Perigo Mine/Gamble Gulch
Gilpin County, Colorado

Site Inspection - Addendum 1

Sampling and Analysis Plan/Quality Assurance Project Plan

Prepared By:

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June 2020

PROJECT MANAGEMENT
2020 Perigo Mine/Gamble Gulch – Site Inspection Addendum

A.1 Approval Sheet

CDPHE Supervising Official: ______________________________

Signature/Date
Kyle Sandor

DRMS Project Manager: ______________________________

Signature/Date
Jeff Graves

Document Revision Log

Revision	Date	Primary Changes
Draft Revision 0	5/19/2020	DAO quality assurance and technical review comments addressed and updated in document

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List of Abbreviations and Acronyms

CA	Corrective Action
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Register
CLP	Contract Laboratory Program
cm	Centimeter
COC	Chain of Custody
CPR	Cardiopulmonary Resuscitation
CVAA	Cold Vapor Atomic Absorption
DRMS	Colorado Division of Reclamation, Mining and Safety
DQA	Data Quality Assessment
DQO	Data Quality Objectives
ESAT	Environmental Services Assistance Team
EPA	United States Environmental Protection Agency
GPS	Global Positioning System
ID	Identification Designation
LCS/LCSD	Laboratory Control Spike/Laboratory Control Spike Duplicate
LIMS	Laboratory Information Management System
MS/MSD	Matrix Spike/Matrix Spike Duplicate
OSHA	Occupational Safety and Health Administration
oz.	Ounce
PE	Performance Evaluation
PQL	Practical Quantitation Limit
PSQ	Principal Study Question
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
%R	Percent Recovery
RPD	Relative Percent Difference
SAP	Sampling Analysis Plan
SAR	Sampling Activities Report
SOP	Standard Operating Procedures
TOPO	Task Order Project Officer
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

A.3 Distribution List

The following is a distribution list of personnel that will receive a copy of the Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) for the Perigo Mine/Gamble Gulch high- and low-flow sampling events scheduled for June 18, 2020 and September 17, 2020. Agency and contractor affiliations are also listed for each individual.

Jean Wyatt	United States Environmental Protection Agency
David Fronczak	United States Environmental Protection Agency
Linda Himmelbauer	United States Environmental Protection Agency
Nicole Marotta	United Sates Environmental Protection Agency
Don Goodrich	United States Environmental Protection Agency
Robyn Blackburn	United States Fish and Wildlife Service
Trez Skillern	United Sates Forest Service
Kyle Sandor	Colorado Department of Public Health and Environment
Jeff Graves	Colorado Division of Reclamation, Mining and Safety
Steve Auer	TechLaw, Inc.

A.4 Project/Task Organization

The following is a list of involved personnel, respective agency, contract affiliation, and general responsibilities.

Managers:	
Jean Wyatt	USEPA Site Assessment/Project Manager responsible for project oversight/management, document review, field sampler, and Corrective Action administration, decision maker
Kyle Sandor/Jeff Graves	Colorado CDPHE/DRMS Managers responsible for project oversight/management, prepare SAP/QAPP, field lead/sampler, Corrective Action administration and decision maker
Nicole Marotta	USEPA ESAT Task Order Project Officer responsible for assessment and oversight of ESAT field and sampling activities
Don Goodrich	USEPA ESAT Analytical TOPO responsible for assessment and oversight of ESAT analytical services
Trez Skillern	USFS coordination on adjacent public lands; assist with field sampling and provide input with regard to wastes discharging on federal lands
Steve Auer	ESAT Team Manager responsible oversight of contractor field staff and
Delegated Quality Assurance Authorizing Officials:	
David Fronczak	EPA Delegated Quality Assurance Officer responsible for overall review of data quality and usability
Bill Fear	ESAT QA Officer responsible for data validation/usability

Field Team:	
EPA Region 8 ESAT Field Lead	ESAT Field Task Lead, ESAT Field QA Lead, Health and Safety Officer responsible for implementation of SAP/QAPP implementation, maintenance of the official approved SAP/QAPP, sample collection, field documentation oversight, report review, and ensures field and laboratory procedures comply with this SAP/QAPP
Robyn Blackburn	USFWS Assist with field lead and health and safety duties, sample collection and field documentation, data review
Bill Schroeder David Fronczak Victor Ketellapper Ryan Monahan	EPA Sample collection and field documentation EPA Sample collection and field documentation EPA Sample collection and field documentation EPA Sample collection and field documentation
Laboratory Group:	
Scott VanOvermeiren	ESAT Analytical Task Lead responsible for sample intake, analysis and analytical report preparation
Scott Walker	ESAT Analytical Support Lead responsible for sample intake, analysis, analytical report preparation, report review, ESAT laboratory QA management

