will be reagent-grade water provided by the analytical laboratory. If detections are reported for equipment or ambient blanks, any remaining water from the suspected lot will be discarded and replaced.

Tubing and filters will be visually inspected for contamination. Tubing and filters will not be reused or decontaminated; only filters that are sealed in the original packaging will be used.

Inventory will be kept for laboratory provided water, tubing, filters, and other consumables.

Maintenance of inventory, inspections, lot numbers, and acceptance of the field supplies and consumables is the responsibility of the Field Team Leader.

7.2 Field Measurement of pH

7.2.1 Field Instrument

A pH meter consisting of a potentiometer, a glass electrode, a reference electrode, and a functioning temperature-compensating device are part of the YSI Professional Plus Meter used for field sampling standards

Use purchased or laboratory-prepared standard buffer solutions of pH values that bracket the expected sample pH range. Buffers with nominal values of 4.0, 7.0 and 10.0 units will be appropriate for most situations. Do not use standards past their expiration dates. If month and year are listed as the expiration date the reagent is considered expired on the first day on the month listed.

7.2.2 Calibration

The YSI meter is calibrated according to factory directions and sent to a manufacturer's representative at regular interval for calibration, or as needed. The YSI meter uses Standard Methods listed in 40 CFR Part 136, Table B, to determine field parameters during sampling. Methods for each field parameter are listed in Analytical Methods and Limits Tables: 12.1.2, 15.2.2, 17.1.5, and 18.1.7.1. For complete details refer to Section 21 - Related Documents for The Water Meter Calibration SWP.

7.2.3 Sample Container

Pour enough of the fresh sample into a clean cup to take the reading. Place the pH electrode in the sample (in the cup) and swirl the electrode. Wait for stabilization and read the pH value.

Turn the meter off after the last sample reading, rinse the electrode thoroughly with de-ionized water and replace the electrode's cap.

7.2.4 In-Situ pH of Samples

After calibrating the multi-probe YSI meter follow the meter's instructions to select the display for reading the pH of the sample. Immerse the probe at the desired depth in the water and wait at least thirty seconds for

stabilization of the reading (record the value when the difference between two readings taken ten seconds apart is not greater than 0.1 unit). Record both pH readings in the appropriate section of the field data sheet.

7.2.5 Flow-through Cells

When using a flow-through cell, the procedure described above for in-situ samples is applicable.

7.2.6 Winter Collection

During periods of extreme cold (less than 0° F), freezing water conditions may interfere with the probe causing the meter to poorly stabilize or give meter drift. In these instances, the sample may be collected in a clean bottle and labeled. Once in the environmental lab, the sample should be refrigerated to preserve integrity. The sample pH should be measured within 24-hours of collection (EPA holding time). This procedural variation as well as the time of measurement and the temperature at measurement must be recorded in the sample notes.

7.3 Field Measurement of Specific Conductance (conductivity)

Specific conductance is a useful method to approximate the total amount of inorganic dissolved solids. The YSI Professional Plus Meter employs automatic temperature compensation and correction on the instrument display value.

7.3.1 Field Instrument

Use any self-contained conductivity instrument suitable for field work, accurate and reproducible to 5% or better over the operational range of the instrument, and preferably equipped with temperature-compensation adjustment.

7.3.2 Standards

Use purchased or laboratory-prepared standard potassium chloride solutions with conductivity values that bracket the expected samples' range. Do not use standards past their expiration dates. If month and year are listed as the expiration date the reagent is considered expired on the first day on the month listed.

7.3.3 Calibration

Consult the instrument operating manual for directions on calibration of field instrumentation. Refer also to the SharePoint ID# in Section 21 - Related Documents for a copy of the Water Meter Calibration SWP. Calibration activities must be recorded, and records of instrument calibrations will be preserved.

7.3.4 Measuring Specific Conductance of Samples

Follow manufacturer's instructions for sample measurement. Immerse or place the conductivity probe or sensor in situ at a measuring location representative of the sampling source. Allow the conductivity instrument to stabilize.

Record the sample conductivity measurement reading. Rinse off the probe with de-ionized water. Follow manufacturer's instructions for probe storage between uses.

7.3.5 In-Situ Measurements at Depth or With Flow-through Cells

After calibrating the instrument as outlined above, follow the manufacturer's instructions to measure the conductivity of the sample. For in-situ measurements immerse the probe at the desired depth and wait for stabilization of the reading and record its value. Follow a similar procedure when using a flow-through cell.

7.3.6 Winter Collection

During periods of extreme cold (less than 0° F), freezing water conditions may interfere with the probe causing the meter to poorly stabilize or give meter drift. In these instances, the sample may be collected in a clean bottle and labeled. Once in the environmental lab, the sample should be refrigerated to preserve integrity. The sample conductivity should be measured as soon as possible, at least within 24-hours of collection (EPA holding time). This procedural variation as well as the time of measurement and the temperature at measurement must be recorded in the sample notes.

7.4 Field Measurement of Temperature

7.4.1 Field Instruments

Pogo uses a YSI instrument for performing field temperature measurements. It is capable of measuring temperature in 0.01°C increments. It is calibrated once a year offsite at a manufacturer approved maintenance facility. Refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Water Meter Calibration SWP.

7.4.2 Measuring Sample Temperature

Insert or place the sensor in-situ at a measuring location representative of the sampling source. Allow the thermometer or temperature sensor to equilibrate to ambient in-situ temperature. Record the temperature to the nearest 0.1°C when the reading stabilizes and remains constant.

7.5 Field Measurement of Dissolved Oxygen (DO)

7.5.1 Field Instrument

Use a membrane/electrode DO meter, with polarographic or galvanic electrode, and a sensitivity that results in a precision of +/- 0.2 mg/L and an accuracy of +/- 0.2 mg/L, alternately if the gain is between 0.7 and 1.5 the calibration is within range. Temperature compensation is performed automatically by the DO meter.

7.5.2 Standards

The field dissolved oxygen meter is calibrated using local barometric pressure and water saturated air. No standards are required for this calibration.

7.5.3 Calibration

The field dissolved oxygen meters are calibrated according to the manufacturer's recommendations for dissolved oxygen. For complete details refer to the Operations Manual of the meter being used. Refer also to the SharePoint ID# in Section 21 - Related Documents for a copy of the *Water Meter Calibration SWP*.

7.5.4 Measuring DO in Samples

YSI meters require at least a 10-minute warm up period after the instrument is turned on before it is able to correctly measure DO. Place the DO probe at the depth and location appropriate for a representative measurement of the sampling source. For example, take the DO of an effluent just before it enters the receiving water. If the effluent is aerated prior to entering the surface water, take the DO reading in the receiving water at the point of effluent entry.

For well mixed surface waters, e.g., fast flowing streams, take the DO reading at approximately one-to-two feet below the surface or at mid-depth. For still or sluggish surface waters, take a reading at one foot below the surface, one foot above the bottom, and at mid-depth. For shallow waters less than two feet, take the reading at mid-depth. Do not take a reading in frothy/aerated water, since unrepresentative, elevated oxygen levels may be obtained.

For groundwater, if it is impractical to place the probe in the well, collect a sample with minimal aeration and measure the DO immediately upon collection. Use a low-flow pumping system with a flow-through cell for best results. See USGS (1998) for further information on flow through systems.

Rinse probe with de-ionized water and store the probe in a saturated atmosphere according to manufacturer's directions when not in use.

If the readings show distinct, unexplainable changes in DO levels, or when the probe has been in waters with high sulfides, recalibrate using the Winkler method or perform maintenance per manufacturer's instructions. While taking a reading, if it is very low (e.g., below 1.0 mg/L), allow it to stabilize, record it and then, remove and rinse the probe, as the environment is very likely anoxic and may contain hydrogen sulfide, which can damage the probe.

Temperature corrections may be necessary. Follow manufacturer instructions for automatic corrections.

7.5.5 Winter Collection

DO, which must be measured in-situ, cannot be taken at ambient temperatures below the normal operating range of the instrument. During severe winter cold DO measurements may not be taken.

7.6 Field Measurement of Turbidity

Turbidity measures the scattering effect that suspended solids have on the propagation of light through a body of water (surface or ground waters). The higher the effect (i.e., intensity of scattered light), the higher the turbidity value. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms cause turbidity in water.

Use a turbidimeter (aka nephelometer) or a spectrophotometer consisting of a light source and one or more photoelectric detectors with a readout device to indicate the intensity of light. The instrument must meet these specifications: (1) the light source must have a tungsten-filament lamp operated at a color temperature between 2000 and 3000°K; (2) the distance traversed by the incident light and scattered light within the sample tube must not exceed 10 cm.; (3) the light detector, positioned at 90° to the incident light, must have an acceptance angle that does not exceed + 30° from 90°; (4) the detector and any filter system must have a spectral peak response between 400 and 600 nanometers; or (5) the instrument sensitivity must permit

detection of a turbidity difference of 0.02 NTU at the 0 - 1.0 NTU scale. Using the appropriate equipment and following the procedures given here, the field accuracy of this measurement is close to %R= 100 + 10% for turbidities in the range of 1 to 100 NTU.

7.6.1 Sample Cuvettes

Use sample cuvettes or tubes of clear, colorless glass or plastic. Keep cells scrupulously clean, both inside and out, and discard if scratched or etched. Never handle them where the light beam strikes the sample.

Clean sample cuvettes by thoroughly washing with laboratory soap (inside and out) followed by multiple rinses with distilled or de-ionized water, and let air-dry.

7.6.2 Standards

Use formazin stock suspension of 4,000 NTU, either prepared according to method SM 2130B, section 3.b, or of commercial origin. Use daily or working standards as outlined below, or, alternatively, purchase standards recommended by the manufacturer. Do not use standards past their expiration dates. If month and year are listed as the expiration date the reagent is considered expired on the first day on the month listed.

Working Formazin Standards

For the turbidity ranges of interest, prepare by diluting the 4,000 NTU stock standard with "high-quality dilution water" (nominal value of 0.02 NTU). Prepare this water by passing laboratory reagent-grade water through a filter with pore size of 0.1 um (rinse the collection flask at least twice with filtrate and discard the next 200 mL).

Secondary Commercial Standards

Use only those certified by the manufacturer to give equivalent calibrations to the primary standards and retain their certificates.

Primary or Secondary Gel-type Standards

Use suspensions of microspheres of styrene-divinylbenzene copolymer that are as stable as the concentrated formazin and more stable than diluted formazin. These standards, available commercially, are also known as "gel-type" standards. They are recommended for field use.

7.6.3 Calibration

The field turbidity meters are calibrated according to the manufacturer's recommendations for turbidity. For complete details refer to the Operations Manual of the meter being used. Also refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Water Meter Calibration SWP.

7.7 Field Measurement of Groundwater Level

Use an electric water level indicator (sounder) to measure water levels. Alternatively, data loggers may be installed in certain monitoring wells to measure water levels over time. Refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Field Hydrologic Data Collection/Instrument Maintenance SWP.

7.7.1 Calibration

Water level indicators do not require calibration. The measurement tape/cable is checked to assure it is undamaged and readable. The sensor is turned on and dipped in water to make sure it is working (beeping) correctly before it is taken into the field. If the water level indicator is damaged, it is replaced with a new meter.

7.7.2 Measuring a Groundwater Level

At each well, remove the protective steel well-head cover and remove the well cap. Lower a sounder into the well until the water surface is encountered. Measure the depth to water (DTW). DTW is defined as the distance from the water surface to the measuring point. Reel in the sounder and remove it from the well. Replace the well cap and secure the locking protective well-head cover. Note and record in the field notes any physical changes (like erosion or cracks) in the protective concrete pad or variation in the total depth of the well. If sampling is also planned, make sure that the DTW is measured before purging begins.

7.8 Field Measurement of Water Flow and Velocity

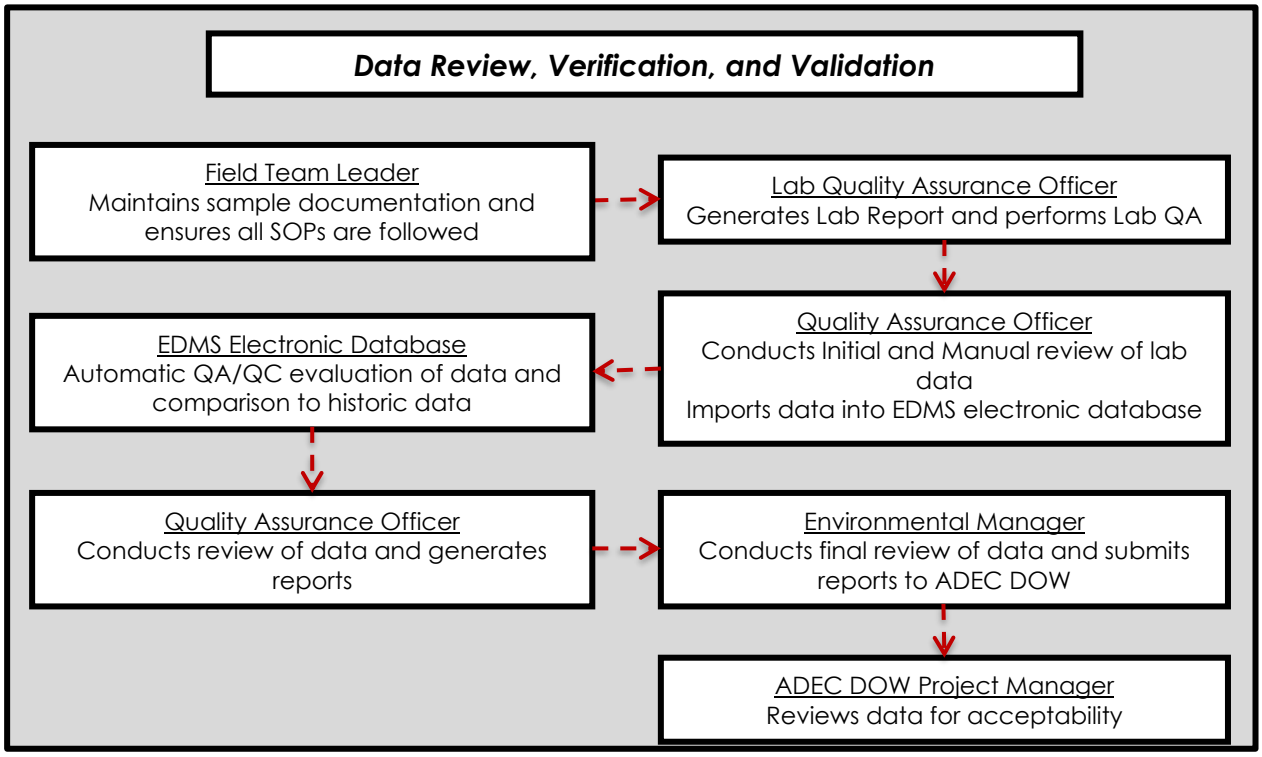
Stream flow data is collected by the United States Geological Survey (USGS) at the Goodpaster River.

7.9 Continuous Monitoring with Multi-Parameter Meters

Pogo has in-line continuous measurement devices to monitor parameters such as: conductivity, pH, temperature, residual chlorine and turbidity. Meters are calibrated weekly by the Electrical & Instrumentation department according to manufacturer's recommendations.

8. DATA REVIEW, VERIFICATION AND VALIDATION

Figure 8.1: Data Review Flow Chart



The QAPP objectives are defined in terms of precision, accuracy, representativeness, completeness, and comparability parameters. The primary goal is to ensure the quality and integrity of the collected samples, the representativeness of the results, the precision and accuracy of the analyses, and the completeness of the data. Data that meets the QAPP objectives and goals will be deemed acceptable. Data that does not meet objectives and goals will be reviewed on a case-by-case basis to ascertain usefulness.

The data review and verification procedure should be completed in a timely manner so that, if possible, re-sampling can be accomplished within holding times or the compliance period. Samples that exceed standards or permit limits may initiate regulatory reporting requirements. Data validation includes laboratory and field data. Pogo uses the Environmental Data Management System (EDMS) developed by EnviroData Solutions, Inc to manage data.

8.1 Initial Review

The initial data review should take place as soon as possible following issuance of the laboratory Sample Receipt.

1. Review the Sample Receipt for a Laboratory ID assigned to each sample, date and time of arrival, chain-of-custody status, and any notes that indicate the quality of the sample on arrival.
2. Check Sample Receipt for sample temperature if applicable. Sample temperature criteria have been established for proper preservation of water, solid, and tissue samples. If the sample temperature is outside of the criteria, i.e., an unpreserved water sample to be analysed for metals is outside the temperature criterion of between 0 and 6°C or a sludge sample to be analysed for TCLP metals is outside the criterion of between 0 and 6°C, all non-detect and positive values are considered to be estimated and the J data qualifier flag shall be applied.
3. Compare the Sample Receipt data with the Request for Analysis and note any discrepancies (i.e., station ID error, missing samples, etc.).
4. Check the Sample Receipt for sample holding time.

8.2 Manual Review of Analytical Data

8.2.1 Data Package Completeness

Verify that the data package is complete and contains, but is not limited to, the following: cover letter signed by the laboratory project manager transmitting the data; Laboratory Report (including QA/QC results), and Laboratory Electronic Data Delivery (EDD) format digital data (for import into EDMS).

8.2.2 Transcription Errors

Check at least 10 percent of the electronic data against the data package to ensure no transcription errors have been made. Although number of samples per month is variable and ranges from forty to over a hundred, a complete data check is performed once a week on one data package (usually involving several sampling sites) from each different laboratory used. This system assures that more than 10% of total data packages received are check for accuracy.

8.2.3 QC Samples

Verify the specified QC samples (laboratory and field) were analyzed and the frequency was adequate as described in the QAPP. Field samples and samples schedules are reviewed monthly to ensure QC samples are collected in accordance with this plan.

8.3 Verification and Validation

After a manual review of the field data and electronic data package, the data file(s) are imported into the EDMS, a process that automatically checks for errors and user-defined warnings and verifies that the correct format was used. Results are automatically checked against standards and notification of any exceedances is immediate. Once data has been imported into EDMS various reports can be generated to validate the data:

- Comparison to Standards;
- Field Blank Evaluation;
- Identify Missing Data;
- Primary-Duplicate Comparison; and
- Qualified Data.

8.3.1 Laboratory Data Qualifier Flags

Data qualifier codes or flags are notations used by laboratories and data reviewers to briefly describe or qualify data and the systems producing data. Data qualifiers are included in the Laboratory Report (e.g., D – data reported from a preparation or analytical dilution; J – estimated value; U – analyte included in the analysis but not detected). Definitions of laboratory data qualifier flags are provided with the Laboratory Report.

8.3.2 EDMS Generated Qualifier Flags

The EDMS data validation routine compares data to prior data, and applies the statistical outlier test (EPA, 1989) to identify questionable data. A minimum of three data values must be available for the statistical outlier test to be performed. EDMS compares data to applicable standards, checks hold times, and compares the cation-anion balance to acceptable limits. Duplicate samples are checked by the validation routine but are not compared to standards. Below are the qualifiers that EDMS may apply to questionable data:

AK – Invalid Data;

NR – Non-Regulatory Sample;

R – Outlier-Above 0.1% significance;

J – Outlier-Above 5% significance;

Data outliers are unusually high or low data values that may be incorrect and may skew the results of statistical analyses.

H – Holding Time Exceeded;

EDMS compares sample analysis date to the sample date to verify the samples were analysed within recommended holding times

HJK – Holding Time Exceeded and 5% Outlier;

K – Cation/Anion Estimate;

EDMS calculates the sum of the anions, sum of cations, sum of cations and anions and the cation-anion percentage difference and adds these parameters to the database. If they are included in the data imported from the analytical lab, the lab's values are also stored in the database. The totals for the cations and anions should balance, since all waters are electrically neutral. If the percentage difference is too high the Cation /Anion Estimate is applied.

HJK – Holding Time Exceeded and 5% Outlier and Cation/Anion Estimate;

HK– Holding Time Exceeded and Cation/Anion Estimate;

HKR – Holding Time Exceeded and 0.1% Outlier and Cation/Anion Estimate;

JK – 5% Outlier and Cation/Anion Estimate; and

KR – 0.1% Outlier and Cation/Anion Estimate.

8.3.3 Review of Qualifier Status Description

After every import of new data, EDMS shows a message stating the data is, or is not, within all limits and standards applied. This is the first level of validation. The second level requires running a validation program immediately after entering or importing data. This validation report shows all analytes that have any qualifier assigned by either the laboratory or by the EDMS validation routines. The reviewer then adds a status description to any flagged data to indicate the usability of the data. These qualifiers include:

1. Accepted without Change;
2. Rechecked by Lab;
3. Rechecked and Changed;
4. Rechecked and not changed;
5. Accepted and removed Qualifier; and
6. Accepted and kept Qualifier.

8.3.4 Hardness Dependent Water Quality Criteria Calculations

When reviewing any analytical parameters, which are hardness dependent that appear to exceed water quality standards, hardness dependent calculations are performed.

The freshwater criterion for cadmium, copper, lead, nickel, silver, and zinc is expressed as a function of total hardness (mg/L CaCO3) in the water column. The action limits for these criteria are calculated for surface and groundwater according to the following equations:

- Aquatic Life Fresh Water Acute (dissolved) = exp {ma [Ln(hardness)] + ba} (CF), or
- Aquatic Life Fresh Water Chronic (dissolved) = exp {mc [Ln(hardness)]+ bc} (CF).

The factors for the equations are provided in Table 8.3.4.1. When using the above equations, for waters with hardness between 25 and 400 mg/L as CaCO3, the criterion will be calculated using the actual ambient hardness of the surface or ground water. If the ambient hardness is outside of this range, a minimum hardness of 25 mg/L or a maximum hardness of 400 mg/L will be used.

Table 8.3.4.1: Parameters for Calculating Freshwater Dissolved metal Criteria That Are Hardness-Dependent*

Parameter	Acute mA	Acute bA	Chronic mC	Chronic bC	Freshwater Conversion Factor (CF)	
					Acute Criterion Maximum Concentration	Chronic Criterion Continuous Concentration
Arsenic	--	--	--	--	1.000	1.000
Cadmium	1.0166	-3.924	0.7409	-4.719	1.136672- [(ln hardness)(0.041838)]	1.101672- [(ln hardness)(0.041838)]
Copper	0.9422	-1.700	0.8545	-1.702	0.960	0.960
Chromium III	0.819	3.7256	0.819	0.6848	0.316	0.860
Chromium VI	--	--	--	--	0.982	0.962
Lead	1.273	-1.460	1.273	-4.705	1.46203 - [(ln hardness)(0.145712)]	1.46203 - [(ln hardness)(0.145712)]
Nickel	0.846	2.255	0.846	0.0584	0.998	0.997
Silver	1.72	-6.52	--	--	0.85	--
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

* Table from Alaska Water Quality Criteria Manual for toxic and Other Deleterious Organic and Inorganic substances

Hardness-dependent metals' criteria may be calculated from the following:

- Criterion Maximum Concentration (dissolved) = exp{mA[ln(hardness)]+bA} (CF)
- Criterion Continuous Concentration (dissolved) = exp{mC[ln(hardness)]+bC} (CF)

8.4 Update Database

Once any concerns with the analytical data identified during the manual review and/or data verification steps have been resolved, and data qualifier flags have been applied and entered into the electronic data file(s) during the data validation step, the EDMS database will be updated with the qualified data.