A.5 Introduction and Problem Definition

In the late 1850s, the Colorado gold rush brought an unprecedented number of people and mining operations into the region. Most of Colorado's mineral mining activity predates the passing of current environmental regulations in the 1970s and 1980s. Before this time, many mining companies did not sufficiently restore mined areas, leaving physical hazards and environmental impacts. Colorado rivers and streams are negatively impacted by acid mine drainage which occurs when oxygen from the air and water reacts with sulfide minerals exposed during past mining activities. Acid mine drainage, which often contains dissolved metals, flows into streams, lakes and groundwater. High levels of metals in Gamble Gulch from acid mine drainage may harm fish and aquatic ecosystems. In addition, the site is in the Boulder Creek watershed and is upstream of agricultural and drinking water resources.

The Perigo mine is located within the Gamble Gulch Mining District located in the Boulder Creek Watershed, approximately 4 miles southwest of Rollinsville, Colorado (Figure 1). The geographic coordinates of the approximate center of the Perigo mine are 39.87985448; -105.530195. The mine is located primarily on private property within the jurisdictional boundaries of the Arapaho and Roosevelt National Forests. The site can be accessed by traveling south from Rollinsville on County Road 119 for about 0.7 miles and then taking a slight right onto County Road 15-N (Gamble Gulch Road). Continue southeast on County Road 15-N for approximately 3.2 miles. Perigo Mine site will be on the right (west) side of the road.

The Perigo townsite was a busy gold mining town with approximately 300 residents in the late 19th Century with several prosperous mines including Perigo mine. Mining at the Perigo began in 1860 and continued sporadically until the early 1940's, with no documented evidence of mining in the last seventy years. The available mine maps indicate that the Perigo vein was developed through two crosscut tunnels, including two adit levels with intervening stopes. The workings are developed along a generally east-west trending system of veins in Precambrian intrusive igneous and metamorphic rocks. The upper workings were historically accessed via the approximately 780-foot-long, northwest/southeast trending Perigo Crosscut, which is not currently accessible due to collapse of the portal (Shannon and Wilson, 2020).

EPA-coordinated multi-agency sampling events were completed from 2011-2014 and a Site Inspection was completed in 2019. The lower collapsed adit portal at Perigo mine is perennially-flowing approximately 200 feet above, and discharging into, Gamble Gulch. The adit discharge is the primary source of contamination associated with this site, which results in significantly elevated concentrations of aluminum, cadmium, copper, manganese, lead, and zinc, all above water quality standards. Several seeps and collapsed portals exist in the vicinity of the Perigo mine, and a larger waste pile near the area of a former stamp mill is also present (Figure 2). In addition, periodic high-flow surges from the Perigo portal result in Gamble Gulch flowing orange. These periodic high-volume surge events and the perennially flowing adits contain significantly elevated concentrations of heavy metals. Gamble Gulch has been on the State's 303(d) list of water-quality impaired waterbodies for nonattainment of pH, dissolved cadmium, copper, and zinc associated with aquatic life, and is in nonattainment due to pH for recreational use.

Since the most recent sampling events in 2014 and EPA Site Inspection report (2019), DRMS has completed installation of additional monitoring wells. The additional wells included in this plan are focused on evaluation of the underground mine workings and seeps, springs and surface water directly associated with the Perigo draining adit in order to assist in quantifying metal loading sources to support ongoing hydrogeologic characterization and acid mine drainage mitigation efforts at the Perigo Mine.

Sampling will be conducted at four groundwater monitoring wells, up to four groundwater seeps, three draining adit sample locations, and three surface water samples in the adjacent Gamble Gulch immediately upstream and downstream of Perigo mine adit discharge. Data will be analyzed and compared to previous sampling events to identify temporal and seasonal changes associated with the site to more comprehensively understand the interaction between both surface and groundwater at the site. This sampling effort and data analysis will guide potential future sampling events and result in remedial strategies tailored to address the specific impacts associated with the Perigo mine.

A.6 Project/Task Description

This SAP has been prepared in accordance with the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4)*, *Requirements for Quality Assurance Project Plans (QA/R-5)*, and the *Guidance for Quality Assurance Project Plans (EPA QA/G-5)*, (EPA, 2001; 2002; 2003; 2006). This SAP/QAPP is designed to guide field work that will include the collection of groundwater, springs/seeps, mine adit discharges, and surface water samples, as well as associated field and laboratory Quality Assurance/Quality Control (QA/QC) samples. It also provides guidance on collecting and reporting sample results associated with isotope and water quality results from groundwater related to underground mine workings in comparison to the adit discharge as well as the surrounding seeps, springs, and surface water. Data generated from the sampling events will be used in accordance with the established DQOs (Section A.7.2).

The following data will be collected or produced by this sampling effort:

- Concentrations of total recoverable/dissolved metals, anions, O18/deuterium, tritium, and in situ field measurements of pH, DO, temperature, and specific conductance in a grab samples from groundwater, draining mine adits, seeps, springs, and surface water samples from Gamble Gulch above and below the Perigo Mine. O-18/deuterium and tritium results will be used in water age differentiation based on different isotopic values. Results will be evaluated for groundwater and surface water as part of an effort to identify water flow/loading from underground mine workings for use in evaluating clean up strategies. Metals and relevant field data will also be reviewed in comparison to Colorado Water Quality Standards in upstream vs downstream evaluation;

- Field data, such as field observation notes, photographs, and Global Positioning System (GPS) locations, used for documenting sample collection and location information.

All sampling and reporting procedures will adhere to those outlined in this SAP/QAPP and EPA/ESAT Region 8 Standard Operating Procedures (SOPs). These procedures and requirements are sufficient in generating data of known quality and specificity needed to characterize concentrations of metals in various mine sites for use by agency or other stakeholders in decision making as needed.

Laboratory analyses for groundwater/mine adit/seeps/springs and surface water samples will include specific isotopes and a list of total recoverable and dissolved metals and anions (Table A.6-1). All samples will be managed and analyzed by ESAT Laboratory in Denver, CO, or for shipping to the designated EPA Contract Laboratory Project (CLP).

CDPHE, DRMS, and EPA Site Assessment/Project Manager, or an assigned designee, will be responsible for determining and directing corrective actions (CAs) if problems are encountered in the field which would impact the way this SAP/QAPP is implemented. All deviations made from this SAP/QAPP will be documented using electronic data collection devices (or in project-specific field notebooks when electronic devices are unavailable). Deviations resulting in major modifications to this SAP/QAPP will be noted and incorporated into all related SAP/QAPP addenda, and applied, as necessary, to subsequent sampling events. Major deviations will also be documented in associated Sampling Activities Report (SAR). Data obtained from these investigations will be used in accordance with the provisions outlined in the DQOs (Section A.7).

A.6.1 Work schedule

Project Managers and field personnel are fully informed and will implement special precautions associated with limiting contact between field personnel and dedicated field equipment, using facemasks and other personal protection equipment, and ensuring social distancing to prevent exposure or contact with COVID-19. These practices have been included in the project-specific Health and Safety Plan.

Two sampling events are planned to be conducted in accordance with this SAP/QAPP on or about June 18, 2020 for characterization of high flow, and September 17, 2020 for characterization of low flow. Chemical analyses of all samples will occur soon after they are collected and received by the ESAT Region 8 laboratory in Lakewood, Colorado, and within the required analytical/sample holding times as indicated on Table A.6-1. Chemical analysis and data reporting will occur over the 2020/2021 winter season, or as analytical data become available. Data reviews and validation will be conducted prior to distributing sampling results and the SAR. The resources time restraints have been jointly coordinated by the participating agencies and incorporated in the DQOs, planning, and scheduling for the sampling events. If resources or scheduling become impacted due to unforeseen circumstances, this SAP/QAPP will be revised or amended as needed.

A.6.2 General Study Areas

Data and sample collection activities described in this SAP/QAPP will be collected at the Perigo mine in Gamble Gulch, Gilpin County, Colorado. Figure A.6.1 provides an overview of the project location, and Figures A.6.2a/A.6.2b provide the locations of monitoring wells, draining adit, springs/seeps and surface water locations. The locations of groundwater springs/seeps are known from previous sampling events, but locations will be verified during the in the field based on site conditions and data quality objectives outlined in this SAP/QAPP. Updated figures with the actual sample locations will be provided at project completion in the SAR.

A.6.3 Resource and Time Restraints

No work described in this SAP/QAPP will be conducted until the necessary financial and human resources are available to collect and analyze samples. This SAP/QAPP has been reviewed by all partners to estimate the financial requirements to conduct all or parts of proposed sampling and analysis activities and determined that there are financial and personnel resources available to conduct the proposed sampling and analysis activities.