8.5 Other Quality Assurance Assessments

Other methods of quality assurance include the participation in the annual EPA DMR-QA study as required by Pogo's APDES Permit. EPA generally delivers notification of the annual study in March; compliance laboratories are notified soon after and studies usually end in July. QA reports are due to ADEC in August and any corrective actions generally due in October. Checklists and schedules are included in the annual testing information packet, as well as addresses etc. for the state DMR-QA Coordinator, see Table 8.5.1 below.

Table 8.5.1: DMR-QA Study General Reporting Schedule

March	Study Begins: Send address verification to state, notify compliance laboratories.
July	Study Ends: Laboratories send data reports to PT providers
August	Laboratories send test results to Pogo
August	Pogo mails copy of laboratories reports to state DMR-QA Coordinator.
October	Any corrective action reports from laboratories for non-acceptable test results, are forwarded to state DMR-QA Coordinator.

9. VISUAL MONITORING PLAN

The purpose of the Visual Monitoring Plan is to:

- Monitor the DSTF facility for signs of damage or potential damage from settlement, ponding, leakage, erosion or operations;
- Monitor the proper placement of incidental, non-hazardous waste that is disposed of in the DSTF;
- Inspect monitoring wells for damage; and
- Monitor wildlife interactions at the DSTF and RTP reservoir.

Table 9.1 identifies where key Visual Monitoring Plan elements are located in the Pogo Mine Monitoring Plan. Table 9.2 provides a facility inspection schedule.

Table 9.1: Visual Monitoring Plan Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Section 21 - Related Documents	Pogo Facilities Map and Monitoring Locations
Appendix A	Drystack and RTP Dam Weekly and Monthly Inspection Form

Table 9.2: Facility Inspection Schedule

Period	Location	Observation(s)
Weekly	DSTF	Surface Operations inspects on days when tailings are being placed, Environmental Department looks for unusual cracks, bulging, signs of settlement, signs of seepage and erosion
	RTP Dam and Flumes	Housekeeping, free of damage, erosion, collapse, subsidence, seepage, damage on facilities, vegetation cleared, cracks in concrete, connection to flume, seepage collection wells, and operating normally
Monthly	Diversion Ditches	. Free of obstacles and damage, erosion, and sediment accumulation
	RTP Dam	Erosion, subsidence, damage on facilities, vegetation cleared, cracks in concrete, connection to flume, and obstacles in flume
Quarterly	Monitoring Wells	Signs of physical damage and check log for needed repairs.
Every Three Years	RTP Dam	Periodic Safety Inspection (PSI).

9.1 Biological Visual Survey Program

Pogo Mine operations personnel perform wildlife visual inspections during normal operations near the DSTF and the RTP Reservoir. Operations personnel note wildlife fatalities and any unusual activities or conditions (sickness,

mortality etc.) surrounding the interactions. The wildlife observations are logged by the Surface Department and the logs sent quarterly to the Environmental Department. If any unusual activities or conditions, such as mortalities or negative animal interactions occur, the Environmental Department and the Pogo Safety Department are notified immediately.

The Safety Department maintains the Public Safety Permit issued by Alaska Department of Fish and Game and performs any animal hazing required.

9.2 Visual Monitoring Program Reporting Requirements

Any issues at the DTSF (such as cracks, bulging or erosion) or issues with the RTP dam (such as settlement or geotechnical concerns) are reported in the quarterly and annual water quality monitoring reports as required by the Waste Management Permit.

Any unusual wildlife interactions, such as mortalities or hazing events, which occur at the DSTF or the RTP Reservoir, are reported in the quarterly and annual water quality monitoring reports although this is not a requirement of the Waste Management Permit.

Quarterly reports are submitted within 60 days of the last day of the quarter. The Annual Report is due March 1 of the following year. A summary of activities is presented to the agencies and public (at least two weeks after the Annual Report is submitted) at the annual meeting. All records of monitoring activities are retained for at least three years and are available upon agency request.

10. WATER MANAGEMENT PROGRAM

The purpose of the Fluid Management Program is to:

- To monitor the RTP Dam as described in RTP Dam Operation and Maintenance Manual.
- To monitor process water management by accounting for water discharged into or withdrawn from the RTP, RTP water recycled to the mill, and water treated and discharged.
- To monitor flumes and piezometers as part of site hydrology characterization.
- To monitor any Temporary Water Use Authorizations (TWUA), Permits to Appropriate Water, and Certificates of Appropriation.

Table 10.1 identifies where fluid management program elements are located in the Pogo Mine Monitoring Plan.

Table 10.1: Fluid Management Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 3.1	Fluid Management Monitoring Schedule
Table 3.2	Hydrology Characterization Monitoring Schedule
Table 3.3	Permits to Appropriate Water and Water Quantity Limits
Table 3.4	Temporary Water Use Authorization (TWUA) & Water Quantity Limits

10.1 Water Balance

Significant measurable inflows and outflows within the RTP watershed are monitored and a monthly water balance is calculated. Flow meters are installed on the major process fluid pathways and are monitored and maintained by the Mill Department and Water Operations.

The Environmental Department is responsible for gathering the following data for the water balance calculations:

- Precipitation is recorded daily during the summer via Pogo's two weather stations. Hourly and total precipitation is record daily. The precipitation is calculated by averaging the total daily precipitation recorded from the airstrip weather station and the weather station on Pogo Ridge. The daily precipitation is recorded in EDMS.
- Annual Snow surveys are performed while snow is present and mean daily temperature is less than 32 °F, refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Snow Survey SWP.
- Bi-monthly visual recording of water volume through the flume as well as datalogger downloads of flow, pressure and temperature, below the Drystack and above the RTP.

10.2 Hydrology Characterization

Flumes

Four flumes were installed in 2012 to help track surface water flows. Flumes are inspected and dataloggers are downloaded bi-monthly when water is flowing. Bi-monthly inspections include clearing debris and sediment as needed, and noting any erosion or settling, replacing desiccant tubes as needed and making sure stilling wells are clear of sediment. The flumes are inspected daily during heavy rainfall storm events. Raw electronic data, downloaded from flumes, is stored in the Environmental Department Group Drive and backed up daily by server. Data is compiled to graphically present collected data. Refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Field Hydrological Data Collection/Instrument Maintenance for Pogo Mine, Alaska SWP.

Piezometers

Several piezometers and thermistors are installed in the DSTF and connect to a wireless data logger that is downloaded monthly. Raw electronic data, downloaded from piezometers, is stored on the Environmental Department Group Drive and backed up daily by server. Data is compiled to graphically present temperature and pressure data. Refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the DSTF Piezometer-Data Downloading and Compiling Manual.

10.3 Water Use Permits

Pogo has several water use permits issued by ANDR.

Permits to Appropriate Water

Annual water use is recorded with flow meters to ensure the Permits to Appropriate Water limits are not exceeded.

- The exception to this is the water withdrawn from the gravel pit pond (LAS 24612) for use as dust suppression on the roads. This value is calculated by tanker load.

Temporary Water Use Authorizations (TWUA)

TWUA exist for the Seepage Collection Well System and Drystack Tailing Diversion Ditch. The Seepage Collection System utilizes a flow meter to track water use. The water collected in the Diversion Ditch was previously calculated from watershed area and rainfall; however, as of the summer of 2013, calculations will include flow data from flumes.

TWUA are utilized for dust suppression on the Pogo Mine Access road and the mine site roads. The quantity of water used for dust suppression is calculated and tracked based on truck tanker loads.

TWUA are also part of the Alaska Placer Mine Application for Hardrock Exploration (APMA/AHEA) permit for the exploration drilling rigs. Exploration drill rigs sometimes get their water from tanker trucks and water use tracked by the tank load. However, sometimes water is pumped directly from the water source into the drill rig holding tank. The maximum capacity of the pumping equipment in a 24–hour period is used to determine the water quantity limits when applying for the APMA/AHEA. This maximum water use is never fully utilized due to the mobilization and demobilization periods of drill rig movement that occur at regular intervals during the drilling season.

10.4 Fluid Management Reporting Requirements

Water balance monitoring results are reported in the quarterly and annual water quality monitoring reports as required by the Waste Management Permit. The annual water use associated with the Water Use Permits and Temporary Water Use Authorizations are presented in the annual report.

10.5 Fluid Management ADEC Notification

In the case of an emergency underground (e.g., too much water in underground workings), treated water may be pumped to the RTP for storage. Whenever treated water is pumped into the RTP, ADEC is informed via written notice.

11. DSTF GEOCHEMISTRY PROGRAM

The purpose of this monitoring is to detect trends in the tailings composition that indicate any acid producing potential.

Table 11.1 identifies where DSTF Geochemistry Program key elements are located in the Pogo Mine Monitoring Plan.

Table 11.1: DSTF Geochemistry Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 7.1	Drystack Sampling Schedule

Location in Plan	Description
Table 7.2	Flotation Tailing and Mineralized Development Whole Rock Chemistry
Table 7.3	Flotation Tailing Interstitial Water Chemistry and Operating Target Ranges

11.1 DSTF Geochemistry Sampling

Table 11.1.1 presents the location and purpose for DSTF geochemistry sampling program.

Table 11.1.1: DSTF Geochemistry Sampling Location and Purpose

Monitoring Station	Location	Purpose
PC002	Drystack, active area of mineralized development rock placement	To monitor for acid generating potential and metal content of rock.
PC003	Solids from filter feed tank underflow	To monitor for acid generating potential and metal content of tailings.

The mineralized development rock sample, PC002, is collected monthly from the DSTF and composited before being sent off to the contract laboratory on a quarterly basis. Small rocks and fines are collected from recently placed mineralized development rock before it is compacted between layers of Drystack material. Approximately 1/3 of an ore bag is collected for each monthly grab sample and composited into a single ore bag at the end of the quarter.

A grab sample of flotation tailing solids or Drystack slurry (PC003-solids) is collected monthly from the filter feed underflow in a covered 5-gallon bucket. At the end of each quarter, the monthly samples are composited and processed through a decontaminated pressure filter to separate the solids from the liquid in the slurry. For more information refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Mineralized Waste Rock (Red Rock) PC002 Geochemistry Sample Collection SWP and the Flotation Tailings Geochemistry and Interstitial Water (PC003) Sample Collection SWP.

Table 11.1.2 provides sampling schedule (including QA/QC samples) and Table 11.1.3 analytical methods used. Table 11.1.4 identifies sample containers and holding times.

Table 11.1.2: DSTF Geochemistry Sampling Schedule

Location	Sample Type	Profile	Frequency
PC002	Grab	Template PC002	Monthly sample, composited by Environmental for quarterly analysis
PC100	Duplicate Grab	Template PC002	Annually (lab collects a homogenized split sample from PC002)
PC003	Grab	Template PC003	Monthly sample, composited by Environmental for quarterly analysis
PC100	Duplicate Grab	Template PC003	Annually

Table 11.1.3: Analytical Methods for DSTF Geochemistry Monitoring

Analyte Group	Parameter	Analytical Method	Units
Basic Acid Base Accounting	Paste pH	Standard	s.u.
	Inorganic Carbon	Sobek	%
	Total Carbon	Sobek	%
	Sulfate Sulfur (HCL Leachable)	LECO	%
	Sulfide Sulfur (calculated)	LECO	%
	Sulfur, Total	LECO	%
	Sulfur as Sulfate	LECO	%
	Neutralization Potential/Acid Potential	Sobek	tCaCO3/1Kt
	Maximum Potential Acidity	Sobek	tCaCO3/1Kt
	Net Neutralization Potential	Sobek	ratio
Metals	Mercury	200.8	ppm
	48 Elements	ICP-MS	ppm

Table 11.1.4: Holding Times and Sample Containers for DSTF Geochemical Sampling

Analyte Group	Parameter Name	Container	Container Size	Preservation	Holding Time
Acid Base Accounting	ABA parameters	Ziploc bag, Tyvek bag	18 oz bags	Ice 4°C	NA
Metals	Metals, except mercury	Polyethylene, Glass	15 g	Ice 4°C	6 months
	Mercury	Polyethylene, Glass	15 g	Ice 4°C	28 days

11.1.1 DSTF Geochemistry Reporting Requirements

PC002 and PC003-solids monitoring results, are reported in tabular form in the Annual Activity and Monitoring Report as required by the Waste Management Permit.

11.1.2 DSTF Geochemistry Exceedances

The PC002 and PC003-solids data is monitored for acid rock generating characteristics within the DSTF. A Neutralization Potential/Acid Potential (NP/AP) ratio of greater than 1.4 means that there is no acid generation.

- If a mineralized waste rock or flotation tailings sample has an NP/AP ratio of less than 1.4, two quarters in a row, sampling frequency will be increased to monthly, to help determine if a trend exists.
- If the more frequent sampling confirms an NP/AP ratio of less than 1.4, and the next two quarterly samples have NP/AP ratios of less than 1.4, ADEC and ADNR will be notified;
- A corrective action plan will be developed in conjunction with ADEC and copied to ADNR.

12. FLOTATION TAILINGS INTERSTITIAL WATER PROGRAM

The original QA/QC objective of the flotation tailings interstitial water program was to compare the chemical nature of the Drystack material being placed to a target range based on the test work and assumptions used during permitting. Pogo calculated new operating target ranges based on data collected from 2006-2010 for Flotation Tailing Interstitial Water. These QA/QC targets better reflect actual operating conditions.

Table 12.1 identifies where Flotation Tailing Interstitial Water Program key elements are located in the Pogo Mine Monitoring Plan.

Table 12.1: Flotation Tailings Interstitial Water Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 7.1	Drystack Sampling Schedule
Table 7.3	Flotation Tailing Interstitial Water Chemistry and Operating Target Ranges

12.1 Flotation Interstitial Water Sampling Procedures

A grab sample for flotation tailings interstitial water is collected at station PC003, which is located at the underflow of the filter feed tank. The slurry is collected in a clean five-gallon bucket and taken to the onsite paste plant filter press. The sample is put through a decontaminated pressure filter to separate the liquid for the solids in the slurry. For more information refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Flotation Tailings Geochemistry and Interstitial Water (PC003) Sample Collection SWP.

Table 12.1.1 provides sampling schedule (including the QA/QC samples) and Table 12.1.2 analytical methods used. Table 12.1.3 identifies sample containers and holding times.

Table 12.1.1: Flotation Tailings Interstitial Water Sampling Schedule

Location	Sample Type	Profile	Analytes	Frequency
PC003	Grab	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se, Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Quarterly
PC100	Duplicate Grab	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se, Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Annual
PC-EB	Equipment Blank	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se, Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Annual

Table 12.1.2: Analytical Methods and Limits for Flotation Tailing Interstitial Water Monitoring

Analyte Group	Parameter	Field Filter	Analytical Method	Units	Minimum Level	Method Detection Limit
Cyanides	Cyanide, Weak Acid Dissociable (WAD)	n	Kelada-01* D2036-06C	µg/L	5.2[1]	1.2
Major Anions	Alkalinity as CaCO3	n	SM 2320B	mg/L	NA	1.2
	Alkalinity, Total	n	SM 2320B	mg/L	NA	1.2
	Chloride	n	EPA 300.0 or 340.2	mg/L	NA	0.1
	Fluoride	n	A4500-F C	mg/L	NA	0.1
	Nitrite-Nitrate as N	n	EPA 353.2	mg/L	80	0.38
	Sulfate	n	EPA 300.0	mg/L	NA	0.1
Major Cations	Calcium	y	EPA 200.7 / 200.8	mg/L	NA	0.013
	Magnesium	y	EPA 200.7 / 200.8	mg/L	NA	0.012
	Potassium	y	EPA 200.7 / 200.8	mg/L	NA	0.31
	Sodium	y	EPA 200.7 / 200.8	mg/L	NA	0.028
Metals	Antimony	y/n	EPA 200.7 / 200.8	µg/L	3	0.027
	Arsenic	y/n	EPA 200.7 / 200.8	µg/L	5	0.044
	Cadmium	y/n	EPA 200.7 / 200.8	µg/L	0.1	0.045
	Chromium	y/n	EPA 200.7 / 200.8	µg/L	10	0.049
	Copper	y/n	EPA 200.7 / 200.8	µg/L	2.2	0.034
	Iron	y/n	EPA 200.7 / 200.8	µg/L	817	2.7
	Lead	y/n	EPA 200.7 / 200.8	µg/L	0.5	0.03
	Manganese	y/n	EPA 200.7 / 200.8	µg/L	NA	0.017
	Mercury	y/n	EPA 245.7	µg/L	0.01	0.00019
	Nickel	y/n	EPA 200.7 / 200.8	µg/L	NA	0.05
	Selenium	y/n	EPA 200.7 / 200.8	µg/L	1.9	0.14
	Silver	y/n	EPA 200.7 / 200.8	µg/L	0.3	0.028
	Zinc	y/n	EPA 200.7 / 200.8	µg/L	16.8	0.084
	Conductivity (Specific Conductance), Field	n	EPA 120.1	µS/cm @ 25°C	NA	10

Analyte Group	Parameter	Field Filter	Analytical Method	Units	Minimum Level	Method Detection Limit
Physical and Aggregate Properties	Dissolved Oxygen, Field	n	SM 4500-O G -2001	mg/L	NA	NA
	Hardness as $CaCO_3$	n	SM 2340B	mg/L	NA	1.0
	pH, Field	n	Standard Method 4500-H+ B-2000 ASTM Method D1293-99 (A or B) USGS Method I-1586-85 (Wastewater)	s.u.	NA	NA
	Temperature, Field	n	EPA 170.1	C	NA	0.1
	Total Dissolved Solids (TDS)	n	SM 2540 C	mg/L	NA	4.8
	Turbidity	n	EPA 180.1	NTU	NA	0.03

[1]APDES Permit # AK0053341 specifies a site-specific ML of 20 µg/L for WAD Cyanide

*Kelada-01 was approved by ADEC as the primary method for WAD Cn analysis. D2036-06C is an alternate method approved when distillation of sample is required, or other instrument issues need resolution.

Table 12.1.3: Holding Times and Sample Containers Flotation Tailing Interstitial Water Sampling

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
Cyanides	Cyanide, WAD	Dark Polyethylene, Glass	500 mL	Cool 4°C, NaOH to pH>12	14 days
Major Anions	Alkalinity	Polyethylene, Glass	1 L	Cool 4°C	14 days
	Chloride, Fluoride & Sulfate	Polyethylene	1 L	Cool 4°C	28 days
	Nitrate+Nitrite	Polyethylene, Glass	250/500 mL	Cool 4°C, H_2SO_4 to pH<2	28 days
Major Cations	Calcium, Magnesium, Potassium, Sodium	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2	6 months
Metals	Metals, except mercury	Polyethylene	250/500 mL	HNO_3 to pH<2	6 months
	Mercury (Method 245.7)	Fluoropolymer, Glass	125/250 mL	either 5 mL/L of pretested 12N HCl or 5 mL/L BrCl solution	28 days
Physical and Aggregate Properties	Conductivity (Specific Conductance)	Polyethylene, Glass	100 mL	None	24 hours
		Polyethylene, Glass	500 mL/1 L	Cool 4°C, Filtered (for EPA 120.1)	28 days
	Dissolved Oxygen	Glass	300 mL	None	Analyze immediately
	Hardness	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
	pH	Polyethylene, Glass	25 mL	None	Analyze immediately
	Temperature	Polyethylene, Glass	25 mL	None	Analyze immediately
	TDS	Polyethylene, Glass	500 mL/1 L	Cool 4°C	7 days
	Turbidity	Polyethylene, Glass	500 mL/1 L	Cool 4°C	48 hours

12.1.1 Flotation Interstitial Water Reporting Requirements

Flotations interstitial water monitoring results are reported in the quarterly and annual activity and monitoring reports as required by the Waste Management Permit. The data is presented graphically and includes the flotation interstitial water operating target ranges.

12.1.2 Flotation Interstitial Water Exceedances

If any of the flotation interstitial water chemistry exceeds the operating target ranges listed in Table 7.3 of the Pogo Mine Monitoring Plan:

- If a flotation interstitial water sample has an NP/AP ratio of less than 1.4, two quarters in a row, sampling frequency will be increased to monthly to help determine is a trend exists.
- If the more frequent sampling confirms an NP/AP ratio of less than 1.4, and the next two quarterly samples have NP/AP ratios of less than 1.4, ADEC and ADNR will be notified
- A corrective Action Plan will be developed in conjunction with ADEC.

13. DEVELOPMENT ROCK SEGREGATION

Development rock is non-gold bearing rock brought to the surface to be disposed of in the DSTF. The development rock segregation program classifies development rock based on sulfur and arsenic concentration for each blasted round.

Development Rock Segregation key elements can also be found in the Pogo Mine Monitoring Plan and the Waste Rock Characterization SWP under Section 21: Related Documents.

The analysis needed to determine the classification on Mineralized and Non-Mineralized waste rock can be performed using either the Pogo Mine Assay Lab benchtop XRF or a handheld XRF. Development rock is classified as "Mineralized" or Non-Mineralized." Mineralized rock is defined as having a sulfur content greater than 0.5% and/or an arsenic content greater than 600 mg/kg (refer to Table 13.2). Non-mineralized rock is defined as having sulfur content less than 0.5% and an arsenic content less than 600 mg/kg.

13.1 Development Rock Analysis

Samples are generated by drill cutting samples or muck samples and either delivered to the Pogo Mine onsite Assay Lab or analyzed using a handheld XRF. To characterize samples using the benchtop XRF, samples are placed into stainless steel drying pans and dried at 116 degrees Celsius for one to six hours. The samples are checked for dryness with a watch glass. Depending on the particle size of the samples, they are crushed, split and pulverized, or split and pulverized. All of the remainder of the sample, which is not pulverized, is called the reject and is placed in a hopper and delivered to the e-feeder and goes into the mill process stream.

A disk is made by weighing one gram of paraffin and nine grams of sample and mixing them together and placing some of the material into an aluminium cap and pressing at 30000 psi. The dilution of the sample with the paraffin, is calculated in the XRF program. The disk is removed from the press and placed in the XRF where it is analyzed for Iron, Sulfur, Calcium, Magnesium, and Arsenic.