Time restraints include a limited seasonal sampling season when field-based data and sample collection activities can be conducted. Field-based data and sample collections can only occur when weather and other mine waste areas are snow free. Access to mine areas can be constrained or completely restricted by snowy conditions and mountainous high-altitude terrain. Time constraints for collecting data would also include the following: 1) sampling will only be conducted during daylight hours; and 2) sampling will be conducted only when weather and site conditions, such as stream flow and stability of mine pile, are deemed safe for field personnel.

A.7 Quality Objectives and Criteria

This section discusses the DQO process and how it is applied to this study. Specific areas addressed in this SAP/QAPP include the planning team and stakeholders, DQOs, and the data quality parameters: metrics precision, accuracy, representativeness, completeness, comparability and sensitivity. Data collected during this sampling event are intended to inform federal and state partners of possible clean up strategies and levels of metal contamination and other water quality field parameters that occur in sampled areas. Metals concentrations will be compared to local background conditions and screening-level human health and ecological benchmarks to provide a relevant context in which to understand analytical results.

A.7.1 Planning Team and Stakeholders

This section identifies members of the DQO planning team and their responsibilities. Planning team members are primary decision makers involved in the preparation of this SAP/QAPP. Stakeholders are individuals or parties who may be impacted by the results of this study or who may use the data generated as a result of the DQO process.

A.7.1.1 DQO Planning Team

Table A.7-1 lists the DQO planning team members, their respective organizations, and area of expertise. The planning team consists of CDPHE, DRMS, EPA, and USFS site managers and other senior project personnel with field and quality assurance/sampling expertise. These individuals are responsible for working through the DQO process to develop DQOs that are sufficient in achieving goals associated with data and sample collection, chemical analysis, and subsequent data uses.

Table A.7-1 - DQO Planning Team

Name	Organization	Area of Expertise
Kyle Sandor	CDPHE	Environmental Protection Specialist
Jeff Graves	DRMS	Geologist/Project Manager
Jean Wyatt	Region 8 EPA	Site Assessment Manager
David Romero	Region 8 EPA	On-Scene Coordinator
Trez Skillern	US Forest Service	On-Scene Coordinator

A.7.1.2 Decision-Making Authority

The Decision Makers have the ultimate authority for making decisions based on the recommendations of the DQO team. There are several Decision Makers associated with these events including CDPHE, Kyle Sandor, DRMS, Jeff Graves and EPA Region 8 Site Assessment Project Manager/Removal Program OSC Jean Wyatt/David Romero, or their assigned designees. The Decision Makers are responsible for ensuring that the DQO process is complete and sufficient to determine and achieve goals associated with data and sample collection, sample chemical analyses, and subsequent data uses.

A.7.1.3 Stakeholders

Stakeholders are persons, interest groups, or communities who have an interest or a stake in activities at a site (EPA, 2017b). Stakeholders may be affected by the results of the study or persons who may use the data resulting from the DQO process at a later time.

Table A.7-2 lists the stakeholder organizations associated with this study and individuals representing those organizations.

Table A.7-2 – Stakeholders

Organization	Representative
USFS	Trez Skillern
Gilpin County Commissioners	TBD
Local property owners	TBD

A.7.2 Data Quality Objectives

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures that the resources required to generate the data are justified. The DQO process consists of the following seven steps:

1. State the problem,
2. Identify the goal of the study,
3. Identify the information inputs,
4. Define the boundaries of the study,
5. Develop the analytic approach,
6. Specify performance or acceptance criteria, and
7. Develop the plan for obtaining data.

During the first six steps of the process, the planning team develops decision performance criteria that will be used to develop the data collection design. The final step of the process involves developing the plan to obtain required data. A brief discussion of these steps and their application to this project are provided in the following sections.

A.7.2.1 Step 1: State the Problem

Discharges from the Perigo mine have resulted in degraded water quality in Gamble Gulch and South Boulder Creek. Contamination from inorganic metals such as lead, zinc, arsenic, cadmium, copper, and manganese, as well as acidic pH levels have been associated with the mine discharges. Historical data have documented that the conditions at and below this mine are elevated above Colorado acute and chronic aquatic life water quality standards (WQS) and may be impacting downstream aquatic life. The mine also exists upstream of agricultural and drinking water resources in Gilpin and Boulder Counties. In addition, periodic, uncontrolled mine surge/discharge events result in high volumes of discolored, metals-laden/contaminated water to flow into Gamble Gulch and downstream to South Boulder Creek. Specific groundwater data associated with different levels of the underground mine workings and adit discharges, seeps/springs and surface water are necessary to complete the conceptual site model and determine potential next steps at Perigo mine.