A single standard disk is run alongside every batch of samples. The standard was created from twenty-four Pogo Mine samples that were collected to cover the normal range of waste rock variability encountered during mining. These twenty-four samples were prepared in the assay lab and sent to a commercial lab for analysis of Iron, Sulfur and Arsenic. The same twenty-four sample disks were used to calibrate the XRF and now comprise the standards that are run in conjunction with each batch of samples. Drift in the instrument is corrected daily by running a manufacturer's adjust standard (PHA, Pulse Height Analysis) each morning and by running three drift samples approximately every two to three months.

Samples discarded after analysis are collected in a 3-gallon bucket and, when full, the disks are weighed, the volume is calculated, and the disks are taken to DSTF. The disposal occurs approximately twice per year.

Characterization using the handheld XRF involves collecting a drill cutting sample in a snack-size Ziploc bag. The sample is mixed and flattened, then readings are taken with the XRF at five locations on the bag.

The sample results are entered into Lab Information Management System (LIMS) and exported to the Muck Segregation Database. For more information about the analytical procedures refer to the SharePoint ID# in Section 21 - Related Documents for the Pogo Mine Assay Lab QAPP.

Data from the Pogo ore body indicates that sulfide-sulfur is the predominant sulfur form and sulfate-sulfur concentrations are very low. Therefore, a total sulfur concentration provides a conservative estimate of the sulfide-sulfur concentration.

13.2 Development Rock DSTF Disposal

Mineralized development rock is encapsulated in the Drystack at least fifty feet from the edge between layers of compacted tailings material. For a more detailed description of mineralized development rock processing refer to the Drystack Tailing Facility Construction and Maintenance Manual.

Table 13.2: Development Rock Segregation Analytical Parameters and Action Limits

Parameter	Units	Action Limit
Sulfur by XRF	percent	greater than 0.5
Arsenic by XRF	Dry mg/kg	greater than 600

13.3 Development Rock Segregation

Development rock segregation and disposal is explained in detail in the Pogo Waste Rock Characterization SWP (refer to the Waste Rock Segregation SWP referenced in Section 21 - Related Documents). It includes a description of:

- Development Rock Sampling;
- Development Rock Geochemical Analysis;
- Development Rock Segregation; and
- Development Rock Tracking and Documentation.

Non-mineralized development rock can be stored in the non-mineralized development rock stockpile for use in construction or erosion control.

13.3.1 Development Rock Segregation Reporting Requirements

Development Rock Segregation monitoring results are reported in the quarterly and annual activity and monitoring reports as required by the Waste Management Permit. Included is the number of rounds blasted as well as the number of rounds that were classified as mineralized development rock.

14. CARBON-IN-PULP TAILING MONITORING PROGRAM

Pogo's Waste Management Permit (2018DB0001) requires WAD cyanide monitoring of Carbon-In-Pulp (CIP) tailings after it goes through the cyanide destruction circuit and prior to use as paste backfill. This ensures that the cyanide destruction process is working within operational controls. The purpose of this monitoring is:

- To verify that all CIP tailings are disposed of underground as part of the paste backfill;
- To verify the action limits for cyanide destruction are met;
  - At least 90% of the samples shall contain less than ten ppm WAD cyanide; and
  - 100% of the samples shall contain less than 20 ppm WAD cyanide.

Table 14.1 identifies where CIP Tailing Monitoring Program key elements are located in the Pogo Mine Monitoring Plan.

Table 14.1: CIP Tailing Monitoring Program Elements in Pogo Mine Monitoring Plan

Location in Plan	Description
Table 7.5	CIP Tailing Sampling Schedule
Table 7.6	CIP Tailing Analysis Profile

14.1 CIP Tailing Sampling Protocol

A sample is always analysed for WAD cyanide before every paste pour at the Pogo Mine Assay Lab. If a PC001 sample meets the action limit of 10 mg/kg WAD Cyanide:

- It is re-sampled to confirm results.

- If the confirmation sample contains less than 10 mg/kg WAD cyanide then the original sample is rejected and removed from the data set used to determine compliance.
- If the mean concentration of the original sample and the confirmatory sample are greater than 20 mg/kg of WAD cyanide then the paste pour is not initiated until the WAD cyanide levels drop below the action level.

14.2 Pogo Mine Assay Lab Procedures

Solution samples from the CIP Stock Tank are delivered to the assay lab by the mill operators or water operators. Samples are vacuum filtered, first thru a Whatman #1 paper filter, then thru a nylon 0.45 micron membrane disk filter. Samples are measured with a graduated cylinder and transferred into the 100mL boiling flasks along with the picric acid solution. In conjunction with the samples, one blank and two standard samples are also analyzed. The samples are heated for 45 minutes and removed when timer rings. Samples are then cooled and run colorimetrically using a Hach DR2010 instrument.

The instrument is re-set to manufacturers specs about every 6 months, calibration log is kept in the assay lab. Sample results are entered into LIMS and into an Excel spreadsheet.

The sample delivery bottles are rinsed and re-used. All of the glass and plastic ware is rinsed and set to dry for re-use. The remaining sample solution and the waste from the analyses are discarded into drums labeled for transport and off-site disposal.

Refer to Section 21 - Related Documents for the Pogo Mine Assay Lab QAPP for further information on laboratory procedures.

14.3 CIP Tailing Reporting Requirements

CIP tailing monitoring results are reported in the quarterly and annual activity and monitoring report as required by the Waste Management Permit. Only WAD cyanide data that was collected just prior to a paste pour, or during a paste pour, is included. The data is presented graphically and includes the CIP action limits.

14.4 CIP Tailing Exceedance

If a CIP Tailing WAD cyanide exceedance occurs:

- If any CIP Tailing WAD cyanide analysis exceeds the target limits prior to a paste pour, the pour is postponed until the cause of the problem is located and corrective action is taken.
- If any CIP Tailing WAD cyanide analysis exceeds the target limits during a paste pour, the cause of the problem is investigated, and corrective action is taken.

A discussion on exceedances along with any corrective actions taken is included in the quarterly and annual reports.

15. SURFACE WATER MONITORING PROGRAM

Pogo's APDES Permit (AK0053341) requires receiving water monitoring:

- To monitor changes that may occur as a result of activities associated with the discharges from the facility;
- To compare upstream and downstream monitoring results and to compare monitoring results for each station over time, to show any trends; and
- To assure that state water quality standards are met and to provide information for future permitting actions.

Pogo's Waste Management Permit (2018DB0001) requires surface water monitoring:

- For parameters at frequencies and locations which ensure that sampling detects any violation of the water quality standard; and
- To ensure that water quality standards are met at the outside edge of the mixing zone in the Goodpaster River.

The following sections explain field sampling procedures and guidance for surface water and sediment sample collection.

15.1 Water Quality

Sampling begins at the furthest downstream station and moves upstream to avoid contamination between stations from upstream sampling activities. Sample collection begins with general parameters and ends with trace metals.

Permit Required Sampling

Sample collection at surface water sites is performed using a dedicated, extending, sampling rod with a laboratory cleaned and certified bottle (unpreserved), or a certified clean bottle from another source, attached at the end. The bottle is attached to the pole for sampling and is rinsed with surface water several times before the water is poured into the sample collection bottle. Alternatively, the laboratory certified sampling bottle can be lowered into the body of water at an angle that allows the water to flow in gently. Pre-preserved samples will not be collected in this way. For more information refer to Section 21 - Related Documents for a copy of the Surface Water Sample Collection SWP.

Winter Surface Water Sampling

An open water lead at the sample site is used for sampling, or, alternatively, a gas-powered ice auger or a handheld ice chisel are used to drill a hole for sampling. Samples are collected by hand using the sample bottle alone or by using an extending sampling rod as described above. A peristaltic pump may also be used with the tubing changed between stations to prevent contamination (very low temperatures may require insulation of pump). Care is taken to avoid contact with the sides of the augured hole.

During extreme winter conditions, it may be necessary to collect field measurements. An adequate number of sample bottles (without preservative) are used to collect the volume of water necessary to complete procedures inside. Field parameters will be measured as soon as possible after the sample is collected. Measurement time and location will be recorded on the data sheets.

Sample Filtration

Previous to July 1, 2017, filtered samples for dissolved metals analysis were required by APDES Permit AK0053341. As total metal analysis only is required after this point, the information below has been retained for future reference as needed.

Samples for dissolved metals are filtered in the field using disposable, trace metal grade 0.45 micron filters and peristaltic field pump powered by 12 volt portable battery pack or in the environmental lab. The filter is attached to silicone tubing by a hose fitting/reducer fitting that is connected to silicon tubing and inserted into the sample bottle. At least three filter volumes (approximately 300-400 ml) of sample water are run through the filter before filling sample bottle.

EPA guidance recommends immediate filtering on site. When possible, samples should be filtered in the field using a portable filtration apparatus. Due to the remoteness of some sample locations and harsh meteorological conditions, it may not always be possible to safely filter samples in the field. When field filtration is not feasible, a bulk bottle will be collected for filtration in the Environmental Laboratory. In this case, the sampler will proceed directly to the laboratory to conduct filtration. The time of sample filtration will be recorded on the sample's field data sheet.

Table 15.1.1 identifies where Surface Water Monitoring Program key elements are located in the Pogo Mine Monitoring Plan.

Table 15.1.1: Surface Water Monitoring Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 8.1	CIP Phase II Active Mining Operations Surface Water Sampling Schedule
Table 8.2	Surface Water Analytical Parameters Profile 13s and Water Quality Standards
Table 8.4	Phase III and IV Closure Operations Surface Water Sampling Schedule
Table 8.5	Phase V Post Closure Surface Water Sampling Schedule

The primary study area includes a 7-mile segment of the upper Goodpaster River near the Pogo Mine (refer to Figure 1.2). Four monitoring stations are used to monitor the water quality in the Goodpaster River (Table 15.1.2).

Table 15.1.2: Surface Water Monitoring Station Locations and Purpose

Monitoring Station	Goodpaster River Location	Purpose
SW01	Above (upstream) the project site, between Stingray and Otter Creeks	Fish tissue analysis and to monitor background water quality.

Monitoring Station	Goodpaster River Location	Purpose
SW12	Below (downstream) the confluence with Central Creek.	Fish tissue analysis and annual monitoring below the mining claim. Collected annually.
SW15	Below (downstream) all project facilities and the confluence with Pogo Creek.	To monitor the water quality below the project facilities.
SW41	Below (downstream) the confluence with Liese Creek.	To monitor the water quality below the off-river treatment works and drainage from the project facilities.
SW42	Below (downstream) Outfall 002 mixing zone.	To monitor the water quality below the mixing zone for Outfall 002.
SW49	Above (upstream) all project facilities. Closer to mine site than SW01. More easily accessible if higher sampling frequency is deemed useful for internal monitoring.	To monitor background water quality.

15.2 Surface Water Sample Collection

Surface water monitoring stations are sampled six times a year during high and low flow conditions. Sampling may be rescheduled due to severe weather conditions. Table 15.2.1 provides surface water sampling schedule (including QA/QC sampling). Table 15.2.2 provides analytical methods and limits. Table 15.2.3 provides holding times and sample containers.

Table 15.2.1: Surface Water Sampling Schedule

Location	Sample Type	Profile	Analytes	Frequency
SW01, SW15, SW41, SW42, SW49	Grab	13s	Alkalinity, Sb, As, Cd, Ca, Cu, WAD Cn, Hardness, Fe, Pb, Mg, Mn, Ni, Hg, Nitrate/Nitrite, Se, Ag, Sulfate, TDS, Zn (total metals only)	Late February to mid-March
SW100	Duplicate Grab			Rotating locations with every sampling event
SW-FB	Blank Grab			Rotating locations with every sampling event
SW01, SW15, SW41, SW42, SW49	Grab	13s	Alkalinity, Sb, As, Cd, Ca, Cu, WAD Cn, Hardness, Fe, Pb, Mg, Mn, Ni, Hg, Nitrate/Nitrite, Se, Ag, Sulfate, TDS, Zn (total metals only)	Mid-May
SW01, SW15, SW41, SW42, SW49	Grab			Mid-June
SW01, SW15, SW41, SW42, SW49	Grab			Early August
SW01, SW15, SW41, SW42, SW49	Grab			Late-September
SW01, SW15, SW41, SW42, SW49	Grab			December
SW-12	Grab	13s	Alkalinity, Sb, As, Cd, Ca, Cu, WAD Cn, Hardness, Fe, Pb, Mg, Mn, Ni, Hg, Nitrate/Nitrite, Se, Ag, Sulfate, TDS, Zn (total metals only)	September / October (Fish Tissue sampling)
SW200	Duplicate Grab			Annual, collect with first sampling event of year
SW-FB2	Blank Grab			Annual, collect with first sampling event of year
Drystack Toe	Grab	13s	Alkalinity, Sb, As, Cd, Ca, Cu, WAD Cn, Hardness, Fe, Pb, Mg, Mn, Ni, Hg, Nitrate/Nitrite, Se, Ag, Sulfate, TDS, Zn (total metals only)	Monthly when water is present

Table 15.2.2: Analytical Methods and Limits for Surface Water Monitoring Profiles

Analyte Group	Parameter	Dissolved Metals?	Analytical Method	Method Revision Number	Units	Minimum Level (ML)[1]	Precision (PQL or MRL)[2]	Accuracy (MDL)[3]
Cyanides	Cyanide, Weak Acid Dissociable (WAD)	n	Kelada-01* D2036-06C	NA	µg/L	20[4]	4.0	1.2
Major Anions	Alkalinity as CaCO3	n	SM 2320B	NA	mg/L	NA	7.0	1.2
	Nitrite-Nitrate as N	n	EPA 353.2	NA	mg/L	80	10	0.38
	Sulfate	n	EPA 300.0	NA	mg/L	25	1.0	0.024
Major Cations	Calcium	y	EPA 200.7 / 200.8	3	mg/L	NA	0.10	0.013
	Magnesium	y	EPA 200.7 / 200.8	3	mg/L	NA	0.10	0.012
	Potassium	y	EPA 200.7 / 200.8	3	mg/L	NA	1.0	0.31
	Sodium	y	EPA 200.7 / 200.8	3	mg/L	NA	1.0	0.028
Metal	Antimony	y/n	EPA 200.7 / 200.8	5.4	µg/L	3	0.10	0.044
	Arsenic	y/n	EPA 200.7 / 200.8	5.4	µg/L	5	0.15	0.084
	Cadmium	y/n	EPA 200.7 / 200.8	5.4	µg/L	0.1	0.10	0.066
	Chromium	y/n	EPA 200.7 / 200.8	5.4	µg/L	10	0.50	0.20
	Copper	y/n	EPA 200.7 / 200.8	5.4	µg/L	2.8	0.25	0.076
	Iron	y/n	EPA 200.7 / 200.8	3	µg/L	817	10	2.7
	Lead	y/n	EPA 200.7 / 200.8	5.4	µg/L	0.4	0.20	0.073
	Manganese	y/n	EPA 200.7 / 200.8	5.4	µg/L	50	0.25	0.66
	Mercury	y/n	EPA 245.1	4	µg/L	0.01	0.00050	0.00015
	Nickel	y/n	EPA 200.7 / 200.8	5.4	µg/L	16	0.25	0.20
	Selenium	y/n	EPA 200.7 / 200.8	5.4	µg/L	1.9	0.50	0.30
	Silver	y/n	EPA 200.7 / 200.8	.4	µg/L	0.3	0.10	0.086
	Zinc	y/n	EPA 200.7 / 200.8	5.4	µg/L	19	2.5	0.55
Physical and Aggregate Properties	Nitrate/Nitrite N	n	EPA 353.2	N/A	mg/L	80	10	0.38
Physical and Aggregate Properties	Conductivity (Specific Conductance), Field	n	EPA 120.1[6]	NA	µS/cm @ 25°C	NA	NA	10
	Dissolved Oxygen, Field	n	SM 4500-O G-2001[6]	NA	mg/L	2	NA	NA

Analyte Group	Parameter	Dissolved Metals?	Analytical Method	Method Revision Number	Units	Minimum Level (ML)[1]	Precision (PQL or MRL)[2]	Accuracy (MDL)[3]
	Hardness as $CaCO_3$	n	SM 2340 B	NA	mg/L	NA	NA	1.0
	pH, Field	n	Standard Method 4500-H+ B-2000 ASTM Method D1293-99 (A or B) USGS Method I-1586-85 (Wastewater)	NA	s.u.	4.0[5]	NA	NA
	Temperature, Field	n	Method 2550 B-2000[6]	NA	C	NA	NA	0.1
	Total Dissolved Solids (TDS)	n	SM 2540 C	21	mg/L	50	25	4.8
	Turbidity, Field	n	EPA 180.1, Rev. 2.0[7]	3	NTU	5	0.50	0.030

[1]Minimum Level (ML) is the level at which analysis will produce recognizable mass spectra and acceptable calibration points.

[2]Practical Quantization Limit (PQL) or MRL Method Reporting Limit is the minimum concentration at which the concentration of a constituent can be measured.

[3]Method Detection Limit (MDL) is the minimum concentration at which analysis will confirm a greater-than-zero concentration.

[4]APDES Permit # AK0053341 specifies a site-specific ML of 20 µg/L and MDL of 10 µg/L for WAD Cyanide

[5] pH range from 4.0 to 11.0

[6] EPA Approved Methods used for YSI Water Meter, also listed on 40 CFR Part 136 Table B

[7] EPA Approved Method, 40 CFR Part 136 Table B

*Kelada-01 was approved by ADEC as the primary method for WAD Cn analysis. D2036-06C is an alternate method approved when distillation of sample is required, or other instrument issues needing resolution.

Table 15.2.3: Holding Times and Sample Containers Surface Water Sampling

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
Cyanides	Cyanide, WAD	Dark Polyethylene, Glass	500 mL	Cool 4°C, NaOH to pH>12	14 days
Major Anions	Alkalinity	Polyethylene, Glass	1 L	Cool 4°C	14 days
	Chloride, Fluoride & Sulfate	Polyethylene	1 L	Cool 4°C	28 days
	Nitrate+Nitrite	Polyethylene, Glass	250/500 mL	Cool 4°C, H_2SO_4 to pH<2	28 days
Major Cations	Calcium, Magnesium, Potassium, Sodium	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2	6 months
Metals	Metals, except mercury	Polyethylene	250/500 mL	HNO_3 to pH<2	6 months

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
	Mercury (Method 245.1)	Fluoropolymer, Glass	125/250 mL	either 5 mL/L of pretested 12N HCl or 5 mL/L BrCl solution	28 days
Physical and Aggregate Properties	Conductivity (Specific Conductance)	Polyethylene, Glass	100 mL	None	24 hours
		Polyethylene, Glass	500 mL/1 L	Cool 4°C, Filtered (for EPA 120.1)	28 days
	Dissolved Oxygen	Glass	300 mL	None	Analyze immediately
	Hardness	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months
	pH	Polyethylene, Glass	25 mL	None	Analyze immediately
	Temperature	Polyethylene, Glass	25 mL	None	Analyze immediately
	TSS, TDS	Polyethylene, Glass	500 mL/1 L	Cool 4°C	7 days
	Turbidity	Polyethylene, Glass	500 mL/1 L	Cool 4°C	48 hours

15.3 Surface Water Reporting Requirements

15.3.1 APDES Reporting Requirements

Surface water monitoring results are reported in the Annual Activity and Monitoring Report. The report includes both analytical results and the graphical evaluation of those results. It compares upstream and downstream data to show any differences and data for each station over time to show any trends. The data is also attached in an electronic spreadsheet. At a minimum the report includes:

- Date of sample collection and analyses;
- Results of sample analysis; and
- Relevant QA/QC information

15.3.2 Waste Management Permit Reporting Requirements

Surface water monitoring results are reported in the quarterly and annual activity and monitoring reports. The reports include information necessary to determine data validity, any water quality trends, or exceedances of the water quality standards.

15.4 Surface Water Exceedance

Pogo's APDES Permit requires monitoring of the surface water sites, and trend analysis of data collected, but defines no water quality limitations. Pogo's Waste Management Permit requires that Alaska State Water Quality Standards be met. If an exceedance of a water quality standard occurs at surface water monitoring station SW15, SW41, or SW42, the Waste Management Permit requires:

- Orally notify ADEC within 24 hours;
- Determine the extent of the exceedance;
- In consultation with ADEC and documented in writing, implement a plan to determine the cause and/or source of the exceedance;
- Submit to ADEC, within 7 working days after an exceedance is verified, a plan for corrective actions to prevent adverse environmental impacts and further exceedances of applicable water quality standards or permit limits; and
- Implement the corrective action plan as approved by ADEC.

16. FISH TISSUE MONITORING PROGRAM

Pogo's APDES Permit requires fish tissue monitoring:

- To monitor long-term changes that may occur as a result of activities associated with the discharges from the facility; and

- To monitor metals concentrations in fish tissue.

The Alaska Fish & Game Fish Resource Permit (for scientific/educational purposes) is required to perform fish tissue collection from the Goodpaster River to fulfill the requirements of the APDES permit.

The monitoring area is a 15-mile segment of the upper Goodpaster River in the vicinity of the Pogo Mine. Fish tissue sampling stations are located above the mine site at surface water sampling station SW01 and below the mine site at surface water sampling station SW12 (Table 16.1)

Table 16.1: Fish Tissue Monitoring Station Locations

Monitoring Station	Goodpaster River Location	Purpose
SW01	Above (upstream) all Pogo Mine facilities.	To monitor background fish tissue concentrations.
SW12	Below (downstream) all Pogo Mine facilities and the confluence with Pogo Creek.	To monitor fish tissue metals concentrations below the Pogo Mine facilities.

Table 16.2 identifies where Fish Tissue Monitoring Program key elements are located in the Pogo Mine Monitoring Plan.

Table 16.2: Fish Tissue Monitoring Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 8.3	Fish Tissue Analytical Profiles and Action Limits

16.1 Fish Tissue Sampling Procedures

A minimum of fifteen juvenile Chinook salmon are collected in late fall prior to freeze-up (usually late September). This allows for the maximum growth of the juveniles, as well as provides repeatable sampling conditions. The sampling criteria are provided in Table 16.1.1.

Table 16.1.1: Fish Tissue Sample Criteria

Criteria	Requirement
Fish Species	Juvenile Chinook salmon
Fish Sample Type	Whole (Individual fish)
Sample Size (Fish Weight in g)	NA
Target Sample Size (Fish Length in mm)	72 to 93 (collect the largest fish if lengths don't meet the target range)
No of Replicates per Station	10
No. of Laboratory QA/QC Fish per Station	5
Total No. of Fish Collected per Station	15
Total No. of Fish Collected Annually	30

Minnow traps are placed at selected locations at SW01 and SW12 sampling stations and left overnight. Minnow traps have the Pogo name, address, telephone number and the Fish Resource Permit number attached. Commercially prepared, sterilized fish eggs are used to bait the minnow traps. If non-commercial eggs are used, they must be disinfected with a 10-minute soak in 1/100 Betadine solution.

On the following day the minnow traps are collected and placed in shallow water while the fish are measured. The first 15 fish to meet the specified criteria at each sampling station are kept for analysis and the rest released unless the permit requires all fish to be measured. Clipped fin tissue may be collected for genetic testing if required by Pogo's Fish Resource Permit.

The ten largest fish from each sampling station are designated to be analyzed individually. The five smallest fish are homogenized into one sample at the lab to be used as a QA/QC sample.

Surface Water sampling is conducted at the same time as the fish tissue sampling. Generally, water samples are collected just prior to setting up minnow traps to reduce the possibility of stirring up sediments. SW12, the downstream site is collected first, and minnow traps set, then the upstream sites at SW01. For more information refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Fish Tissue Sample Collection SWP.

16.1.1 Fish Tissue Analysis

Table 16.1.1.1 provides fish tissue analytical methods and associated MRL.

Table 16.1.1.1: Analytical Methods and Limits (Fish Tissue Matrix)

Parameter	Method	Units	MRL
Length	Field	mm	1
Weight	Standard Method	grams	0.1
Antimony	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	0.5
Arsenic[1] (inorganic)	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	0.5
Cadmium	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	0.8
Copper	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	1.0
Lead	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	0.5
Mercury[2], Total	EPA 1631 or EPA 7471A	Wet mg/kg	0.03
Nickel	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	0.5
Selenium	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	1.5
Silver	SW6020 (metal analysis by ICP/MS)	Wet mg/kg	0.2

[1] Total inorganic arsenic rather than total arsenic is to be determined. For this application, it is assumed that all of the arsenic is inorganic.

[2] Mercury in fish and shellfish tissue is present primarily as methylmercury. Because of the high cost of analyzing for methylmercury, total mercury is analyzed. A conservative assumption is made that all mercury is present as methylmercury. This approach is deemed to be most protective of human health and most cost-effective (EPA, 2000).

Fish tissue holding times and sample containers are provided in Table 16.1.1.2.

Table 16.1.1.2: Holding Times and Sample Containers for Fish Tissue Samples

Parameter Name	Container	Preservation	Maximum Holding Time
Metals	Polyethylene, Ziploc Bag	Freeze Fish Immediately, <20 ^{0}C	6 months
Total Mercury		Freeze Fish Immediately	28 days

16.1.2 Shipping Fish Tissue Samples

Fish tissue samples are shipped frozen with enough gel ice to ensure the fish are still frozen when they arrive at the laboratory. Mercury has the shortest holding time; therefore, frozen fish are generally sent to the laboratory within two weeks of their collection date.

16.2 Fish Tissue Reporting Requirements

16.2.1 APDES Reporting Requirements

The laboratory analytical report of the fish tissue samples, including QA/QC information, is submitted (as a PDF file) with the Annual Activity and Monitoring Report. Also included is the raw data in an electronic spreadsheet. The annual report graphically presents the analytical results over time, comparing upstream and downstream monitoring results to show any differences or trends.

16.2.2 Alaska Fish & Game Reporting Requirements

A Fish Resource Permit is obtained for the Delta Junction, Alaska Department of Fish & Game Department in the spring to collect fish tissue samples in September. The complete Fish Resource Permit application and sampling plan is due by August 1. The Delta Fish and Game Biologist is notified of the fish tissue sample collection date at least one week ahead of time so that they can join the Pogo sampling team. A copy of the permit must be carried by a sampling team member at all times during sampling activities. A Preliminary Data Collection report is due to the Department of Fish and Game, Division of Sport Fish by November 5 of the same year. This includes a summary of the fish captured with date, GPS coordinates, species type, length and final disposition (collection, mortality, or release). A Research Report is due to the Department of Fish and Game, Division of Sport Fish by April 5 of the following year, and must update the preliminary report with any data that remained outstanding from the preliminary report.

16.3 Fish Tissue Trend Analysis

There are no action limits for fish tissue analysis. The annual review of the graphical data presented in the Annual Activity and Monitoring Report will indicate any adverse trends. If an adverse trend appears, consultation with ADEC will take place to develop a corrective action plan.

17. GROUNDWATER MONITORING PROGRAM

Pogo's Waste Management Permit (2018DB0001) requires groundwater monitoring:

- At compliance monitoring wells MW12-500, MW12-501, MW12-502;
- Monitoring wells MW18-001, MW18-002, MW18-003A, MW18-003B;
- At background monitoring wells MW04-213 and MW11-216; and
- At the monitoring wells MW11-001A and MW11-001B between the DSTF and the RTP.

The groundwater monitoring program provides sampling parameters at frequencies and locations that ensure sample results are representative and statistically useful.

MW12-500, MW12-501, and MW12-502

- Monitor for an exceedance of a water quality standard and the Upper Tolerance Limit Concentrations Triggering Corrective Actions (see table 17.1).
  - Bedrock wells MW03-500, 501 and 502 were replaced with alluvial wells MW12-500,501, 502 in 2012 after a well collapsed.
- As per 18AAC 70.020 (Waiver #3, Permit 0131-BA002), if dissolved analyses show water quality at, or closely approaching the applicable water quality criteria, Total Recoverable analyses shall be added to the analytical requirements starting with the next scheduled sampling event (18 AAC70). Due to historic high levels of metals we collect both dissolved and total recoverable metal samples at the MWs.
- Monitor for a statistically significant increase in concentration above the applicable water quality for the parameters monitored; and
- Monitor for a statistically significant increase above background in water quality.

MW18-001, MW18-002, MW18-003A, MW18-003B

- Monitoring wells MW18-001, MW18-002, MW18-003A, and MW18-003B were all constructed in 2018 to monitor water quality in Liese Creek Valley.
- MW18-003A and MW18-003B were placed as a nested pair downstream of Flume 4.
- MW18-003B was designed to replace MW04-213 and has a stronger relationship to the groundwater associated with underground workings. MW04-213 was last sampled in the third quarter, 2019, and is no longer sampled.

MW11-216 and the wells MW11-001A and MW11-001B

- Monitor trends in groundwater quality; and
- Monitor trends in groundwater elevation.

This section outlines the procedures required for sampling and monitoring of groundwater. Monitoring wells are designated as shallow or deep wells.

Shallow monitoring wells are completed in river gravels or overburden with depths ranging from 20 to 90 feet below ground surface (bgs) and were installed to monitor groundwater geochemistry within the Liese Creek and Goodpaster River valleys.

Deep monitoring wells are located on Pogo Ridge and Liese Creek and were completed in bedrock with depths ranging from 150 to 1000 feet bgs. These wells were installed to monitor groundwater geochemistry within the L1 and L2 ore bodies and country rock outside of the ore zone.

MW12-001A and MW12-001B

MW12-001A and 001B are part of a hydrogeological study and are not required by the Waste Management Permit (2018DB0001), to be monitored.

The following sections describe general requirements for groundwater sample collection. General requirements apply to all monitoring wells that are sampled on site. Specific requirements are addressed for shallow and deep monitoring wells in later sections.

17.1 Sampling Procedures

1. Calibrate field meters and document results.

2. Read depth to water with electronic water level meter (sounder) and record to nearest 0.01 (hundredth of a foot) at measuring point (MP) marked on riser pipe. Triple-rinse probe and bottom two feet or more of cable with de-ionized (DI) or potable water after each use.
3. If well is frozen, record depth to frozen surface and thaw well by plugging heat trace into generator.
4. Calculate well volume

   The volume, in gallons per linear foot, for various monitoring wells can be calculated as follows:

   $v = \pi r^2 (cf)$

   v = volume in gallons per linear foot

   $\pi = 3.142$

   r = radius of monitoring well (feet)

   cf = conversion factor (7.48 gal/ft3)

   Field data sheets show volume in gallons per linear foot for the common size monitoring wells used on site. Using those conversion factors, the above equation becomes:

   Well Volume = (h)(v)

   h = height of water column (ft) and

   v = volume in gallons per linear foot

5. Purge three well volumes of water.

   Purge well until a minimum of three times the calculated well water volume is removed, and the temperature, conductivity and pH of the purged water stabilize. If the well is unusually silty or field parameters won't stabilize, it may be necessary to purge more than three well volumes until conditions improve. Water flow is considered stabilized when parameters for two consecutive readings meet the criteria listed below.

   Table 17.1.1 Parameter Stabilization Criteria

Parameter Name	Stabilization Criteria
pH	+/- 0.5 Standard Unit (SU)
Specific Conductance	+/- 5%
DO	+/-DO 0.2 mg/L or 10% saturation
Turbidity	+/- 5%

6. Collect field parameters for every well volume and at sample time.
7. Rinse field meter(s) with DI water after each sample is taken.
8. Wear clean latex/nitrile sampling gloves when collecting the sample.
9. Collect water sample by filling appropriate bottles. Add preservative as required.
10. EPA guidance recommends immediate filtering on site. When possible, samples should be filtered in the field using a portable filtration apparatus. Due to the remoteness of some sample locations and harsh meteorological conditions, it may not always be possible to safely filter samples in the field. When field filtration is not possible, a bulk bottle will be collected for filtration in the Environmental Field Laboratory. In this case, the sampler will proceed directly to the laboratory to conduct filtration. The time of sample filtration will be recorded on the sample's field data sheet.

    Samples for dissolved metals are filtered using disposable, trace metal grade 0.45-micron filters and a peristaltic field pump powered by 12 volt portable battery pack. The filter is attached to silicone tubing and inserted into the sample bottle.

    Use clean tubing in the pump for each well sampled.

    Disposable in line filters are used to collect samples for dissolved metals analysis. At least three filter volumes (approximately 300 to 400 ml) of sample water are run through the filter before filling sample bottle.

Grundfos Dedicated Pump Sampling

Two deep water wells, MW11-216 and MW11-001B were drilled and completed as proper monitoring wells (four-inch diameter casing with sounder tube) in 2011. Two shallow water wells, MW12-500 and MW12-501, were drilled and completed as proper monitoring wells in 2012. These two wells have low flow dedicated pumps

installed to collect water samples. MW18-001, MW18-002, MW18-003A, and MW18-003B were completed with a 2-inch diameter casing and also have low-flow dedicated pumps installed.

Dedicated pumps are connected to a small generator and a Grundfos controller to purge the wells. Pump flow rates are adjusted to produce a flow rate appropriate for the particular monitoring well and static water level.

Waterra® Inertial Pump Sampling

Shallow monitoring well purging and sampling is accomplished with the Waterra® Inertial Pump. A Waterra® foot valve and tubing are dedicated to every well. The system consists of a stainless-steel foot valve and a length of plastic tubing that when oscillated up and down in the well produces a flow of water. This system has proven to be a simple, reliable and versatile sampling system. Figure 17.1.1, below, is a diagram of the sampling system showing a cross sectional view of the foot valve and tubing in the well (courtesy of Waterra®).

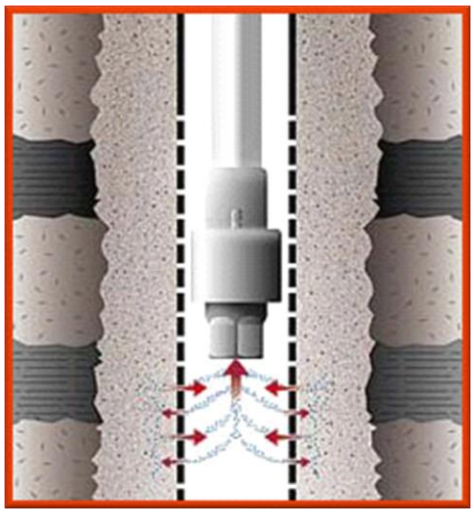


Figure 17.1.1: Cross Section of Waterra® Foot Valve

The groundwater monitoring programs are designed to monitor any groundwater impact from the DSTF, RTP or underground workings. Table 17.1.1 identifies where Groundwater Monitoring Program key elements are located in the Pogo Mine Monitoring Plan. Table 17.1.2 provides groundwater monitoring program station locations.

For more information refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Monitoring Well Sample Collection SWP.

Table 17.1.2: Groundwater Monitoring References to Pogo Mine Monitoring Plan

Location in Plan	Description
Table 9.1	Phase II Active Mining Operations Groundwater Sampling Schedule
Table 9.2	Groundwater Analytical Parameters Profile 13g and Water Quality Standards
Table 9.3	Upper Tolerance Limit Concentration Triggering Corrective Action
Table 9.4	Phase III and IV Closure Operations Groundwater Sampling Schedule
Table 9.5	Phase V Post Closure Groundwater Sampling Schedule
Table 9.6	Hydrology Characterization Groundwater Sampling Schedule

Note: Baseline data for MW11-001A, 001B, MW11-216, MW04-213 is presented in the 2015 Monitoring Plan.

Table 17.1.3: Groundwater Monitoring Station Locations

Monitoring Program	Monitoring Stations	Location	Purpose
Detection (Compliance Points)	MW12-500, MW12-501, MW12-502	Down gradient of the Recycle Tailings Pond (RTP)	To detect seepage from the RTP.
	MW18-001, MW18-002, MW18-003A, MW18-003B	Down gradient of the Recycle Tailings Pond (RTP)	To monitor Liese Creek valley for any constituents from the RTP.
Trend	MW11-216	Down gradient of the ore body on Pogo Ridge	To monitor groundwater quality and elevation trends as mining proceeds.
	MW11-001A	Down gradient of the Drystack and up gradient of the RTP	To monitor groundwater quality and elevation trends from the Drystack runoff.
	MW11-001B	Down gradient of the Drystack and up gradient of the RTP	To monitor groundwater quality and elevation trends from infiltration groundwater below the Drystack.
Hydrology Characterization	MW12-001A	Pogo Airstrip	Alluvial well as part of the East Deep Hydrology Study
	MW12-001B	Pogo Airstrip	Bedrock well as part of the East Deep Hydrology Study

Note: MW04-213 was replaced with MW18-003B at the end of Q3 in 2019.

Table 17.1.3 provides sampling schedule (including QA/QC sampling), Table 17.1.4 provides analytical methods and limits, and Table 17.1.5 presents holding times and sample containers.

Table 17.1.4: Groundwater Sampling Schedule

Location	Sample Type	Profile	Analytes	Frequency
MW11-216	Grab	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se, Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Semi-Annually
MW-100	Duplicate Grab			Annually, rotating locations between MW11-216 and MW04-213
MW-FB	Blank Grab			Annually, rotating locations between MW11-216 and MW04-213
MW12-500, MW12-501, MW12-502	Grab	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se, Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Quarterly
MW100	Duplicate Grab			Annually, rotating locations between MW12-500, MW12-501, and MW12-502
MW-FB	Blank Grab			Annually, rotating locations between MW12-500, MW12-501, and MW12-502
MW18-001 MW18-002 MW18-003A MW18-003B	Grab	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se,	Quarterly

Location	Sample Type	Profile	Analytes	Frequency
MW-100	Duplicate Grab		Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Annually, rotating locations between MW18-001, MW18-002, MW18-003A and MW18-003B
MW-FB	Blank Grab			Annually, rotating locations between MW18-001, MW18-002, MW18-003A and MW18-003B
MW11-001A, MW11-001B	Grab	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se, Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Quarterly
MW-100	Duplicate Grab			Annually, rotating locations between MW11-001A and MW11-001B
MW-FB	Blank Grab			Annually, rotating locations between MW11-001A and MW11-001B
MW12-001A, MW12-001B	Grab	13g	Alkalinity, Sb, As, Cd, Ca, Chloride, Cr, Cu, Fluoride, Hardness, Fe, Pb, Mg, Mn, Hg, Ni, Nitrate / Nitrite, K, Se, Ag, Na, TDS, Sulfate, TKN, Zn, (metals total and dissolved), WAD Cn	Quarterly
MW-100	Duplicate Grab			Annually, rotating locations between MW12-001A and MW12-001B
MW-FB	Blank Grab			Annually, rotating locations between MW12-001A and MW12-001B
LT99-009	Static Groundwater Level Measurement	NA	NA	Quarterly
MW99-216	Static Groundwater Level Measurement	NA	NA	Quarterly

Table 17.1.5: Analytical Methods and Limits for Groundwater Monitoring

Analyte Group	Parameter	Dissolved Metals?	Analytical Method	Method Revision Number	Units	Minimum Level (ML)[1]	Precision (PQL)[2]	Accuracy (MDL)[3]
Cyanides	Cyanide, Weak Acid Dissociable (WAD)	n	Kelada-01* D2036-06C	N/A	µg/L	5.2[4]	4.0	1.2
Major Anions	Alkalinity, Total	n	SM 2320B	N/A	mg/L	NA	7.0	1.2
	Chloride	n	EPA 300.0	N/A	mg/L	NA	1.0	0.071
	Fluoride	n	A4500-F C	N/A	mg/L	NA	0.20	0.0022
	Nitrite-Nitrate as N	n	EPA 353.2	N/A	mg/L	80	10	0.38
	Sulfate	n	EPA 300.0	N/A	mg/L	NA	1.0	0.024
Major Cations	Calcium	y	EPA 200.7 / 200.8	3	mg/L	NA	0.10	0.013
	Magnesium	y	EPA 200.7 / 200.8	3	mg/L	NA	0.10	0.012
	Potassium	y	EPA 200.7 / 200.8	3	mg/L	NA	1.0	0.31
	Sodium	y	EPA 200.7 / 200.8	3	mg/L	NA	1.0	0.028
Metals	Antimony	y/n	EPA 200.7 / 200.8	5.4	µg/L	3	0.10	0.044
	Arsenic	y/n	EPA 200.7 / 200.8	5.4	µg/L	5	0.15	0.084
	Cadmium	y/n	EPA 200.7 / 200.8	5.4	µg/L	0.1	0.10	0.066

Analyte Group	Parameter	Dissolved Metals?	Analytical Method	Method Revision Number	Units	Minimum Level (ML)[1]	Precision (PQL)[2]	Accuracy (MDL)[3]
	Chromium	y/n	EPA 200.7 / 200.8	5.4	µg/L	10	0.50	0.20
	Copper	y/n	EPA 200.7 / 200.8	5.4	µg/L	2.2	0.25	0.076
	Iron	y/n	EPA 200.7 / 200.8	3	µg/L	817	10	2.7
	Lead	y/n	EPA 200.7 / 200.8	5.4	µg/L	0.5	0.20	0.073
	Manganese	y/n	EPA 200.7 / 200.8	5.4	µg/L	NA	0.25	0.66
	Mercury	y/n	EPA 245.1	4	µg/L	0.01	0.00050	0.00015
	Nickel	y/n	EPA 200.7 / 200.8	5.4	µg/L	NA	0.25	0.20
	Selenium	y/n	EPA 200.7 / 200.8	5.4	µg/L	1.9	0.50	0.30
	Silver	y/n	EPA 200.7 / 200.8	5.4	µg/L	0.3	0.10	0.086
	Zinc	y/n	EPA 200. 7 200.8	5.4	µg/L	16.8	2.5	0.55
Physical and Aggregate Properties	Conductivity (Specific Conductance), Field	n	EPA 120.1	NA	µS/cm @ 25°C	NA	NA	10
	Dissolved Oxygen, Field	n	SM 4500-O G-2001	NA	mg/L	NA	NA	NA
	Hardness as $CaCO_3$	n	SM 2340 B	NA	mg/L	NA	NA	1.0
	pH, Field	n	Standard Method 4500-H+ B-2000 ASTM Method D1293-99 (A or B) USGS Method I-1586-85 (Wastewater)	NA	s.u.	NA	NA	NA
	Temperature	n	EPA 170.1 (Field)	NA	C	NA	NA	0.1
	Total Dissolved Solids (TDS)	n	SM 2540 C	21	mg/L	NA	25	4.8
	Turbidity, Field	n	EPA 180.1	3	NTU	NA	0.50	0.030

[1]Minimum Level (ML) is the level at which analysis will produce recognizable mass spectra and acceptable calibration points.

[2]Method Detection Limit (MDL) is the minimum concentration at which analysis will confirm a greater-than-zero concentration.

[3]Practical Quantization Limit (PQL) is the minimum concentration at which the concentration of a constituent can be measured.

[4]APDES Permit # AK0053341 specifies a site-specific ML of 20 µg/L and DML of 10 µg/L for WAD Cyanide

*Kelada-01 was approved by ADEC as the primary method for WAD Cn analysis. D2036-06C is an alternate method approved when distillation of sample is required, or other instrument issues need resolution.

Table 17.1.6: Holding Times and Sample Containers Groundwater Sampling

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
Cyanides	Cyanide, WAD	Dark Polyethylene, Glass	500 mL	Cool 4°C, NaOH to pH>12	14 days
Major Anions	Alkalinity	Polyethylene, Glass	1 L	Cool 4°C	14 days
	Chloride, Fluoride & Sulfate	Polyethylene	1 L	Cool 4°C	28 days

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
	Nitrate+Nitrite	Polyethylene, Glass	250/500 mL	Cool 4°C, H_2SO_4 to pH<2	28 days
Major Cations	Calcium, Magnesium, Potassium, Sodium	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2	6 months
Metals	Metals, except mercury	Polyethylene	250/500 mL	HNO_3 to pH<2	6 months
	Mercury (Method 245.1)	Fluoropolymer, Glass	125/250 mL	either 5 mL/L of pretested 12N HCl or 5 mL/L BrCl solution	28 days
Physical and Aggregate Properties	Conductivity (Specific Conductance)	Polyethylene, Glass	100 mL	None	24 hours
		Polyethylene, Glass	500 mL/1 L	Cool 4°C, Filtered (for EPA 120.1)	28 days
	Dissolved Oxygen	Glass	300 mL	None	Analyze immediately
	Hardness	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months
	pH	Polyethylene, Glass	25 mL	None	Analyze immediately
	Temperature	Polyethylene, Glass	25 mL	None	Analyze immediately
	TSS, TDS	Polyethylene, Glass	500 mL/1 L	Cool 4°C	7 days
	Turbidity	Polyethylene, Glass	500 mL/1 L	Cool 4°C	48 hours

17.1.1 Groundwater Reporting Requirements

Pogo imports electronic data from the contract laboratories directly into EDMS as discussed in Section 8. The data is compared to the mean of the background data and any significant statistical variation (Outlier above 0.1% Significance, and Outlier Above 5% Significance) is noted and qualified within the EDMS database. Monitoring results are reported in the quarterly and annual reports. All groundwater sampling data is graphed in the quarterly and annual reports. If any statistically significant changes or trends occur, ADEC is contacted.