A.7.2.2 Step 2: Identify the Goals of the Study

The purpose of this step is to define the Principle Study Questions (PSQs) that data collection efforts will attempt to resolve. The PSQs help determine appropriate data inputs. Estimation statements are used to identify specific decisions or information that may be used to gain a greater understanding of existing environmental conditions. Three PSGs have been identified:

- PSQ1 – Are there differences in water age and/or total/dissolved metals and water quality concentrations and field parameters that would imply different sources and inform remedial alternatives?
- PSQ2 - What is nature of heavy metals concentrations in different sources of groundwater/seeps/springs vs surface water and how do concentrations compare to upgradient surface water not likely impacted by historical mining?

Estimation Statements

PSQ1 - Are there differences in water age and/or total/dissolved metals and water quality concentrations and field parameters that would imply different sources and inform remedial alternatives?

The proposed sampling design will collect water quality parameters and samples at various background and mine impacted locations throughout the study area in order to determine metal concentrations and apparent age of water. Data will be analyzed between each of the sites for correlations and variations to assist in developing a more robust site conceptual model that includes commonalities in sources for various water sample locations. A site conceptual model will be used to guide additional work and assessment of remedial alternatives at the site.

PSQ2 – What is nature of heavy metals concentrations in different sources of groundwater/seeps/springs vs surface water and how do concentrations compare to upgradient surface water not likely impacted by historical mining?

Metals concentrations will be compared to relevant human health or ecologically-based toxicity benchmarks and water quality standards. This evaluation will be used in interpreting and presenting the context of analytical results with regard to potential impacts from the mine waste material. This PSQ will also be used to characterize the degree of migration and potential for exposure/risks and assist in decisions by the agencies and stakeholders.

A.7.2.3 Step 3: Identify Information Inputs

The purpose of this step is to identify the data required to answer the PSQs listed in Section A.7.2.2. The primary information and decision inputs will be data generated from field observations, field instruments, environmental sampling, and chemical analyses of sampled groundwater/adit/seeps/springs/surface water. The required data to answer the PSQs are as follows:

- Measured detections of O18/deuterium and tritium isotopes concentrations in groundwater from various underground mine levels, draining mine adits, seeps/springs and surface water samples collected from the mine and surrounding areas;
- Groundwater levels in monitoring wells and draining adit/seeps/springs flow and stream flow measurements to estimate metals loading;
- Measured metals and anions concentrations in surface water samples collected from upgradient of Perigo mine known to be unimpacted by mining-related features; and
- Applicable human health and aquatic life WQS in comparison to metals concentrations detected in various water media at the site.

Table A.6-1 provides a list of isotopes, metals and metalloids that will be measured in collected groundwater and adit/seeps/springs/surface water samples (respectively). The tables also summarize the analytical methods, required sample volume, sample preservation, and holding times.

Collection of field data and field measurements associated with sample collection activities will include:

- Recording/documenting geospatial sample location data;
- Collecting groundwater levels in monitoring wells, draining adit/seeps/springs and stream flow measurements and recording in situ field measurements including water quality (pH, temperature, DO, and specific conductivity);
- Photographing sample locations, recording sample descriptions/other notable observations in an electronic data collection device or a field notebook;
- Recording all required sample information on Chain of Custody (COC) forms; and,
- Documenting deviations from this SAP/QAPP.

Analytical laboratory actions will include:

- Documenting receipt of samples;
- Determining if sample handling and condition are within acceptable limits and do not jeopardize chemical analysis;
- Laboratory analyses of groundwater and adit/seeps/springs/surface water for O18/deuterium/tritium and total/dissolved metals (Table A.6-1)
- Documenting deviations from this SAP/QAPP and analytical narratives in a dedicated laboratory notebook; and
- Reporting results to appropriate data delivery system (details provided in Section B.10 *Data Management*).

The following factors will be evaluated in the overall decision-making process:

- In situ measurements and analytical results to assess water quality characteristics, differences in water age in order to evaluate attribution of different sources of mine water/groundwater and surface water in the overall conceptual site model which contribute to water quality degradation, and
- Relative comparisons of analytical results to unimpacted metals concentrations upstream of the site.

A.7.2.4 Step 4: Define the Boundaries to the Study

The objective of this step is to define the spatial and temporal components of the study area. The scale of the decision making for the estimation statements is defined by combining the population of interest with the spatial and temporal boundaries of the site. Practical constraints that could interfere with sampling are also identified. Implementing this step helps ensure that the data are representative of the population.

Spatial Boundaries

The study area boundary comprises the underground workings, groundwater, and adit discharges from and in the vicinity of Perigo mine, as well as natural groundwater springs/seeps and a segment of Gamble Gulch immediately upstream and downstream of the Perigo mine adit discharge (Figures A.6-2a and A.6-2b). Historical upstream and downstream surface water locations in Gamble Gulch have been identified and will be sampled during the high and low flow field events.

Temporal Boundaries

Sampling is scheduled to occur between June and September 2020 at Perigo mine and surrounding areas in order to determine variability and seasonally representative high flow and low flow conditions.

Scale of Inference

Groundwater/Draining Adit/Seeps/Springs/Surface Water Samples. Draining mine adit samples will be collected directly from or in close proximity of the portal and at the bottom of the adit drainage pathway prior to drainage discharge into Gamble Gulch. Isotope concentrations from the adit drainage are expected to reflect water age of the adit discharge as it exits from underground for comparison to groundwater from other mine level and surrounding locations and seeps/springs/surface water.

Metals concentrations at the portal are expected to represent the unadulterated draining mine adit conditions prior to being influenced by mine waste pile or other surface water influences. The sample from the bottom of the adit drainage pathway is expected to represent the metals concentrations immediately prior to discharging into Gamble Gulch and reflect fate and transport influences such as metals concentrations increasing due to mine waste pile contribution or metals concentrations decreasing due to soil or waste adsorption/absorption into the surrounding mine waste/soils.

Surface water grab samples will also be collected from upstream and downstream of the discharge stream and mine waste piles based on observed draining mine adit discharges and mine waste run off entering the adjacent surface water bodies. The upstream metals concentrations represent the conditions prior to the specific mine waste discharge/mine influence, and downstream of the draining adit/mine waste pile represents the combined contribution from the mine waste pile and the draining adit discharge.

Water age, field parameters, and concentrations of metals will be reviewed to support refinement of a conceptual site model in order to evaluate potential clean up options that may be considered for the site.

A.7.2.5 Step 5: Develop the Analytic Approach

Analytical methods and results associated with the isotope testing, metals, and anion data and sample collection effort will be used to determine sources of different groundwater from various underground workings and differences in metals/anions water quality in order to assess the relative differences in groundwater sources. All data will be evaluated to assess next steps needed at Perigo mine.

Analytical results obtained from isotopes during this project will be used in order to assess attribution of different groundwater sources and any observed differences in correlated metals concentrations and as compared to the other surrounding areas and upstream surface water sample results. Detected metals concentrations will also be compared to relevant WQS.

Finally, sample collection, handling, and analytical procedures described herein are critical in generating data of known quality and defensibility. These procedures include, but are not limited to, following guidance provided in this SAP/QAPP, documenting guidance deviations, adhering to data and sample COC procedures, and conducting field and analytical QA/QC measures.

A.7.2.6 Step 6: Specify Performance or Acceptance Criteria

The purpose of this step is to specify the tolerable limits on decision errors, which are used to establish performance goals for the data collection design. For this project, the number of samples is based on knowledge of the underground mine workings and adits and associated groundwater, draining mine adits, groundwater seeps and springs, and the adjacent surface water body.

In order to mitigate the potential for false positive or false negative errors associated with field sampling, sample collection processes will be consistent with established and relevant SOPs. This includes collection of duplicate samples for isotopes, total/dissolved metals and anions with subsequent analysis using Relative Percent Difference [RPD] statistics and implementing a decontamination procedure. For laboratory analyses of samples collected for metals, QA/QC steps, such as the use of laboratory control samples, Matrix Spike/Matrix Spike Duplicate (MS/MSDs), and blank samples will be utilized and consistent with ESAT Region 8 laboratory reporting requirements.

According to the EPA (2017a) *National Functional Guidelines for Inorganic Superfund Methods Data Review*, a control limit of 20% for water for the RPD shall be used for original and duplicate sample values that are ≥ five times the contract required quantitation limit. Note, that these requirements are laboratory guidelines which may not apply to all field situations.

RPD values will be calculated using the following equation:

$$RPD = 100x \quad \frac{|\text{Sample Result} - \text{Duplicate Result}|}{0.5\ (\text{Sample Result} + \text{Duplicate Result}}$$

For laboratory analysis of samples, quality assurance/quality control (QA/QC) steps (such as using laboratory controls, matrix spikes/matrix spike duplicates [MS/MSD], blanks, etc.) will be consistent with EPA CLP Region 8 requirements. Data collection, sample processing, chemical analyses, and reporting will follow steps and requirements described in EPA-approved SOPs. Appropriate QA/QC measures will be in place (e.g., collection of field duplicates, laboratory splits, calibration data) as specified in this SAP/QAPP to reduce the risk of sampling and analytical error.