17.1.2 Groundwater Exceedances

Pogo's Waste Management Permit requires that Alaska State Water Quality Standards are met. If a statistically significant exceedance of a water quality standard is detected from validated data at groundwater monitoring stations, MW12-500, MW12-501, and MW12-502 then the Waste Management Permit requires:

- Orally notify ADEC within 24 hours;
- Determine the extent of the exceedance;
- In consultation with ADEC and documented in writing, implement a plan to determine the cause and/or source of the exceedance;
- Submit to ADEC, within 7 working days after an exceedance is verified, a plan for corrective actions to prevent adverse environmental impacts and further exceedances of applicable water quality standards or permit limits; and
- Implement the corrective action plan as approved by ADEC.

18. EFFLUENT MONITORING PROGRAM

Pogo's APDES Permit # AK0053341 requires effluent monitoring:

- To monitor the limits placed on the types and amounts of pollutants that are discharged;
- To ensure protection of water quality and human health; and
- To detect an exceedance of an effluent limitation.

Pogo discharges to the Goodpaster River through two outfalls. Outfall 001, the discharge point for treated mine drainage and excess precipitation, is located at latitude 64° 28' 12" N and longitude 144° 55' 03" W (NAD 83). Outfall 002, the discharge point for treated domestic wastewater, is located at latitude 64° 26' 36" N and longitude 144° 56' 30" W (NAD 83). Discharge outfalls are shown on Figure 1.2.

Table 18.1 identifies where Effluent Monitoring Program key elements are located in the Pogo Mine Monitoring Plan.

Table 18.1: Effluent Monitoring Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 10.1	Effluent Monitoring Outfall Locations
Table 10.2	Effluent Monitoring Schedule
Table 10.3	Outfall 001 Weekly Analytical Parameters Profile 10a and Effluent Limits
Table 10.4	Outfall 001 Monthly Analytical Parameters Profile 10b and Effluent Limits
Table 10.6	Outfall 011 Weekly Analytical Parameters Profile 11a and Effluent limits
Table 10.7	Outfall 011 Quarterly Analytical Parameters Profile 11b and Effluent limits
Table 10.8	Monthly Effluent Sewage Treatment Plant Outfall 002 Analytical Parameters Profile 12a and Effluent Limits
Table 10.9	Quarterly Influent Sewage Treatment Plant STP002 Analytical Parameters Profile 12b and Effluent Limits

18.1 Effluent Sampling Procedures

Sampling is conducted periodically (including QA/QC sampling) as described in Table 18.1.1. Sampling may be rescheduled due to severe weather conditions. For more information refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the APDES Outfall Sample Collection SWP.

Table 18.1.1: Effluent Sampling Schedule

Station ID	Sample Type	Profile	Analytes	Frequency	Annual No. of Samples	Schedule
Outfall 001	Grab	10a	Cu, WAD Cn, Pb, Mn	Weekly	52	NA
WW-100	Duplicate Grab	10a	Cu, WAD Cn, Pb, Mn	≥10%	6	Jan / Mar / May / July / Sept / Nov
WW-FB	Blank Grab	10a	Cu, WAD Cn, Pb, Mn	≥10%	6	Jan / Mar / May / July / Sept / Nov
Outfall 001	Grab	10b	Cd, Hg, Zn, Turb, Hardness	Monthly	12	NA
WW-100	Duplicate Grab	10b	Cd, Hg, Zn, Turb, Hardness	≥10%	2	Feb / Oct
WW-FB	Blank Grab	10b	Cd, Hg, Zn, Turb, Hardness	≥10%	2	Feb / Oct
Outfall 001	Grab	WET Test	Fathead minnow & Water flea	Annual, prior to August 1	1	June
NPDES 001b	Grab	10a	Cu, WAD Cn, Pb, Mn	Weekly	52	NA
WW-100	Duplicate Grab	10a	Cu, WAD Cn, Pb, Mn	≥10%	6	Jan / Mar / May / July / Sept / Nov
WW-FB	Blank Grab	10a	Cu, WAD Cn, Pb, Mn	≥10%	6	Jan / Mar / May / July / Sept / Nov
NPDES 001b	Grab	10b	Cd, Hg, Zn, Turb, Hardness	Monthly	12	NA

Station ID	Sample Type	Profile	Analytes	Frequency	Annual No. of Samples	Schedule
WW-100	Duplicate Grab	10b	Cd, Hg, Zn, Turb, Hardness	≥10%	2	Feb / Oct
WW-FB	Blank Grab	10b	Cd, Hg, Zn, Turb, Hardness	≥10%	2	Feb / Oct
Outfall 011	Grab	11a	WAD Cn	Weekly	52	NA
WW-100	Duplicate Grab	11a	WAD Cn	≥10%	6	Jan / Mar / May / July / Sept / Nov
WW-FB	Blank Grab	11a	WAD Cn	≥10%	6	Jan / Mar / May / July / Sept / Nov
Outfall 011	Grab	11b	As, Cd, Cu, Fe, Pb, Mn, Hg, Sb, Zn, TDS, Sulfate, TSS, Hardness	Quarterly	4	NA
WW-100	Duplicate Grab	11b	As, Cd, Cu, Fe, Pb, Mn, Hg, Sb, Zn, TDS, Sulfate, TSS, Hardness	≥10%	1	April
WW-FB	Blank Grab	11b	As, Cd, Cu, Fe, Pb, Mn, Hg, Sb, Zn, TDS, Sulfate, TSS, Hardness	≥10%	1	April
Outfall 002	Grab	12a	BOD 5-day, TSS, Fecal Coliform, Nitrate-Nitrite, As, Cd, Cu, Pb, Mn, Hg, Zn	Monthly	12	NA
WW-100	Duplicate Grab	12a	BOD 5-day, TSS, Fecal Coliform, Nitrate-Nitrite, As, Cd, Cu, Pb, Mn, Hg, Zn	≥10%	2	Mar / Jun
WW-FB	Blank Grab	12a	BOD 5-day, TSS, Fecal Coliform, Nitrate-Nitrite, As, Cd, Cu, Pb, Mn, Hg, Zn	≥10%	2	Mar / Jun
STP 002	Grab	12b	BOD 5-day, TSS	Quarterly	4	NA
WW-100	Duplicate Grab	12b	BOD 5-day, TSS	≥10%	1	Sept
WW-FB	Blank Grab	12b	BOD 5-day, TSS	≥10%	1	Sept

18.1.1 Flow

Flow discharge rates are monitored continuously at Outfall 001, Outfall 011, and Outfall 002. If there is no discharge from Outfall 011 for 72-hours, routine sampling of Outfall 001 is not required. However, when discharge from Outfall 011 commences, a sample from Outfall 001 is required within 36-hours. Sampling at Outfall 002 is only required if discharge of treated effluent occurs, however, when discharge recommences, a sample is required within 24-hours.

18.1.2 Turbidity

Turbidity is measured at station NPDES 001B, the influent to the Off River Treatment Works (ORTW) and represents the natural condition of the Goodpaster River. The discharge going out Outfall 001 cannot be more than 5 NTU's greater than the natural condition. When using the handheld turbidity meter, the turbidity data collected at NPDES 001B must be taken within one hour of the turbidity data collected at Outfall 001.

18.1.3 Stream Gauging

Stream Gauging is necessary to determine whether there is sufficient water flowing in the Goodpaster River to allow discharge. If flow drops below 20 cf/s discharge is not allowed. Low flow conditions generally do not occur unless ice thickens to the point that the Goodpaster River channel becomes very narrow. The USGS maintains a stream flow gauge on the Goodpaster River near the Goodpaster Bridge. USGS stream flow data is available online at: http://waterdata.usgs.gov. USGS usually emails current data to the Environmental

Department as a courtesy. However, in the winter, if the USGS is not able to monitor river flow the Environmental Department performs stream gauging as needed to determine river flow rate.

18.1.4 Fecal Coliform

Fecal Coliform sampling at Outfall 002 has a hold time of 8 hours from time of collection to the beginning of analysis. The APDES permit allows 6 hours of transit time, if the lab begins analyzing the sample within 2 hours.

18.1.5 Mixing Zone for Outfall 002

The mixing zone in the Goodpaster River, near the sewage effluent outfall line is posted with signs upstream and downstream. The signs inform the public that a mixing zone exists, that treated and disinfected wastewater is being discharged and that users of the area should exercise caution. Signs provide name of the company, company address and contact phone numbers, and advise the public not to bathe in or consume raw aquatic products harvested from the mixing zone.

18.1.6 Effluent Sample Collection

All water samples are stored in a refrigerator until ready for shipment. Any required preservative may be added to sample bottles at the contract lab previous to delivery or added in the field as samples are collected. When dissolved metals samples are collected, protocol requires samples to be filtered within 15 minutes of sample collection. When possible, samples should be filtered in the field using a portable filtration apparatus. Due to the remoteness of some sample locations and harsh meteorological conditions, it may not always be possible to safely filter samples in the field. When field filtration is not possible, a bulk bottle will be collected for filtration in the Environmental Laboratory. In this case, the sampler will proceed directly to the laboratory to conduct filtration. The time of sample filtration will be recorded on the sample's field data sheet.

Table 18.1.7.1 describes the applicable laboratory analytical methods, minimum levels for method detection limits, and the laboratory method detection limits. For all effluent monitoring, an ML less than the effluent limitations must be achieved. The Method Detection Limit is determined by the contract laboratory's instrumentation capabilities.

Field filtering is required by some parameters:

- y – filtered in the field before preservation,
- n – not filtered in the field,
- y/n parameter dependent; dissolved metals are field filtered, total or total recoverable metals are not.

Table 18.1.7.1: Analytical Methods and Limits for Effluent Monitoring

Analyte Group	Parameter	Dissolved Metals?	Analytical Method	Method Revision Number	Units	Minimum Level (ML)[1]	Precision (PQL or MRL)[2]	Accuracy (MDL)[3]
Aggregate Organics	Biochemical Oxygen Demand (BOD_5)	n	EPA 405.1 or SM 5210B	2005	mg/L	30	2	NA
Cyanides	Cyanide, Weak Acid Dissociable (WAD)	n	Kelada-01* D2036-06C	N/A	µg/L	9.0[4]	4.1	1.2
Major Anions	Nitrite-Nitrate as N	n	EPA 353.2	N/A	mg/L	80	10	0.38
	Sulfate	n	EPA 300.0	N/A	mg/L	NA	1.0	0.024
Microbiological	Fecal Coliform	n	Colilert 18	N/A	#/100 mL	200	1.0	1.0
Metals	Arsenic	y/n	EPA 200.7 / 200.8	5.4	µg/L	NA	0.15	0.084
	Cadmium	y/n	EPA 200.7 / 200.8	5.4	µg/L	0.1	0.10	0.066
	Copper	y/n	EPA 200.7 / 200.8	5.4	µg/L	2.8	0.25	0.076
	Iron	y/n	EPA 200.7 / 200.8	3	µg/L	817	10	2.7
	Lead	y/n	EPA 200.7 / 200.8	5.4	µg/L	0.4	0.20	0.073

Analyte Group	Parameter	Dissolved Metals?	Analytical Method	Method Revision Number	Units	Minimum Level (ML)[1]	Precision (PQL or MRL)[2]	Accuracy (MDL)[3]
	Manganese	y/n	EPA 200.7 / 200.8	5.4	µg/L	50	0.25	0.66
	Mercury	y/n	EPA 245.1	4	µg/L	0.01	0.00050	0.00015
	Mercury – Low Level	y/n	EPA 1631E	E	ng/L	0.5	0.15	0.08
	Selenium	y/n	EPA 200.7 / 200.8	5.4	µg/L	NA	0.50	0.30
	Zinc	y/n	EPA 200.7 / 200.8	5.4	µg/L	19	2.5	0.55
Physical and Aggregate Properties	Conductivity (Specific Conductance), Field	n	EPA 120.1	NA	µS/cm @ 25°C	NA	NA	10
	Dissolved Oxygen, Field	n	SM 4500-O G-2001	NA	mg/L	NA	NA	NA
	Hardness as $CaCO_3$	n	SM 2340 B	NA	mg/L	NA	NA	1.0
	pH, Field	n	Standard Method 4500-H+ B-2000 ASTM Method D1293-99 (A or B) USGS Method I-1586-85 (Wastewater)	NA	s.u.	NA	NA	NA
	Temperature, Field	n	EPA 170.1	NA	C	NA	NA	0.1
	Total Dissolved Solids (TDS)	n	SM 2540 C	21	mg/L	NA	25	4.8
	Total Suspended Solids (TSS)	n	SM 2540 D	21	mg/L	20	1.0	0.50
	Turbidity	n	EPA 180.1	3	NTU	NA	0.50	0.030

[1]Minimum Level (ML) is the level at which analysis will produce recognizable mass spectra and acceptable calibration points.

[2]Method Detection Limit (MDL) is the minimum concentration at which analysis will confirm a greater-than-zero concentration.

[3]Practical Quantization Limit (PQL) or Method Reporting Limit (MRL) is the minimum concentration at which the concentration of a constituent can be measured.

[4]APDES Permit # AK0053341 specifies a site-specific ML of 20 µg/L and DML of 10 µg/L for WAD Cyanide

*Kelada-01 was approved by ADEC as the primary method for WAD Cn analysis. D2036-06C is an alternate method approved when distillation of sample is required, or other instrument issues need resolution.

Samples should be analysed as soon as possible after collection, however, the times listed are the maximum times that samples may be held before analysis and still be considered valid. Table 18.7.1.2 represents holding times and sample containers for effluent sampling.

Table 18.7.1.2: Holding Times and Sample Containers Effluent Sampling

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
Aggregate Organics	Biochemical Oxygen Demand (BOD)[5]	Polyethylene, Glass	1 L	Cool 4°C	48 hours

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
Cyanides	Cyanide, WAD	Dark Polyethylene, Glass	500 mL	Cool 4°C, NaOH to pH>12	14 days
Major Anions	Alkalinity	Polyethylene, Glass	1 L	Cool 4°C	14 days
	Chloride, Fluoride & Sulfate	Polyethylene	1 L	Cool 4°C	28 days
	Nitrate+Nitrite	Polyethylene, Glass	250/500 mL	Cool 4°C, H_2SO_4 to pH<2	28 days
Major Cations	Calcium, Magnesium, Potassium, Sodium	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2	6 months
Metals	Metals, except mercury	Polyethylene	250/500 mL	HNO_3 to pH<2	6 months
	Mercury (Method 245.1 or 1631E)	Fluoropolymer, Glass	125/250 mL	either 5 mL/L of pretested 12N HCl or 5 mL/L BrCl solution	28 days
Microbiological	Fecal Coliform	Polyethylene, Glass	100 mL (sterile)	Cool 4°C, Remove Chlorine	8 hours for APDES Permit AK-005334-1, 30 hours for drinking water
Physical and Aggregate Properties	Conductivity (Specific Conductance)	Polyethylene, Glass	100 mL	None	24 hours
		Polyethylene, Glass	500 mL/1 L	Cool 4°C, Filtered (for EPA 120.1)	28 days
	Dissolved Oxygen	Glass	300 mL	None	Analyze immediately
	Hardness	Polyethylene, Glass	250/500 mL	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months
	pH	Polyethylene, Glass	25 mL	None	Analyze immediately
	TSS, TDS	Polyethylene, Glass	500 mL/1 L	Cool 4°C	7 days
	Turbidity	Polyethylene, Glass	500 mL/1 L	Cool 4°C	48 hours

Shipping Samples

When any sample is shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation (DOT) Hazardous Materials Regulations (49 CFR). All field personnel should be familiar with these requirements and how they relate to samples shipped to off-site laboratories.

Table 18.7.1.3 presents general guidelines for shipment of samples in compliance with 49 CFR.

Table 18.7.1.3: Guidelines for Sample Shipment in Compliance with 49 CFR

Sample Type	49 CFR Regulatory Interpretation
Unpreserved water samples	Unpreserved water is not subject to 49 CFR restrictions on transportation.

Sample Type	49 CFR Regulatory Interpretation
Drinking water, ambient water, and treated effluent preserved with: ▪ Nitric Acid ▪ Sulfuric Acid ▪ Hydrochloric Acid ▪ Sodium Hydroxide	When preserved in accordance with an EPA standard sampling methodology, samples preserved with these analytes do not meet the definition of a corrosive material in §173.137 and are not subject to 49 CFR restrictions on transportation.
Unpreserved biological specimens	Unpreserved biological specimens are not subject to 49 CFR restrictions on transportation.
Unpreserved rock	Unpreserved rock is not subject to 49 CFR restrictions on transportation
Other samples not listed	Consult 49 CFR to determine whether materials meet the definition of a hazardous material in §173.137 and what may be required for shipment.

As described in a February 3, 2003 letter from the DOT to the EPA, environmental samples which are preserved at the EPA prescribed guidance concentrations, even when reasonably over-preserved, are not corrosive materials and are not subject to the Hazardous Materials Regulations of 49 CFR 171.

Chlorine and Fecal Coliform

If free chlorine is present in the sample, then Sodium Thiosulfate ($Na_2S_2O_3$) preservative should be used. Free chlorine can react with organic compounds to form chlorination by-products. Free chlorine is likely to be found in chlorinated municipal drinking waters and treated wastewaters. Sodium Thiosulfate, a reducing agent, is used to remove the free chlorine. Contract laboratories provide coliform sampling bottles pre-preserved with Sodium Thiosulfate.

Conductivity

Conductivity analyses can be performed in either the field or laboratory. If method EPA 120.1 is used and analysis is not completed within 24-hours of sample collection, the sample should be filtered through a 0.45-micron filter and stored at 4°C. Filter and apparatus must be washed with high quality distilled water and pre-rinsed with sample before use.

18.2 Effluent Reporting Requirements

Table 18.2.1 presents the annual reporting schedule associated with Pogo's APDES Permit and the Annual Activity and Monitoring Report required by the ADEC Waste Management Permit.

Table 18.2.1: Reporting Schedule

	DMR Reporting	Quarterly Water Quality Monitoring Report	Annual Activity and Monitoring Report	
			Report	Presentation
Due	Submitted electronically via NetDMR by the 20th day of the following month.	No later than 60 days after the last day of the quarter (three total, for the first three quarters of every year).	March 1 of the following year	Not sooner than two weeks after submittal of the Annual Report
Present to	ADEC	ADEC	ADEC	ADEC, ADNR
Format	NetDMR, on the EPA CDX website	Paper and electronic copy	Paper and electronic copy	Presentation
Graphical Presentation	NA	A comparison of monitoring results upstream and downstream and over time to show trends (x-y plots).	Same as quarterly report	Same as annual report
Electronic Appendix	NA	Sample collection date, analysis date, analytical method, method detection limit, units, sample results, data qualifier flag, and any other relevant QA/QC information.	Same as quarterly report	Same as quarterly report

18.2.1 DMR Reporting Requirements

DMR reporting occurs monthly, and is submitted via NetDMR, on the EPA, CDX online system. As of July 1, 2017, all data collected during any month must be entered into NetDMR by the 20th of the following month. DMR data can be entered individually into NetDMR or uploaded on a dedicated csv file. Transmittal letters, and any other information, are uploaded as an attachment. Hardcopies or email copies are no longer required if reporting is completed through NetDMR.

DMR Reporting Values

For Discharge Monitoring Report (DMR) purposes only as required by APDES permit AK-0053341:

- For a single sample, if a value is less than the method detection limit (MDL), then report "less than {numeric value of the MDL}" and if a value is less than the minimum level (ML), then report "less than {numeric value of the ML}."
- For purposes of calculating monthly averages, zero may be assigned for values less than the MDL; the numeric value of the MDL may be assigned for values between the MDL and the ML. If the average value is less than the MDL, then report "less than {numeric value of the MDL}" and if the average value is less than the ML, then report "less than {numeric value of the ML}." If a value is greater than the ML, then report and use the actual value.

Site Specific WAD Cyanide

Pogo has a site-specific Minimum Level (ML) of 20 µg/L and an MDL of 10 µg/L for WAD Cyanide. Any analytical result less than 20 µg/L will be reported on the DMR as <20 µg/L. The MDL will not be used to calculate averages for WAD CN, as with other parameters, because it is a site-specific ML.

Free Passage of Fish

Water withdrawal from the Goodpaster River will cease when the instream flow decreases below 20 cubic feet per second. At all other times, water withdrawal must not exceed 15,000 gpm.

Flood Conditions at ORTW

Flow from Outfall 001 is normally recorded on the DMR from the two dilution pumps pulling water in from the river. The assumption is groundwater/rainwater contributions to in-flow are minimal and that this is the most accurate way to measure flow back into the river. However, when flooding conditions occur this is no longer true. As flood water rises the Mill monitors the level indicator on the weir at Outfall 001 and calculates flow out of the ORTW. When flow/flood water approach the APDES flow limit for Outfall 001 (15,800 gpm) discharge is shut down. At this point it is required that Pogo ask permission from ADEC to continue discharge during the flood. This is usually done by email. The flow limitation was originally written into the permit to prevent Pogo from drawing down the Goodpaster during low flow conditions. This does not apply during flooding.

During flooding conditions, a flow over the Outfall 001 Weir of greater than 15,800 gpm will not be reported as an exceedance as the excess water is a natural condition and not due to any action on Pogo's part. In support of this, the DMR will reflect the dilution pump flow and will not show an exceedance. This must be explained in the DMR cover letter and in the notes section of the DMR. Examples of emails requesting permission to continue discharge during flooding conditions and examples of DMR cover letter explanations are in Appendix A.

Continuous Meters for pH

If continuous meters are present at Outfall 001 and Outfall 011 data is collected in the DCS. If the continuous readings are outside the effluent limits for less than 60 minutes (or less than the total or 7 hours and 26 minutes for the month) it is reported in the monthly DMR cover letter as an excursion and the data is not used in the monthly DMR. If, however the exceedance lasts for more than 60 minutes, the data is included in the DMR and an exceedance is reported on the monthly DMR. Required weekly sampling of pH with handheld meters is included with any DCS data for monthly DMR reporting.

Continuous Meters for Turbidity

Continuous meters for Turbidity are in place at both NPDES 001B and Outfall 001. This data is collected in the DCS and averaged with any handheld readings taken during sampling events. Handheld turbidity readings are not required, but are performed if there are any unusual conditions or upsets occurring.

Fecal Coliform Geometric Average

For monthly DMR reporting the Fecal Coliform data must be averaged using a geometric mean, not a numeric mean. If the sample is non-detect, the detection level is used to calculate the geometric mean.

Percent Removal at STP

A sample of the sewage treatment plant influent (STP002) is required during the first month of the quarter. A BOD and TSS sample results from STP002 must be compared to BOD and TSS sample results from the sewage treatment plant effluent sample (0.) collected at the same time as the influent. Quarterly percent removal is calculated for both BOD and TSS using the formula: [(influent-effluent) / influent] x 100.