Analytical data will be evaluated in accordance with precision, accuracy, representativeness, completeness, and comparability parameters through use of laboratory control samples, calibration data, and results of MS/MSD samples. This data evaluation effort and associated criteria used to reduce and/or quantify error are described in Section A.7.5.

A.7.2.7 Step 7 Develop Plan for Collecting Data

This SAP/QAPP includes all information needed to document, collect, perform laboratory analyses, and report results associated with groundwater/adit/seeps/springs/ and surface water samples. Groundwater isotope/carbon analysis associated with underground mine workings and mine adit discharges will be used in comparison with natural groundwater springs and stream surface water in order to determine the age, flow direction, flow velocity and discharge of groundwater associated with the mine. Physiochemical and metals data will also be collected to support the assessment of contaminant transport, discharge, and mine impacts. This information will be used in order to complete a conceptual site model and to assess potential next steps at the mine. This focused sampling strategy is based on professional interpretation of current site data and as in accordance with guidance provided in the CLP Field Samplers Handbook (EPA, 2014), and EPA/ESAT SOPs (Appendix A).

A.7.3 Sampling Locations

The Perigo mine and Gamble Gulch are located on land with mixed-ownership, including both private and public land. Access to Perigo mine has been granted by the property owner and public lands has been granted by the partners associated with this sampling event. The expected number of samples at the mine has been based on historical data and focused project objectives associated with attribution of underground sources of groundwater and adit discharges associated with the Perigo mine. Groundwater seeps and springs that are included were previously observed in past field events, however, a limited number of additional seeps/springs that have not been included on Table A.7.3 may be added based on field observations in order to support project objectives.

A general description of sample locations, descriptions, and activities that will take place are listed in Table A.7-3. Note that these locations are based on best available information, but exact locations will ultimately be based on site conditions as identified during sampling. Actual physical sample locations will be documented using electronic data collection devices (field iPads). A brief description of the sampling locations will be recorded in the electronic data collection device for each mine site. Field documentation information will consist of the property ID, sample coordinates, date, and time. EPA (2017) SOPs *Field Data Collection Using GPS [Global Positioning System]and Collector for ArcGIS* and *Survey123 for ArcGIS* will be followed when using electronic data collection devices. Photographs will be collected using the electronic data collection iPad device to document notable observations encountered when sampling. If there are deviations from this SAP/QAPP or applicable SOPs, including the decision to not sample a location because conditions are either unsafe or inaccessible or if any 'opportunity samples' are collected, all will be recorded in the electronic data collection iPad device. Deviation information will be shared and discussed with the decision makers and other field managers so that appropriate CAs can be taken.

A.7.4 Criteria, Action Limits, and Laboratory Detection Limits

Table A.6-1 provides Practical Quantitation Limit (PQLs) for the EPA Region 8 ESAT and CLP laboratory and analytical methods that will be used to analyze groundwater, adit/seeps/springs, and surface water samples. In order to determine if matrix PQLs are low enough to be useful, they were compared to the Colorado Water Quality Standards. All PQLs were determined to be lower/sensitive enough for use in comparison to their respective WQS, which are the screening benchmarks for this project. Note that the reported PQLs are only estimates based on the average sensitivity of the laboratory instruments. In the event that actual PQLs exceed the WQS screening benchmarks for this project, the Project Managers will evaluate the data to determine if the DQOs were met and assess the impact or limitations on the project.

A.7.5 Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity

This section describes how data generated during the course of this project will be validated. The documentation of the data evaluation effort will be in the form of the worksheets prepared during validation. These worksheets will be included as an appendix to a SAR associated with this sampling and analysis effort. The SAR will be prepared to identify problems that may affect data usability or require that the data be qualified. The SAR report will discuss all precision, accuracy, representativeness, completeness, comparability, and sensitivity parameter results from the data validation and overall usability of the data for project objectives. Any biases associated will also be discussed. Biases refer to the systematic or persistent distortion of a measurement process that causes errors in one direction. The extent of bias will be determined by evaluating the laboratory initial calibration/continuing calibration verification, Laboratory Control Spike/Laboratory Control Spike Duplicate (LCS/LCSD), blank spikes, and MS/MSD samples.

The data will be assessed for the following criteria:

- *Precision* – The measure of agreement among repeated measurements of the same property under identical or substantially similar conditions that is expressed as the RPD between the sample pairs. An acceptable RPD is 20% for water samples (EPA, 2017a).