Permit stipulations allow additional samples to be collected at STP 002. When multiple corresponding influent and effluent samples are collected in a quarter, the percent removal calculation compares the average of influent BOD and TSS against the average of effluent BOD and TSS. In this circumstance, quarterly percent removal is calculated for BOD and TSS using the formula: [(avg influent)-(avg effluent)] / (avg influent) x 100.

18.3 Exceedance of Effluent Limits

If an effluent limitation has been exceeded:

- Notify the ADEC by telephone at the APDES Non-Compliance Hotline (877) 569-4114, within 24 hours of becoming aware of:
  - Any non-compliance that may endanger health or the environment;
  - Any unanticipated bypass that exceeds any effluent limitation,
  - Any upset that exceeds any effluent limitation; and
  - A violation of a maximum daily discharge limitation at Outfall 001, Outfall 011 and Outfall 002.
- Submit a written report within five days of becoming aware of any event requiring 24-hour notification. The report shall include:
  - A description of the noncompliance and its cause;
  - The period of noncompliance, including exact dates and times;
  - The estimated time noncompliance is expected to continue if it has not been corrected; and
  - Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
- Non-compliance incidents, not required under 24-hour notification, are submitted in the monthly DMR (e.g. exceedance of the monthly average, pH exceedances from the continuous meters).

19. WHOLE EFFLUENT TOXICITY TESTING PROGRAM

The APDES permit requires chronic toxicity tests on effluent samples from Outfall 001:

- To characterize and measure the absolute chronic toxicity of the effluent from Outfall 001, and
- To measure compliance with whole effluent toxicity triggers.

Table 19.1 identifies where Whole Effluent Toxicity (WET) Testing Program key elements are located in the Pogo Mine Monitoring Plan.

Table 19.1: WET Testing Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 7.5	Outfall 001 Annual Whole Effluent Toxicity Testing and Target Level

19.1 Whole Effluent Toxicity (WET) Sampling Procedures

A WET sample will be collected annually, before August 1, at the same time as the receiving water (SW01, SW15, SW41, SW42, and SW49) monitoring samples are collected.

A minimum of three grab samples will be collected at two-day increments (Monday, Wednesday, and Friday) to provide adequate WET test solutions. A second WET test is conducted as a QC duplicate and is sent to a second laboratory to run a concurrent WET test.

During the week of the WET Test, samples are also collected and analyzed with the combined profile of the Outfall 001 weekly and monthly sampling on the second day effluent is collected for the WET test (Wednesday). This sample also fulfills the sampling requirements for the weekly/monthly sample for Outfall 001.

Sampling may be rescheduled due to severe weather conditions. The WET sample must be collected during a period when effluent discharge from Outfall 011 is occurring, generally in mid -June, but before August 1. Refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Whole Effluent Toxicity (WET) Test Sample Collection SWP.

WET Tests conducted in 2011 thru 2017 analyzed the water flea (Ceriodaphnia dubia) and the fathead minnow (Pimephales promelas). Toxicity was not observed in either species during this sample period. Future samples will sample only the fathead minnow.

WET sample collection schedule along with QA/QC samples is shown in Table 19.1.1.

Table 19.1.1: WET Sample Collection Schedule

Monitoring Period		Test Organism	Sampling Period	Sampling Day	Grab Sample Size	Notes
Compliance Lab	Screening (first two suites of tests in 2011 and 2012) And Monitoring 2013 - 2017	Fathead minnow & Water flea	Mid-June (if Discharge from Outfall 011 is occurring), or before August 1	Day 1	Laboratory Specification	
				Day 3	Laboratory Specification	Collect samples for weekly and monthly profiles at Outfall 001. Collect coincident with surface water sampling.
				Day 5	Laboratory Specification	--
Back-up Lab	Screening (first two suites of tests in 2011 and 2012) And Monitoring 2013 - 2017	Fathead minnow & Water flea	Mid-June (if Discharge from Outfall 011 is occurring), or before August 1	Day 1	Laboratory Specification	
				Day 3	Laboratory Specification	Collect samples for weekly and monthly profiles at Outfall 001. Collect coincident with surface water sampling.
				Day 5	Laboratory Specification	--
Compliance Lab	Monitoring (2018 Onward)	Fathead Minnow	Mid-June (if Discharge from Outfall 011 is occurring), or before August 1	Day 1	Laboratory Specification	--
				Day 3	Laboratory Specification	Collect samples for weekly and monthly profiles at Outfall 001. Collect coincident with surface water sampling.
				Day 5	Laboratory Specification	--
Back-up Lab	Monitoring (2018 Onward)	Fathead Minnow	Mid-June (if Discharge from Outfall 011 is occurring), or before August 1	Day 1	Laboratory Specification	
				Day 3	Laboratory Specification	Collect samples for weekly and monthly profiles at Outfall 001. Collect coincident with surface water sampling.
				Day 5	Laboratory Specification	--

A toxicity unit (TUc) is a unit of measure for effluent toxicity; increasing values reflect higher impacts. The IC25 is the percentage of effluent at which the organisms exhibit 25 percent reduction in a biological measurement such as reproduction or growth. It is calculated statistically and used in chronic toxicity testing.

TUc = 100/IC25

The toxicity testing on each organism must include a series of five test dilutions (100%, 75%, 50%, 25%, and 12.5%) with a control (Table 19.1.2).

Table 19.1.2: Analytical Methods (Toxicity)

Analyte Group	Parameter	Method	Units	Conditions	End Points
Whole Effluent Toxicity	Fathead Minnow, *Pimephales promelas*, Larval Survival and Growth Test	EPA 1000.0 (EPA, 2002a)	TUc	Moderately Hard Synthetic Fresh Water (MHSF) five test dilutions (100%, 75%, 50%, 25%, and 12.5%) and a control	IC25 Growth
	Daphnid, *Ceriodaphnia dubia*, Survival and Reproduction Test	EPA 1002.0 (EPA, 2002a)	TUc		IC25 Repro-duction

If either of the reference toxicant tests or the effluent tests does not meet all test acceptability criteria as specified in the test methods manual, the WET test must be re-sample and re-test within 14 days of receipt of the test results.

Data does not exist to support the development of a WET limit at this time; a target level of chronic toxicity of 2 TUc applies for the purposes of determining compliance with APDES Permit AK0053341, Section 1.4.3 (See Table 19.1.3).

Table 19.1.3: WET Testing Organisms and Target Level (Outfall 001)

Analyte Group	Test Organism	Short-term Chronic Test	Units	Target Level
Toxicity	Water flea (*Ceriodaphnia dubia*)	survival and reproduction test		
	Fathead minnow (*Pimephales promelas*)	larval survival and growth test	TU_C	2

19.1.1 WET Sample Collection

Three CUBITAINERS® of the appropriate size are provided by each laboratory for the annual sampling event. All sample containers are rinsed with source water before being filled with sample. After use with receiving water or effluents, CUBITAINERS® and plastic jugs are punctured to prevent reuse.

Samples collected are chilled to 0-6°C during or immediately after collection and shipped to the laboratory. Ice, in the form of poly bottles of frozen distilled water, should be used. Loose bags of cube ice are not accepted by airlines and gel ice is not cold enough. Sufficient ice should be placed with the sample in the shipping container to ensure that ice will still be present when the sample arrives at the laboratory and is unpacked. Insulating material should not be placed between the ice and the sample in the shipping container. Table 19.1.1.1 represents holding times and sample containers for WET sample collection.

Table 19.1.1.1: Holding Times and Sample Containers for WET sampling

Analyte Group	Parameter Name	Container	Container Size	Preservation	Maximum Holding Time
Toxicity	Whole Effluent Toxicity	Polyethylene	4 L per test	Ice to 0-6°C, with minimum head space	36 hours

19.2 WET Reporting Requirements

WET reporting is done on the Annual DMR for Outfall 001 (001Y). If the TU_C is less than 2, then No Toxicity is reported. A complete copy of the WET test laboratory results is attached to the Annual Activity Monitoring Report (due March 1 the following year).

Also to be included in the Annual Report:

- Dates of sample collection and initiation of each test;
- Flow rate at Outfall 001 at time of sample collection;
- Toxicity trigger of 2 TUc; and
- Results of split sample from Outfall 001 collected at beginning of WET test.

Any results from Accelerated Testing should be submitted to ADEC within two weeks of receiving it from the lab and a full report in four weeks. Or if accelerated testing is unnecessary, a full report is due to ADEC four weeks after the investigation is completed, submitted with the DMR for the month following the investigation.

19.3 Exceedance of WET Test

- ADEC will be notified in writing within two weeks of receipt of the test results; and
- Accelerated testing will be initiated within two weeks of receipt of the test results that indicate an exceedance.
  - If the cause of the exceedance is known and corrective actions have been implemented then conduct one accelerated test. If the toxicity trigger is exceeded in this test, then implement a Toxicity Reduction Evaluation.
  - Or conduct four more biweekly tests over an eight-week period. If the toxicity trigger is exceeded in any of the four tests, then implement a Toxicity Reduction Evaluation.

20. DRINKING WATER PROGRAM

Drinking Water Monitoring fulfills the requirements of the Potable Water System Operation Approval for PWSID: 372643 (Pogo Lower Camp) and PWSID 372685 (Pogo Permanent Camp) as well as the State of Alaska Drinking Water Regulations, 18 AAC 80. Both water systems are classified as Type: Non-Transient, Non-Community, Class A Source: Ground Water Under the Influence of Surface Water (GWUDISW).

Table 20.1 Identifies where Drinking Water Program key elements are located in the Pogo Mine Monitoring Plan.

Table 20.1: Drinking Water Program Elements in the Pogo Mine Monitoring Plan

Location in Plan	Description
Table 11.1	Drinking Water Monitoring Schedule for Pogo Lower Camp PWSID 372643
Table 11.2	Drinking Water Monitoring Schedule for Pogo Permanent Camp PWSID 372685
Table 11.3	Drinking Water Sampling Parameters for Pogo Lower Camp PWSID: 372643 and Pogo Permanent Camp PWSID: 372685 and Maximum Contaminant Limits
Table 11.4	Drinking Water Operation Approval Limits for Pogo Lower Camp PWSID: 372643
Table 11.5	Drinking Water Operation Approval Limits for Pogo Permanent Camp PWSID: 372685

20.1 Drinking Water Sampling Procedures

Monitoring Summaries for Pogo Public Water Systems

Sample schedules and requirements for the Pogo Permanent Camp and Pogo Lower Camp are established by the DEC Drinking Water Program and are outlined in annually distributed Monitoring Summaries.

Specific details for monthly total coliform end point samples are prescribed in the Pogo Permanent Camp and Pogo Lower Camp Revised Total Coliform Rule Site Sampling Plans. Samples are collected monthly from a rotating series of potable water end-point sources specified in the Sampling Plans.

Additional details on sample site locations and scheduling is listed in Tables 20.1.1 and 20.1.2:

Table 20.1.1: Pogo Lower Camp Sampling Sites and Schedule PWSID: 372643

Site ID	Location	Monthly T-Coli and Chlorine Residual	Quarterly Bromate	Lead & Copper	Other Sampling
Pogo Lower Camp	Pogo Lower Camp				Sanitary Survey – 2027
DS029	Potable Water Treatment Plant #3, Entry Point into system		Samples collected during 1st month of quarter	Aug 2023 & Aug 2026	Nitrate & VOC's-Annual in May Arsenic & Inorganics-2029
DS031	E-Wing Rm E-24 Sink	May & Oct		Aug 2023 & Aug 2026	
DS080	Kitchen Prep Area Sink	Apr & Sept		Aug 2023 & Aug 2026	Nov TTHM/HAA5
DS082	Men's Dry (back middle sink)	Jan, Jun & Nov		Aug 2023 & Aug 2026	

Site ID	Location	Monthly T-Coli and Chlorine Residual	Quarterly Bromate	Lead & Copper	Other Sampling
DS083	Women's Dry (middle Sink)			Aug 2023 & Aug 2026	
DS084	Men's Shower Sink	Feb Jul & Dec		Aug 2023 & Aug 2026	
DS085	Women's Shower Sink	Mar, Jun & Aug			
*DS090	New Kitchen Prep Sink (2023)			Aug 2023 and Aug 2026	Nov TTHM/HAA5

*Furthest point in the lower camp potable water distribution system.

Table 20.1.2: Pogo Permanent Camp Sampling Sites and Schedule PWSID: 372685

Site ID	Location	Monthly T-Coli and Chlorine Residual	Quarterly Bromate	Annual Lead & Copper	Other Sampling
Pogo Permanent Camp	Pogo Permanent Camp				Sanitary Survey - 2026
DS050	Potable Water Treatment Plant #2, Entry Point into system		Samples collected during 1st month of quarter	Aug 2022 *Every 3 years	Nitrate & VOC's-Annual in May Arsenic & Inorganics-2029
DS053	Dorm A 3rd Floor Sink (room # A328)	Jan, Jun & Nov			
DS056	Admin Building Lunchroom sink			Aug 2022	Dec: TTHM/HAA5
DS057	Mobile Maintenance Lunchroom			Aug 2022	
DS059	Mill Building Lunchroom	Mar & Aug		Aug 2022	
DS060	Rear Kitchen Sink, Prep area	Apr & Sept		Aug 2022	
DS061	Dorm C 2nd Floor sink (room # C 226)	Feb, Jul & Dec			
DS063	Mill Bench Offices (AMEC Chateau) Lunchroom sink	May & Oct		Aug 2022	

20.1.1 Total Coli, E. Coli & Chlorine Residual

Bacteriological sampling is conducted monthly and a chlorine residual reading is taken at the same time with the handheld colorimeter. When collecting a sample remove any screens from faucet and let the water run cold for at least 5 minutes before sampling. The analytical results from these monthly samples are reported directly from the laboratory to ADEC.

If other sampling (outside the required monitoring) takes place it is designated a "Special Sample" on the COC. For example, if a new eyewash station, shower, or plant filter is installed, Water Operations personnel will "shock"

it with a strong chlorine solution after which a total coliform sample is collected before it is put into use. These samples are designated "Special "and not reported directly to ADEC from the laboratory.

20.1.2 Bromate Sampling

Quarterly bromate samples are collected at the PWTP entry points only.

20.1.3 Lead & Copper Sampling

Lead & Copper samples are collected as "First Draw" samples. When collecting a sample from the designated sampling site, no screens are removed from the faucet and water is run for approximately three to five minutes, then turned off for a minimum of six hours (not to exceed 8 hours). Faucets are taped off and "Do Not Use Water" signs hung on them. After the minimum six-hour waiting is period is complete, the sample bottle is placed directly under the tap and the cold water turned on until bottle is filled.

If any plumbing repairs or replacements have occurred since the last sampling event it is noted on the COC.

A signed sampler affidavit (supplied by the laboratory) must accompany every lead and copper sample bottle. Refer to the SharePoint ID# in Section 21 - Related Documents for a copy of the Drinking Water Lead and Copper Sample Collection SWP.

Both potable water systems are currently only required to be sampled once every three years for lead and copper.

Arsenic, Nitrate and VOC

Arsenic, Nitrate and Volatile Organic Compounds (VOCs) are sampled annually at the entry point of the PWTP. VOC vials are filled carefully to form a meniscus on the surface of the vial before the lid is screwed on. This prevents air bubbles form forming in the vials. Vials are then turned upside down to check for air bubbles. If a vial contains air bubbles it is rejected by the laboratory. VOCs always include a prefilled and sealed travel blank also provided by the laboratory.

TTHM & HAA5

TTHM & HAA5 samples are collected annually at the ends of the distribution systems. TTHM sampling begins with collecting the sample into a 500 ml amber glass bottle with preservative provided by the laboratory. This is shaken slightly to mix, then the four amber glass vials are filled from this bottle to prevent air bubbles from forming (as described above for the VOC sampling).

Old and New Inorganics

Pogo is required to collect Old Inorganics and New Inorganics once during a cycle of eight years (current cycle is from 2020 to 2029). Samples were collected in 2020 and are due in 2029.

Table 20.1.5.1: Holding Times and Sample Containers Drinking Water Sampling

Analyte Group	Parameter Name	Analysis Method	Container	Container Size	Preservation	Maximum Holding Time
Major Anions	Chlorine	EPA method 330.5, DPD method	Glass	10 mL	N,N-diethyl-p-phenylenediamine.	Read Immediately
	Nitrate	EPA 353.2 or SM4500-NO3E	Polyethylene, Glass	125 mL	Cool 4°C	48 hours
	Bromate	EPA 317.0	Polyethylene, Glass	100 mL	Cool 4°C	28 days
Metals	Arsenic	EPA 200.7 / EPA 200.8	Polyethylene	250 mL	HNO_3 to pH<2	6 months
	Lead & Copper	EPA 200.7 / EPA 200.8	Polyethylene	1000 mL	HNO_3 to pH<2	6 months
	Old Inorganics					
	Arsenic	200.7 / 200.8	Polyethylene, Glass	250 mL	HNO_3 to pH<2	6 months
	Barium	200.7 / 200.8				
	Cadmium	200.7 / 200.8				
	Chromium	200.7 / 200.8				

Analyte Group	Parameter Name	Analysis Method	Container	Container Size	Preservation	Maximum Holding Time
	Mercury	EPA 245.1				
	Selenium	EPA 200.7 / 200.8				
	Fluoride	EPA 200.7 / 200.8	Polyethylene, Glass	125 mL	Cool 4°C	28 days
	New Organics					
	Antimony	EPA 200.7 / 200.8	Polyethylene, Glass	250 mL	HNO_3 to pH<2	6 months
	Beryllium	EPA 200.7 / 200.8				
	Nickel	EPA 200.7 / 200.8				
	Thallium	EPA 200.7 / 200.8				
	Cyanide, WAD	Kelada-01 / SM4500-CNE	Polyethylene, Glass	1000 mL	NaOH to pH >11	14 days
Microbiological	T. Coli & E. Coli	SM 9223B	Polyethylene, Glass	125 mL	Cool 4°C	30 hours
Organics	HAA5	EPA 552.2	Amber Glass	500 mL	NH_4Cl	14 days
	TTHM	EPA 524.2	4 Amber Glass Vials	40 mL	HCl	14 days
	Volatile Organic Compounds	EPA 524.2	4 Amber Glass Vials	40 mL	HCl	14 days

20.2 Drinking Water Reporting Requirements

Waivers are required for pesticides & other organics (Synthetic Organic Compounds or SOCs). Waiver forms are provided by ADEC. Waivers are good for three years. The SOC waivers for the Pogo Lower Camp and the Pogo Permanent Camp were submitted for renewal in 2022. The next SOC renewal is due in 2025.

The Asbestos Waiver is a signed affidavit on file with ADEC indicating that Pogo has no asbestos piping in either potable water distribution systems. This waiver does not have to be renewed unless new piping is added to either of the distribution systems.

ADEC required monthly Drinking Water reports are due by the 10th of every month. A separate report is submitted for the Pogo Lower Camp and the Pogo Permanent Camp. The monthly data is collected at both Potable Water Treatment Plants (PWTPs) by Water Operators and is entered into EDMS by Environmental Department. Data entered includes: entry point chlorine, turbidity (after filtration), flow rate during peak water treatment plant flow, ozone residual (at PWTP#2, Permanent Camp), and chlorine residual collected during monthly total coliform sampling. The monthly report is generated by EDMS and is emailed to ADEC by the Environmental Department.

Also entered into EDMS but not included in the ADEC monthly report are the total gallons drawn from the drinking water wells and the amount of disodium phosphate added to the anti-corrosion system.

A Sanitary Survey must be conducted every five years for both potable water distribution systems. The Pogo Lower Camp is due for a Sanitary Survey in 2026 and The Pogo Permanent Camp is due in 2027. The surveys are conducted by a third-party consultant and submitted to ADEC.

20.3 Exceedances of Potable Water Quality Standards

If an exceedance of a Water Quality Standards occurs, or an exceedance of the Operational Approval Limits occurs, ADEC needs to be notified as soon as possible. If other disruptions to the systems occur, such as over-chlorination or ozone generator breakdown, these also need to be reported immediately. If the event occurs after business hours a message should be left on the phone. A follow-up email goes to the ADEC Project Manager for Pogo, describing the situation and what corrective actions are being taken. Table 20.3.1 gives contact names and numbers for ADEC.

Table 20.3.1: Drinking Water Exceedance/Upset Reporting to ADEC

Contact Person	Phone Number
Michael Sharp, ADEC Project Manager	(907) 451-2178

After Hours Message	1-800-770-2137

21. RELATED DOCUMENTS

Document Name	Document Number
APDES Outfall Sample Collection	PGO-ENV-038-SWP
DSTF Piezometer Data Downloading & Compiling Manual	PGO-ENV-002-SWP
Drinking Water Lead and Copper Sample Collection	PGO-ENV-035-SWP
Field Hydrological Data Collection - Instrument Maintenance	PGO-ENV-009-SWP
Fish Tissue Sample Collection	PGO-ENV-036-SWP
Flotation Tailings Geochemistry and Interstitial Water (PC003) Sample Collection	PGO-ENV-040-SWP
Mineralized Waste Rock (Red Rock) PC002 Geochemistry Sample Collection	PGO-ENV-034-SWP
Monitoring Well Sample Collection	PGO-ENV-033-SWP
Snow Survey	PGO-ENV-032-SWP
Surface Water Sampling on the Goodpaster River	PGO-ENV-030-SWP
Water Meter Calibration	PGO-ENV-037-SWP
Whole Effluent Toxicity (WET) Test Sample Collection	PGO-ENV-031-SWP
Waste Rock Characterization	PGO-ENV-042-SWP
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
Pogo Assay Laboratory Quality Assurance Plan	PGO-PRO-ALA-062-PLA

22. REFERENCES

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23. REVISIONS

Quality Assurance Project Plan Revisions			
Revision #	**Date**	**Change**	**By**
1	February 2012	Addition to D-Wing Dorm at Lower Camp	Pogo
2	March 2012	DSTF Expansion and New Diversion Ditch	Pogo
3	May 2012	Extension to MWTP#2 for 2 New Sand Filters	Pogo
4	October 2012	Upgrade Section of ORTW Pipeline	Pogo
5	December 2012	East Deep Expansion Power Distribution System	Pogo
6	June 2012	Begin Mining East Deep Ore Zone	Pogo
7	September 2013	MWTP#3 Construction	Pogo
8	January 2014	ORTW Line-More Pipe Replacement	Pogo
9	March 2014	New CIP Stock Tank	Pogo

Quality Assurance Project Plan Revisions			
Revision #	**Date**	**Change**	**By**
10	August 2017	General updates to comply with APDES Permit No. Ak0053341	Pogo
11	October 2017	Updates to reflect SOP revisions and new contacts	Pogo
12	June 2018	Updates to reflect Plan of Operations Approval and Waste Management Permit Renewals	Pogo
13	November 2019	General updates to comply with APDES Permit No. AK0053341 and Pogo's ADEC Waste Management Permit No. 2018DB0001	Pogo
13.1	November 2021	Updates for changes in personnel	Pogo
14	January 2022	General updates throughout document	Pogo
15	May 2023	General updates throughout document	Pogo

Table 22.1: Table of Significant Changes

Change #	Change Requested By	Description	Affected Section
1	Pogo	Addition to D-Wing Dorm at Lower Camp	None
2	Pogo	DSTF Expansion and New Diversion Ditch	None
3	Pogo	Extension to MWTP#2 for 2 New Sand Filters	None
4	Pogo	Upgrade section of ORTW pipeline	None
5	Pogo	East Deep Expansion Power Distribution System	None
6	Pogo	Begin mining East Deep Ore Zone	Sections 9, 10, 17, 18, 20, 21, 22 and Appendices
7	Pogo	MWTP#3 Construction	Section 18.2.1
8	Pogo	ORTW Line-More Pipe Replacement	None
9	Pogo	New CIP Stock Tank	None
10	Pogo	General Update for Permit Renewal	Numerous sections, appendices, and SWP general update
11	Plan of Ops Renewal	Updates to reflect SWP revisions and new contacts	Pogo
12	Plan of Ops Renewal	Renewed by ADNR/ADEC effective May 24, 2018	Reviewed in entirety
13	Pogo	Annual Update	Numerous sections, document reference numbers replaced appendices and SWP
14	Pogo	Annual Update	Numerous sections, document reference numbers, and SWP general update

24. APPENDIX A

DTSF and RTP Dam Weekly and Monthly Inspection Form

Reference No: 294151

Inspections - Pogo Checklist

PGO - ENV - RTP Dam & Dry Stack Weekly Inspection - PGO - ENV - RTP Dam & Dry Stack Weekly Inspection

Prompt	Yes	No	N/A	Explanation	Comments
Date of inspection:	☐	☐	☐		
Seepage Collection Wells	☐	☐	☐	Are all pumps running in Auto Mode? Do the well motor speeds and water levels indicate that the wells are working properly? Are lights (emergency and standard) functional?	
RTP Dam	☐	☐	☐	Are dam faces free of vegetation, erosion, collapse, subsidence? Is downstream dam free of seepage? Is dam crest free of subsidence and damage to facilities? Are reservoir walls free of erosion and collapse? Are dam abutments (north and south) free of erosion and seepage?	
Spillway Inlet (Concrete) and Outfall (Flume)	☐	☐	☐	Is spillway inlet (concrete) free of new cracks and properly connected to flume (culvert)? Are existing cracks stable? Have any new cracks formed? Is spillway outfall (flume) free of damage, obstacles and erosion on the ground? Are spillway abutments (north and south) free of erosion and seepage?	
Drystack	☐	☐	☐	is the dry stack free of unusual cracks and signs of settlement? is the dry stack free of bulging and seepage? Is the dry stack free of erosion, rills, and gullies? Are 2% slopes being maintained?	
Describe and document any maintenance activities completed in response to deficiencies noted in previous inspections.	☐	☐	☐	Notes:	
Any unusual events? Describe and document dam performance. (Seismic, weather, etc.)	☐	☐	☐	Notes:	

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Correspondence

Permission to continue discharge during flood conditions

Permission to use WAD Cyanide method

25. APPENDIX B

Laboratory QA/QC Tables

Laboratory Quality Control Samples for Method 300.0

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/20 samples	< ½ MRL	Re-prep/ reanalyze	Analyst/Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Re-prep/ reanalyze	Analyst/Lab Manager	Contaminants	Reliability of detections
Storage Blank	N/A for this method	< ½ MRL	Re-prep/ reanalyze	Analyst/Lab Manager	Contaminants	Reliability of detections
Instrument Blank	Every Run, each 10 samples	< ½ MRL	reanalyze	Analyst/Lab Manager	Contaminants	Reliability of detections
Lab Duplicate	1:20 Every Run	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Re-prep/ reanalyze	Analyst/Lab Manager	Precision	+/- 20% max
Lab Matrix Spike	1:20 Every Run	75-125 %	Re-prep/ reanalyze	Analyst/Lab Manage	Accuracy	Detect matrix bias
Matrix Spike Duplicate	1:20 Every Run	75-125% RPD < 20%	Re-prep/ reanalyze	Analyst/Lab Manage	Accuracy / Precision	detect matrix bias, on-homogeneity
Lab Control Sample	Every Run	85-115 %	Re-prep/ reanalyze	Analyst/Lab Manage	Accuracy	+/- 15%
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A
Calibration Check	Every Run	90-110%	Reanalyze	Analyst/Lab Manage	Calibration Accuracy	+/- 10%
MRL Check	Every Run	70-130%	Reanalyze	Analyst/Lab Manage	Calibration Accuracy	Reliability of detections

Laboratory Quality Control Samples for Method 524.2

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every 20 samples, each batch	< ½ MRL	Analyst/Lab Manager	Contaminants	Detects reliable	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	With all samples stored/shipped together	< ½ MRL	Re-prep/ reanalyze	Analyst/Lab Manager	Contaminants	Reliability of detections
Instrument Blank	When carryover indicated	< ½ MRL	reanalyze	Analyst/Lab Manager	Contaminants	Reliability of detections
Lab Duplicate	Detects > MRL, all MCL outliers	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Re-prep/ reanalyze	Analyst/Lab Manager	Precision	Confirmation
Lab Matrix Spike	N/A	N/A	N/A	N/A	N/A	Not required for DW
Matrix Spike Duplicate	N/A	N/A	N/A	N/A	N/A	Not required for DW
Lab Control Sample	Every 20 samples, each batch	70-130 %	Re-prep/ reanalyze	Analyst / Lab Manager	Accuracy	+/- 15%
Surrogates	Every Run, every sample	70-130 %	Re-prep/ reanalyze	Analyst / Lab Manager	Accuracy	Detect possible matrix bias
Internal Standards	Every Run, every sample	70-130 %	Re-prep/ reanalyze	Analyst / Lab Manager	Accuracy	Detect bias
Calibration Check	Every Run	70-130 %	Re-prep/ reanalyze	Analyst / Lab Manager	Calibration Accuracy	+/- 30%
Tune Check	Every Run	Per Method	Re-prep/ reanalyze	Analyst / Lab Manager	Mass spectral Accuracy	Accurate identifications
MRL Check	Every Run	50-150%	Re-prep/ reanalyze	Analyst / Lab Manager	Detection limits	Reliable MRL

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/ 20 samples	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	With all samples stored/shipped together	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Instrument Blank	Every Run	< ½ MRL	reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Lab Duplicate	MSD used					
Lab Matrix Spike	Every 20 samples, each batch	70-130%	Report-alert to possible bias	Analyst / Lab Manage	Matrix Accuracy	Detect matrix bias
Matrix Spike Duplicate	Every 20 samples, each batch	70-130%, RPD <20%	Report-alert to possible bias	Analyst / Lab Manage	Matrix Accuracy / Precision	detect matrix bias
Lab Control Sample	Every 20 samples, each batch	+/- 30%	Re-prep/ reanalyze	Analyst / Lab Manage	Lab Accuracy	+/- 30%
Surrogates	Every Run	70-130%	Re-prep/ reanalyze	Analyst / Lab Manager	Accuracy	Detect possible matrix bias
Internal Standards	Every Run	+/- 30% of ICAL	Re-prep/ reanalyze	Analyst / Lab Manager	Accuracy	Detect bias
MRL Check	Every Run	50-150%	Re-prep/ reanalyze	Analyst / Lab Manager	Detection limits	Reliable MRL
LPC	Every Run	Per Method	Instrument maintenance /reanalyze	Analyst / Lab Manager	Adequate chromatography	Accurate identifications
Calibration Check	Every Run	+/- 30%	Re-prep/ reanalyze	Analyst / Lab Manager	Calibration Accuracy	+/- 30%
Second Column	All runs	+/-30% if no interference	Reanalyze	Analyst / Lab Manager	Identification	Accurate identifications

Laboratory Quality Control Samples for Method 200.8

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/20 samples	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	Generally N/A for this method					
Instrument Blank	Every Run, every 10 samples	< MDL, CA if > ½ MRL or samples < 5x CCB	reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Lab Duplicate	1:20 Every Run	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Precision	+/- 20% max
Lab Matrix Spike	Every 20 samples, each batch	70-130%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy	Detect matrix bias
Matrix Spike Duplicate	Every 20 samples, each batch	70-130%, RPD <20%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy / Precision	detect matrix bias
Lab Control Sample	Every 20 samples, each batch	85-115%	Re-prep/ reanalyze	Analyst / Lab Manager	Lab accuracy	+/- 15%
Surrogates	N/A					
Internal Standards	Every Run	60-125% of ICB	Reanalyze	Analyst / Lab Manager	Accuracy	Maintain stability
MRL Check	Every Run	50-150%	Reanalyze	Analyst / Lab Manager	Detection limits	Reliable MRL
Tune Check	Every Run	To meet method criteria	Do not run if fail	Analyst / Lab Manager	Mass accuracy+	Instrument tune
Calibration Check	Every run/10 samples	90-110%	Reanalyze	Analyst / Lab Manager	Calibration Accuracy	+/- 10%

Laboratory Quality Control Samples for Method 200.7

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run / 20 samples	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	Generally N/A for this method					
Instrument Blank	Every Run, every 10 samples	< MDL, CA if > ½ MRL or samples < 5x CCB	reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Lab Duplicate	1:20 Every Run	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Re-prep/ reanalyze	Analyst / Lab Manager	Precision	+/- 20% max
Lab Matrix Spike	Every 20 samples, each batch	70-130%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy	Detect matrix bias
Matrix Spike Duplicate	Every 20 samples, each batch	70-130%, RPD <20%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy / Precision	detect matrix bias
Lab Control Sample	Every 20 samples, each batch	85-115%	Re-prep/ reanalyze	Analyst / Lab Manager	Lab accuracy	+/- 15%
Surrogates	N/A					
Internal Standards	MS/MSD failure	70-130%	Report-alert to possible bias	Analyst / Lab Manager	Digestate Accuracy	Detect matrix bias in digestate
MRL Check	Every Run	50-150%	Reanalyze	Analyst / Lab Manager	Detection limits	Reliable MRL
Tune Check	Every Run	To meet method criteria	Do not run if fail	Analyst / Lab Manager	Mass accuracy+	Instrument tune
Calibration Check	Every run/10 samples	90-110%	Reanalyze	Analyst / Lab Manager	Calibration Accuracy	+/- 10%
Interference Check	Every run start of run	90-110% for main spikes; per method for others	Reanalyze analytes impacted	Analyst / Lab Manager	Interference correction check	Per method

Laboratory Quality Control Samples for Method 4500

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/20 samples	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	When cross-contamination suspected	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Instrument Blank	Every Run	< ½ MRL	reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Lab Duplicate	1/20 every batch	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Reprep/ reanalyze	Analyst / Lab Manager	Precision	CV < 20%
Lab Matrix Spike	1/20 every batch	71-114 %	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy	Detect matrix bias
Matrix Spike Duplicate	1/20 every batch	71-114 % RPD < 20%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy / Precision	detect matrix bias
Lab Control Sample	1/20 every batch	71-114%	Reprep/ reanalyze	Analyst / Lab Manager	Lab accuracy	71-14%
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A
Distilled RL Check	Every run	50-150%	Reprep/ reanalyze	Analyst / Lab Manager	Detection limits	Reliable MRL
Calibration Check	Every run, 1:10 samples	90-110%	Reanalyze	Analyst / Lab Manager	Calibration Accuracy	+/- 10%

Laboratory Quality Control Samples for Method 2540D TSS

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/20 samples	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	N/A					
Instrument Blank	N/A					
Lab Duplicate	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Reprep/ reanalyze	Analyst/Lab Manager	Precision	CV < 20%	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL
Lab Matrix Spike	Every 20 samples, each batch	70-130%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy	Detect matrix bias
Matrix Spike Duplicate	Every 20 samples, each batch	70-130%, RPD <20%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy / Precision	detect matrix bias
Lab Control Sample	Every 20 samples, each batch	70-130%	Reprep/ reanalyze	Analyst / Lab Manager	Lab accuracy	+/- 30%
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A

Laboratory Quality Control Samples for Method 2540C TDS

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/20 samples	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	N/A	N/A	N/A	N/A	N/A	N/A
Instrument Blank	N/A	N/A	N/A	N/A	N/A	N/A
Lab Duplicate	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Reprep/ reanalyze	Analyst/Lab Manager	Precision	CV < 20%	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL
Lab Matrix Spike	Every 20 samples, each batch	70-130%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy	Detect matrix bias
Matrix Spike Duplicate	Every 20 samples, each batch	70-130%, RPD <20%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy / Precision	detect matrix bias
Lab Control Sample	Every 20 samples, each batch	80-120%	Reprep/ reanalyze	Analyst / Lab Manager	Lab accuracy	+/- 20%
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A

Laboratory Quality Control Samples for BOD (SM5210B)

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/20 samples	< 0.2 ppm per method	Do not use Dilution water batch again per method, flag/reject results (cannot reprep)	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< 0.2 ppm per method	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	N/A	N/A	N/A	N/A	N/A	N/A
Instrument Blank	N/A	N/A	N/A	N/A	N/A	N/A
Lab Duplicate	Every Run/20 samples	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Report deviation	Analyst / Lab Manager	Precision	CV < 20%
Lab Matrix Spike	N/A	N/A	N/A	N/A	N/A	N/A
Matrix Spike Duplicate	N/A	N/A	N/A	N/A	N/A	N/A
Lab Control Sample	1/20 per method	85-115 %	Do not use data	Analyst / Lab Manager	Accuracy	85-115%
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A
Lab Control Sample Duplicate	1/20 per method	85-115 %	Do not use data	Analyst / Lab Manager	Accuracy	85-115%

Laboratory Quality Control Samples for N

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Method Blank	Every Run/20 samples	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Reagent Blank	If method blanks fail	< ½ MRL	Reprep/ reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Storage Blank	N/A	N/A	N/A	N/A	N/A	N/A
Instrument Blank	Every 10 samples	< ½ MRL	reanalyze	Analyst / Lab Manager	Contaminants	Reliability of detections
Lab Duplicate	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL	Reprep/ reanalyze	Analyst/Lab Manager	Precision	CV < 20%	RPD <20% samples>5X MRL; ± MRL for samples <5X MRL
Lab Matrix Spike	Every 20 samples, each batch	70-130%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy	Detect matrix bias
Matrix Spike Duplicate	Every 20 samples, each batch	70-130%, RPD <20%	Report-alert to possible bias	Analyst / Lab Manager	Matrix Accuracy/ Precision	detect matrix bias
Lab Control Sample	Every 20 samples, each batch	80-120%	Reprep/ reanalyze	Analyst / Lab Manager	Lab accuracy	+/- 20%
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A

Laboratory Quality Control Samples for Kelada-01

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Instrument Calibration	6 point daily initial Calibration	Linear Regression Line r ≥0.995	Prepare new standard/ reanalyze	Analyst / Lab Manager	Calibration of instrument and response linearity	Reliability of detections
Initial Calibration Verification	Done after initial calibration	%R = 90-110	Repeat once/recalibrate/prepare new standards	Analyst / Lab Manager	Evaluates accuracy/bias in calibration standards	Reliability of detections
Continuing Calibration Verification	One for every 10 samples and at the end of analytical sequence	%R = 90-110	Reprep/ reanalyze all samples associated with bad CCV	Analyst / Lab Manager	Verifies instrument calibration and stability throughout analyses.	Reliability of detections
Method Blank	One for every daily analytical sequence.	< RL	Reprep/ reanalyze	Analyst / Lab Manager	Measures and evaluates possible contamination in reagents and materials used in method	Reliability of detections
Lab Fortified Blank	Follows a valid ICV and method blank	%R = 90-110	Repeat/ recalibrate/ prepare fresh standards	Analyst / Lab Manager	Evaluates spiking technique and method accuracy	Reliability of detections
Matrix Spike	Every 10 samples	%R = 80-120	Verify spiking technique and LFB performance	Analyst / Lab Manager	Evaluates accuracy and method performance in a sample matrix	Detect matrix bias
Matrix Spike Duplicate	Every 10 samples	%R = 80-120 RPD = 10%	Verify spiking technique and LFB performance	Analyst / Lab Manager	Evaluates method performance in a sample matrix, accuracy, and precision	Detect matrix bias
MDL Studies	MDL study is evaluated annually by calculating the MDL_{spike} and MDL_{blank}	MDL< PQL	Repeat if obvious problem occurs / Adjust reporting limit to > MDL	Analyst / Lab Manager	Evaluates overall method detection limits in clean sample matrix. Actual samples may have higher MDL.	Detect instrument MDL accuracy
LOD Verification	The LOD is performed quarterly	Positive Result with signal to noise ratio above 3	Examine method or prep steps/ verify MDL study/ repeat	Analyst / Lab Manager	Instrument precision	Detect / verify instrument limits
LOQ Verification	The LOQ is performed quarterly	%R = 70-130	LOQ≤ reporting limit	Analyst / Lab Manager	Instrument precision	Detect / verify instrument limits
External PE Samples	Semi-annually, WS and WP study samples. Also internal audit samples	Within specified inter-laboratory control limits	Reprep/ reanalyze	Analyst / Lab Manager	External review of analytical method accuracy	Compare method to other labs

LABORATORY QC	FREQUENCY #	METHOD/ SWP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	DATA QUALITY INDICATOR (DQI)	MEASUREMENT QUALITY OBJECTIVE
Control Charting and Proof of Competency	Quarterly, statistical review of method QC data for each analyst, or as needed	Data statistically within control limits	Correct method problem / adjust control limits	Analyst / Lab Manager	Statistical process control	Evaluates analyst competency
LCS1	Zinc Cyanide Positive control to ensure WAD CN- is being decomposed	%R = 90-110	Verify spiking technique / correct method problem	Analyst / Lab Manager	Evaluates Method performance	Detects method issues
LCS2	Ferricyanide negative control to ensure tightly bound CN- is not decomposed	%R ≤ 5	Verify spiking technique / correct method problem	Analyst / Lab Manager	Evaluates Method performance	Detects method issues
LCS3	Ferrocyanide negative control to ensure tightly bound CN- is not decomposed.	%R ≤ 5	Verify spiking technique / correct method problem	Analyst / Lab Manager	Evaluates Method performance	Detects method issues
Relative Error or Relative Standard Error	Daily	RE=≤50% for lowest calibration point RE=≤10% for all other calibration points	Reprep standards / recalibrate / revaluate calibration model	Analyst / Lab Manager	Evaluates calibration accuracy and method performance	Detects calibration method issues

Laboratory Quality Control Samples for Mercury by 1631E

Laboratory QC	Frequency	Method/SWP QC Acceptance Limits	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Measurement Quality Objective
Method Blank	Every run, 3 blanks per 20 samples	< MRL	Reprep/reanalyze	Analyst/ Lab Manager	Contaminants	Detects reliable
Reagent Blank	N/A	N/A	N/A	N/A	N/A	N/A
Storage Blank	N/A	N/A	N/A	N/A	N/A	N/A
Instument Blank	Every run, each 10 samples	< MRL	Samples with un-qualifiable results are reanalyzed	Analyst/ Lab Manager	Contaminants	Detects reliable
Lab Duplicate	N/A	N/A	N/A	N/A	N/A	N/A
Lab Matrix Spike	Every run, 1 per 10 samples	Recovery: 71-125%	Reprep/reanalyze	Analyst/ Lab Manager	Accuracy	Detect matrix bias
Matrix Spike Duplicate	Every run, 1 per 10 samples	Recovery: 71-125%, RPD: <24%	Reprep/reanalyze	Analyst/ Lab Manager	Accuracy/ Precision	Detect matrix bias/ non-homogeneity
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A
Calibration Check	Every run	Recovery: 79-121%	Recalibrate	Analyst/ Lab Manager	Calibration Accuracy	Calibration Accuracy
MRL Check	Quarterly	Recovery: 77-123%	Reprep/reanalyze	Analyst/ Lab Manager	Reporting Limit Accuracy	Accuracy of detects at RL
Lab Control Sample	Every run, 1 per 20 samples	Recovery: 77-123%	Reprep/reanalyze	Analyst/ Lab Manager	Accuracy	Accuracy

D2036C METHOD QA/QC Parameters

WEAK ACID DISSOCIABLE (WAD) DISTILLATION AND ANALYSIS OF CYANIDE
AMERICAN STANDARDS TEST METHOD (ASTM) D2036C-06/09

Energy Laboratories, Inc. ELI SOP 50-106-10
Standard Operating Procedure Revision Date: September 17, 2019

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Instrument Calibration	A 6 point daily initial calibration using: 0.002, 0.005, 0.05, 0.1, 0.2 and 0.5 mg/L standards. FIA uses a 7 point daily calibration including a blank.	Linear Regression Line r ≥0.995	Correct problem Prepare new standards. Recalibrate	Calibration of instrument and check of response linearity.
Initial Calibration Verification (ICV)	Follows valid initial calibration. A second source standard is used.	%R = 90-110	. Repeat once . Recalibrate . Prepare fresh standards	Evaluates accuracy/bias in calibration standards.
Initial Calibration Blank (ICB)	Follows a passing ICV.	< Reporting Limit	. Repeat once . Correct problem . Reanalyze all samples associated with ICB	Measures and evaluates possible contamination in reagents and materials used in method.
Continuing Calibration Verification (CCV)	One for every 10 samples and at the end of every analytical sequence. A mid-range standard is used.	%R = 90-110	. Repeat once . Remake and reanalyze . Recalibrate and reanalyze all samples associated with failing CCV	Verifies instrument calibration and stability throughout analyses.
Continuing Calibration Blank (CCB)	One for every 10 samples and at the end of every analytical sequence.	< Reporting Limit	. Repeat once . Correct problem . Reanalyze all samples associated with CCB.	Measures and evaluates possible contamination in reagents and materials used in method.
Method Blank (MBLK)	One for every batch of 10 samples.	< Reporting Limit	. Repeat once . Correct problem . Reanalyze all samples associated with method blank	Measures and evaluates possible contamination in reagents and glassware used in method.
Laboratory Control Sample (LCS)	One for every batch of 10 samples.	%R for aqueous samples = 85-115 %R for soil samples = 60-140	. Repeat once . Recalibrate . Prepare fresh standards	Evaluates method accuracy.
Laboratory Fortified Blank (LFB)	Follows passing calibration verification.	%R = 90-110	. Repeat once . Recalibrate . Prepare fresh standards	Evaluates method accuracy.
Matrix Spike (MS)	One for every set of 10 samples.	%R for aqueous matrix = 70-130 %R for soil matrix = 50-150	. Verify spiking technique . See LCS performance . If matrix interference is verified report as is	Evaluates method performance in a sample matrix.

Matrix Spike Duplicate (MSD)	One for every set of 10 samples.	%R for aqueous matrix = 70-130 %R for soil matrix = 50-150 RPD for aqueous matrix=10% RPD for soil matrix=30%	. Verify spiking technique . See LCS performance . If matrix interference is verified report as is	Evaluates method precision.
LCS1	Zinc Cyanide Positive control to ensure WAD CN^- is being decomposed.	%R = 85-115 for distillation %R = 90-110 for Kelada analysis	. Correct method problem . Verify spiking technique	Evaluates Method performance
LCS2	Ferricyanide negative control to ensure tightly bound CN^- is not decomposed.	%R = ≤5%	. Correct method problem. . Verify spiking technique.	Evaluates Method performance
LCS3	Ferrocyanide negative control to ensure tightly bound CN^- is not decomposed.	%R = ≤5%	. Correct method problem . Verify spiking technique	Evaluates Method performance
Relative Error or Relative Standard Error	Daily	%RE=≤50% for lowest calibration point %RE=≤10% for all other calibration points	. Re-prepare standards and recalibrate . Reevaluate calibration model	Evaluates calibration accuracy and method performance.
Batch Definitions	Each set of 20 analytical samples distilled on the same day	All associated QC must pass	. Reanalyze once . Re-calibrate and reanalyze . Re-prepare batch	None
Linear Calibration Range (LCR)	Every six months per method requirement or whenever calibration range changes	Calculated standard values within 10% of expected	1. Reanalyze 2. Redistill and reanalyze	Used to determine linear range for instrument by first calibrating the instrument, then reanalyzing the calibration standards
MDL Studies	A minimum of two MDLspike solutions are prepared and analyzed every quarter. The method detection limit study is evaluated annually by calculating the MDLspike and the MDLBlank. A minimum of 6 months of Method Blank results or 50 data points (whichever is greater) analyzed from the previous year are used to calculate the MDLBlank.	MDL must be less than the PQL	Adjust the reporting limit to ≥MDL	Evaluates the overall method detection limit.
LOQ Verification	Quarterly	%R=70-130%	LOQ ≤ reporting limit; if it is not then re-run at a higher concentration within the calibration range, until acceptance criteria are met	Generally 3-10x the MDL
LOD Verification	Quarterly or whenever a new MDL study is required.	Positive Result with signal to noise ratio of at least 3.	. Examine method or preparatory steps . Verify MDL study . Repeat analysis	Spike at 2-3X calculated MDL.Required for each analyte/method to verity calculated MDL.
External PE Samples	Semi-annually, WS and WP study samples. Also internal audit samples	Within specified inter-laboratory control limits	. Repeat . Correct problem	External review of analytical method accuracy. Historically, excellent performance.
Control Charting and Proof of Competency	Annual, statistical review of method QC data for each analyst, or as needed.	Data statistically within control limits.	. Correct method problem . Adjust control limits	For statistical process control.

Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry EPA Method 245.1/ 7470A QA/QC Parameters

Energy Laboratories, Inc. ELI SOP 50-046-08
Standard Operating Procedure Revision Date: May 6, 2021

QA Indicator	Frequency	Acceptance Criteria	Corrective Action	Comments
Sample Preparation	All samples digested	Meet method QC Criteria for the matrix	1)Re-analyze the sample 2)Re-digest the sample/batch	
Instrument Calibration	Daily, after maintenance or as needed.	R^2 □ 0.995	1) Recalibrate 2) Prepare fresh standards and recalibrate 3) Assess possible causes for failing calibration and adjust method if necessary.	At least 4-point calibration including blank. Calibration standards are not required to be digested by 245.1. Linear calibration curve used.
Initial Calibration Verification (ICV)	Immediately following calibration	R% = 90-110	1) Prepare fresh ICV, Reanalyze 2) Prepare fresh standards/ICV, 3) Recalibrate and reanalyze.	Evaluates accuracy/bias in calibration standards. Must be a second source standard. Functions as QCS per 245.1
Method Blank (MBLK)	1/preparation batch	Larger of ±1 * lowest reporting limit or 2.2 X MDL (245.1) < RL (7470)	11) Re-analyze MBLK 2) Re-digest samples from batch which fail acceptance criteria or flag and report data. 3) Test-re-prep all reagents for contamination.	Evaluates overall method including possible contamination in reagents and glassware utilized in preparatory batch. Functions as LRB per 245.1
Continuing Calibration Verification 1 (CCV1)	Initial CCV, immediately ran after ICV, once per calibration.	%R= 95-105% (245.1) % R=90-110% (7470)	1.) Reanalyze CCV1 2.) Recalibrate	Establishes the ability to generate precision and recovery. Named IPR in Cetac software.
Continuing Calibration Verification (CCV)	Analyzed after every 10 analytical samples and at end of run.	R%= 90-110%	1) Reanalyze CCV 2) Recalibrate and rerun all samples since last passing CCV.	Evaluates instrument drift throughout analytical sequence. Functions as IPC per 245.1
Continuing Calibration Blank (CCB)	Run every 10 analytical samples, run immediately after CCV.	Larger of ±1 * RL or 2.2 X MDL (245.1) < RL (7470)	1) Check for high concentration sample 2) Rinse and Reanalyze CCB 3) Reanalyze samples since last passing CCB	Evaluates baseline drift, contamination in the analytical system, and analyte carryover.

QA Indicator	Frequency	Acceptance Criteria	Corrective Action	Comments
Laboratory Control Sample (LCS)	1/preparation batch	90-110% (245.1-LL) 85-115% (245.1) 80-120% (7470)	1) Re-pour or re-inject. 2) Re-digest/re-prepare all QC and samples since last valid CCV 3) Recalibrate.	Evaluates overall method accuracy/bias for the Preparatory Batch. Must be second source. If prepared the same as MS/MSD will evaluate the spiking technique.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	Minimum 1/10 samples (245.1) 1/20 samples (7470)	%R=70-130% RPD <30% (245.1) %R=75-125% RPD <20% (7470)	LCS/LFB/ICV must be passing. 1) If matrix interference suspected report as found, or 2) Re-analyze and respike if no matrix interference suspected, or 3) Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance Functions as LFM per 245.1
Sample Dilution (SD)	Every spiked parent sample (7470)	<10% RPD	1) Remake and rerun. 2) Evaluate concentration level. 3) Report qualified data.	Evaluates for an interference with spiked samples.
MDL	**Initial MDL:** <u>Samples:</u> Analyze at least 7 MDL samples over at least 3 calendar days. <u>Study:</u> Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing MDL:** <u>Samples:</u> Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. <u>Study:</u> Annually, recalculate MDL spike and MDL blank from overall historical data	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.

QA Indicator	Frequency	Acceptance Criteria	Corrective Action	Comments
LOD Verification	Annually, immediately following MDL Study.	Positive Result above signal-tonoise	1) Examine method or preparatory steps, 2) Verify MDL study, 3) Repeat analysis.	Spike at 1-3X calculated MDL for single analyte test.
LOQ Verification	**Initial LOQ:** Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing LOQ:** Samples: Analyze at least 1 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, verify that acceptance criteria is met.	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification: > Calculated MDL	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	**If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.**
Linear Dynamic Range (LDR)	Annually, or whenever method changes might affect sensitivity	Calculated standard values within 10% of expected.	1) Repeat 2) Correct problem 3) Adjust upper calibration limit	Used to determine upper linear range for instrument.
Control Charting	Annual statistical review of method.	Data statistically within control limits.	1) Trend Analysis/ Method Review 2) Correct method/instrument problem. 3) Replace analyst.	For statistical process control.

QA Indicator	Frequency	Acceptance Criteria	Corrective Action	Comments
Demonstration of Capability (DOC)	Initially for each new analyst, annually thereafter	4 passing LCS (or other second source QC), passing PT study results, or qualifying statement from supervisor. Method requirements for initial DOCs and ongoing DOCs must be met.	Provide additional training Replace analyst.	Demonstrates proficiency to perform the method and obtain acceptable results for each analyst.
External PE Samples	Semiannual WS and/or WP sample	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	1) Complete corrective action report 2) Repeat with make-up study (for failure of 2 out of 3)	External review of analytical method accuracy. Commonly RTC studies.
Batch Definition	20 analytical samples.	Pass method QC criteria specified above	Re-analyze batch or qualify results.	A group of samples and associated QC.

EPA METHOD 245.7 METHOD QA/QC PARAMETERS

MERCURY ANALYSIS BY COLD VAPOR FLUORESCENSE SPECTROMETRY

Energy Laboratories, Inc. ELI SOP 50-321-03
Standard Operating Procedure Revision date: January 19, 2021

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Batch Definition	Each batch of 20 samples	Must pass all method QC criteria as specified above	Reanalyze batch or qualify results.	A group of samples and associated QC.
Sample Preparation	All samples digested	Meet method QC criteria for the matrix.	Reanalyze sample. Re-prepare sample/batch.	
Instrument Calibration (IC)	At least daily, after maintenance, or as needed. At least 5 non-zero standards. All standards are digested.	RSD ≤15% Low standard recovery %R = 75-125	Perform instrument maintenance. Re-calibrate. Prepare new standards. 4) Clean area and system, and prepare new reagents and standards.	Establishes calibration curve over a range of analyte concentrations to quantify analytes of interest. Calibration validity tested by second source LCS analysis.
Method Blank (MBLK)	Minimum 1/20 samples or for each batch- whichever is more frequent.	Larger of ±1 * MRL or 2.2 X MDL	Reanalyze Re-digest samples from batch which fail acceptance criteria or flag and report data. Test/re-prep all reagents for contamination. Clean area and system, begin from top.	Evaluates calibration accuracy, reagent/glassware contamination, and instrument carryover. This is equivalent to a reagent blank.
Laboratory Control Sample (LCS)	Minimum 1/20 samples or for each batch-whichever is more frequent. Analyzed before samples at beginning of a batch. Fulfills the QCS requirement of method 245.7	%R = 80-120	Repeat analyses Prepare new standards Re-calibrate Re-extract and re-analyze samples associated with failed LCS.	Evaluates method accuracy. Must be Second Source Standard per NELAC. Also used to evaluate spiking technique for MS/MSD analysis.
Continuing Calibration Verification (CCV) = Ongoing Precision Recovery (OPR) per 245.7	Analyzed after calibration before samples, every 10 samples and at end of run. Same source as calibration standards.	%R = 76-113	Remake and reanalyze twice consecutively- both CCVs must pass in order for data sequence to be valid Correct problem and reanalyze all samples since last valid CCV	Evaluates instrument drift throughout analytical run. Typically uses midpoint calibration standard or ICV Per method, OPR solution is 10 ng/L standard.
Continuing Calibration Blank (CCB)	Analyzed after every CCV after calibration before samples, every 10 samples and at end of run.	Larger of ±1 * lowest reporting limit or 2.2 X MDL	Check for high concentration sample. Reanalyze CCB. 3) Reanalyze all samples associated with failing CCB.	Evaluates baseline drift, contamination in the analytical system, and analyte carryover.
Field Blank	1 per client sample set	< PQL	1) Reanalyze. 2) Clean system. 2) Re-digest sample or flag data.	Assesses contamination from field conditions during sampling.

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	1) CORRECTIVE ACTION	COMMENTS
Equipment Blank	1 per apparatus used	< PQL	2) Reanalyze. 3) Clean system. 4) Resample or flag data	Assesses contamination from equipment used for sampling and analysis.
Trip/Bottle Blanks	1 per client sample set	< ±1 * MRL	Reanalyze. Clean system. Clean bottles or change out acid, reanalyze. 4.) Resample or flag data.	Evaluates shipping and laboratory sources of contamination, and field handling.
Filter Blanks	1 per filter batch	< lowest PQL of filtered samples	Reanalyze. Clean system. Re-filter, re-digest, and reanalyze.	Prepared using same apparatus, conditions, and preservatives as samples. Assesses contamination from filter apparatus.
Matrix Spike and Matrix Spike Duplicate (MS/MSD)	Minimum 1 set/10 samples	%R = 80-120 RSD= ≤18%	1) If matrix interference suspected report as found, or 2) Reanalyze and re-spike if no matrix interference suspected, or 3) Use “A” qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance. Results not evaluated when sample analyte concentration > 4X spike level. Spike with same source as LCS. Control limits valid for spike level 1/3 of sample amount or higher.
Initial Demonstration of Performance	Once per laboratory, to demonstrate suitability to run method. Consists of a method blank ran in tandem with IPR samples (see below) and an MDL study.	Blank < MRL	1)Clean system and area 2)Remake reagents 3)Repeat until criteria met	Required before method can be performed on analytical samples. Demonstrates the laboratory’s ability to generate acceptable recovery and precision, and system is acceptable for analysis.
Initial Precision and Recovery (IPR)	Once per laboratory, to demonstrate suitability to run method. 4 replicates of 10 ng/L solution analyzed	%R = 78–108 RSD = ≤16%	1)Clean system and area 2)Remake reagents 3)Repeat until criteria met	Demonstrates the laboratory’s ability to generate acceptable recovery and precision, and system is acceptable for analysis. IPR solution must be same source as calibration standards stock.

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
MDL Studies	A minimum of 2 MDL_{spike} solutions are prepared and analyzed quarterly. The MDL study is evaluated annually by calculating the MDL_{spike} and MDL_{blank}. A minimum of six months of method blank results or 50 data points (whichever is greater) analyzed from the previous year are used to calculate the MDL_{blank}.	< PQL	Repeat if obvious problem occurs, Adjust reporting limit to > MDL.	Evaluates overall method detection limits in clean sample matrix. Actual samples may have higher MDL.
LOD Verification	Quarterly	Positive Result with signal to noise ratio of at least 3	1) Examine method or preparatory steps, 2) Verify MDL study, 3) Repeat analysis.	Spike at 2-4X the calculated MDL for multiple analyte tests.
Linear Dynamic Range (LDR)	Annually, or whenever method changes might affect sensitivity.	Calculated standard values within 10% of expected.	1) Repeat. 2) Correct problem. 3) Adjust upper calibration limit.	Used to determine upper linear range for instrument.
Low Level Read-back Verification (LLRV)	Analyzed at beginning of run.	%R = 80-120	1) Determine cause. 2) Recalibrate and rerun affected samples. 3) Prepare fresh standards and/or LLRV.	Verifies Instrument ability to quantitate analytes near the reporting limit.
LOQ Verification	Quarterly	%R= 60-140	LOQ≤ reporting limit; if it is not then re-run at a higher concentration, within the calibration range, until acceptance criteria are met	Generally 3-10X the MDL
External PE Samples	At minimum, biannually	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies).	Complete corrective action report. Repeat with another make-up study for failing study.	External review of analytical method accuracy.
Control Charting and Proof of Competency	Quarterly statistical review of method. QC data for each analyst or as needed, MDL, PE samples.	Data statistically within control limits.	Correct method/instrument problem. QA Audit method Replace analyst	For statistical process control.

EPA 353.2
Method QA/QC Parameters
NO3+NO2, NO2

Energy Laboratories, Inc. ELI SOP 50-291-04
Standard Operating Procedure Revision Date: April 27, 2020

QA SAMPLE/ SAMP TYPE CODE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Instrument Calibration	Initially, after maintenance, or when needed due to peak shifts or QC failures.	r ≥ 0.995 Standards must be run in order of decreasing concentration. RE = Generally same as CCV requirements. Lowest point may be set statistically. Number of Calibration points: Ave RF = 4 Linear = 5 Quadratic = 6 Cubic = 7 Polynomial = 3 + #equation factors (min 7)	Perform instrument maintenance Recalibrate Prepare/Purchase new standards	Establishes calibration curve over a range of analyte concentrations to quantify analytes of interest. Minimum of a blank and 5 calibration points required.
Linear Calibration/Dynamic Range (LCR/LDR)	Initially, then every 6 months. Or with major changes in equipment.	Residuals (Percent Recovery of standards) recommended being within CCV limits.	1) Evaluate alternate non-linear calibration models, especially for lowest and highest calibration points.	LCR/LDR is the linear portion of a calibration curve.
Cadmium Column Efficiency Check (CEFF)	Water = Each daily analytical sequence and after initial calibration	NO2 = 80-120%, or statistical limits	) Recondition/recharge Cd column,) Replace with fresh column	This ensures that the cadmium reduction column is effectively converting NO3 to NO2.
Initial Calibration Verification (ICV)	Immediately following calibration, daily when used as Analytical Sequence LCS for analyses without Prep	%Rec = 90-110	Repour and rerun. Prepare fresh calibration standards and/or ICV. Recalibrate and rerun.	Evaluates calibration accuracy and method performance. Must be prepared from second source standard. For aqueous analyses, the ICV is equivalent to a Laboratory Control Sample (LCS).
Initial Calibration Blank (ICB/MBLK)	Immediately follows ICV	< Lowest reporting limit. Evaluate MBLK down to MDL.	Prepare fresh blank Re-pour blanks, recalibrate, and rerun.	Evaluates calibration accuracy, reagent/ glassware contamination, and instrument carryover.
Continuing Calibration Verification (CCV)	Run every 10 samples and at end of run.	%Rec = 90-110	Remake and rerun. Recalibrate and rerun samples since last valid CCV	Evaluates instrument drift throughout analytical sequence. Typically uses midpoint calibration standard or ICV

QA SAMPLE/ SAMP TYPE CODE	FREQUENCY	ACCEPTANCE CRITERIA	1) CORRECTIVE ACTION	COMMENTS
Continuing Calibration Blank (CCB)	Run after every CCV. (Run every 10 samples and at the end of run)	< Lowest reporting limit	) Check for high conc. sample.) Prepare fresh blank.) Rerun samples since last valid CCB.	Evaluates baseline drift, contamination in the analytical system, and analyte carryover.
Matrix Spike (MS/MSD)	1/10 samples	Water %Rec = 90-110, %RPD ≤ 10	LFB must be passing If matrix interference suspected report as found, or Re-analyze and re-spike if no matrix interference suspected, or Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance. MSD also evaluates method precision.
Duplicate Sample (DUP)	1/10 samples Optional	% RPD ≤ 10	Rerun sample pair, evaluate for sample homogeneity or Report with qualifiers***	Evaluates method precision. MSD duplicate analyses preferred on some methods.
Laboratory Fortified Blank (LFB)	1/daily sequence	%Rec = 90-110 (Limits may be set statistically depending on method)	) Re-prep and rerun.) Recalibrate and rerun.	Evaluates spiking technique and when prepared from a source independent of the calibration standards can also measure method performance.
Method Blank (MBLK)	1/soil preparation batch	<Lowest reporting limit	1) Re-digest samples from batch, or 2) Qualify sample data	Evaluates overall method including possible contamination in reagents and glassware utilized in preparatory batch.
External PE Samples	WS, WP and internal blind and double blind samples.	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	) Complete corrective action report) Repeat with another make-up study (for failure of 2 out of 3)	External review of analytical method accuracy.
MDL	**Initial MDL:** <u>Samples:</u> Analyze at least 7 MDL samples over at least 3 calendar days. <u>Study:</u> Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing MDL:** <u>Samples:</u> Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. <u>Study:</u> Annually, recalculate MDL spike and MDL blank from overall historical data.	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.

QA SAMPLE/ SAMP TYPE CODE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
LOD Verification	Annually after evaluation of MDL study.	Positive Result, (above background)	Examine method or preparatory steps, Verify MDL study, Repeat analysis Consult QA	Spike at 2-3X calculated MDL for single analyte test
LOQ Verification	**Initial LOQ:** Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing LOQ:** Samples: Analyze at least 1 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, verify that acceptance criteria is met.	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification: > Calculated MDL	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	**If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.**
Control Charting and Proof of Competency	Annual statistical review of method.	Data statistically within control limits.	1) Trend Analysis/ Method Review 2) Correct method/instrument problem. 3) Replace analyst	For statistical process control.
Batch Definition	Water = Each daily analytical sequence Prepped Samples = Soils = Defined by Omega prep batch	Must pass all method QC criteria	Re-analyze batch or qualify results	A group of samples and associated QC

*** DUP Qualifier (Canned Comment) for use when values are low and the % RPD criteria does not apply.
Since the difference between the analytical result for the sample and its duplicate is less than the reporting limit, the RPD variance is not considered significant.

2540C Method QA/QC Parameters
Filterable Residue, Total Dissolved Solids (TDS) Standard Method

Energy Laboratories, Inc. ELI SOP 50-0003-06
Corporate Standard Operating Procedure Revision Date: April 22, 2020

QA SAMPLE/ SAMP TYPE CODE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Balance Calibration	Day of use verification (over range of measurements and prior to analysis) Weekly full range verification Annual outside service	Within balance verification acceptance limits.	See Balance Use and Maintenance SOP.	Establishes calibration curve over a range of masses.
SAMP		Residue between 2.5 and 200 mg TDS/SC ratio – Varies based on SC.	Reanalyze with different volume of sample Reanalyze for confirmation Report with comment**	
Duplicate Sample (DUP)	1/10 samples	%RPD ≤5 or ±PQL	Rerun 10 samples associated with sample pair Evaluate for sample homogeneity - rerun duplicate pair Report with qualifiers***	Evaluates method precision
Laboratory Control Sample (LCS)	1/20 samples	%Rec = 90-110	1) Correct problem 2) Reanalyze all samples associated with failed LCS	Evaluates overall method accuracy/bias for the batch.
Method Blank (MBLK)	1/20 samples	<PQL	Correct Problem Reanalyze samples from batch associated with contaminated method blank, or 3) Qualify sample data 4) Report samples with results 10x the MBLK result.	Evaluates overall method including possible contamination in reagents and glassware utilized in preparatory batch.
Confirmation Weigh Back	Repeat for all samples until constant weight is reached or maximum of 3x.	≤0.5 mg or ≤4% of previous weight	Repeat drying cycle to constant weight, After three successive weigh backs, qualify data. Reanalyze sample.	Unless required by a regulatory agency to confirm weights for all samples, 1 per day for sample batches with overnight oven drying time periods is acceptable.
External PE Samples	WS and/or WP and internal blind and double blind samples.	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	Complete corrective action report Repeat with another make-up study (for failure of 2 out of 3)	External review of analytical method accuracy.
Control Charting and Proof of Competency	Annual statistical review of method.	Data statistically within control limits.	Trend Analysis/ Method Review Correct method/instrument problem. Replace analyst	For statistical process control.
Batch Definition	Each batch of 20 samples	Must pass all method QC criteria	Reanalyze batch or qualify results	A group of samples and associated QC

The sample did not yield the method required minimum residue of 2.5 mg. * DUP Qualifier (Canned Comment) for use when values are low and the %RPD criteria does not apply.
Since the difference between the analytical result for the sample and its duplicate is less than the reporting limit, the RPD variance is not considered significant.