  - Field duplicates: RPD criteria met?
  - Laboratory duplicates: RPD criteria met?
  - Method of standard dilution performed and criteria met?
  - MS/MSD: RPD criteria met? (If applicable)

- *Accuracy* – The measure of how close measured values are to the true values being measured. Accuracy analyses are helpful in identifying systematic errors associated with sampling and analysis methods.

  - MS/MSDs: Are Percent Recovery (%R) criteria met?
  - LCS/LCSD samples: Are %R criteria met?
  - Initial and continuing calibration recoveries met?
  - Interference check sample recoveries met?
  - Inductively coupled plasma serial dilution recoveries met?

- *Representativeness* – The measure of the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, a process condition, or an environmental condition.

  - Sampling procedures and design: criteria met?
  - Holding times and preservation: criteria met?
  - Custody: all COC forms complete and provided in data package?
  - Blanks: contaminants present?

- *Completeness* – A measure of the amount of valid data obtained from a measurement system. The actual percentage of completeness is less important than the effect of completeness on the data set. Completeness will be assessed by the total number of samples collected versus the amount of samples planned.

  - The number of valid analytical results is comparable with the number determined necessary during establishment of DQOs.

- *Comparability* – The qualitative term that expresses the confidence that two data sets can contribute to common interpretation and analysis. Comparability is used to describe how well samples within a data set, as well as two independent data sets, are interchangeable.

  - Data compares with similar analysis and data sets?
  - Sample collection methods comparable to similar data sets?
  - Laboratory analytical methods comparable to similar data sets?

- *Sensitivity* – The ability to discriminate between small differences in analyte concentrations related to the rate of change in response when there is a small change in stimulus; this is reflected in the calibration curve.

  - Did chemical analyses meet or exceed PQLs documented in Table A.6-1?

Uncertainty of validated data will be evaluated by the Partner Project Managers or their designee to determine if the DQOs were met. In the event that the DQOs were not met, they will be reviewed to determine if they are achievable and may be revised if necessary, and the data may be further evaluated to determine the impact to the project. Data usability and limitations will be evaluated by the CDPHE, DRMS and EPA Site Assessment Project Managers.

A.8 Special Training/Certifications

All field data and sample collection personnel will be trained or have experience conducting work described in this SAP/QAPP. All personnel associated with activities described in this SAP/QAPP will have read this SAP/QAPP and understand the materials and requirements presented herein.

All field staff will have completed the Occupational Safety and Health Administration (OSHA) *40-hour Health and Safety Course for Hazardous Waste Site Worker Training* in accordance with Sections e and p of OSHA 29 Code of Federal Regulations (CFR) 1910.120 and maintain this certification with annual eight-hour Hazardous Waste Site Operations Refresher Training as required by Sections (e) and (q) of OSHA 29 CFR 1910.120.

All field staff will have completed American Red Cross Standard First Aid and adult Cardiopulmonary Resuscitation (CPR) training and maintain this certification annually for adult CPR and every two years for Standard First Aid. Each state and federal agency, as well as EPA contractors are required to designate Health and Safety Managers to ensure that all field staff complete the training requirements as stipulated by OSHA.

Each agency and contractor involved with this sampling effort will ensure training is provided for their respective staff. The training documentation for field personnel is stored at each of the respective agencies or contractor facilities, or as required by each respective agency.

A.9 Documentation and Records

Sample collection, handling, and analysis documentation will be recorded using electronic data collection devices, field notebooks, COC forms, and ESAT Region 8 laboratory sample inventory and analysis files, in accordance with the *Contract Laboratory Program Guidance for Field Samplers* (EPA, 2014). Field data will be generated and maintained as described in this section. ESAT Region 8 laboratory records will be generated and retained according to procedures described in the EPA (2017d) Region 8 Quality Management Plan (QMP).

Field data will be recorded in electronic data collection devices (e.g., iPads) or field notebooks at the time of data collection. Electronic data-collection devices will be used to record all critical field data associated with each sample. Notebooks will be used to document any observations, events, deviations, and CAs that cannot be documented using electronic data collection devices. They will also be available as a backup in case electronic data collection devices are unavailable or not functioning properly. The personnel doing the recording in field notebooks will initial and date all measurements, observations, and any other notations made.

In addition to a brief description of the sampling locations, field water quality measurements will be recorded in the electronic data collection device or a field notebook if an electronic device is unavailable at the time of data collection. A photo log will be maintained using the electronic data collection device and will include a photo number, the location it was taken, and a description of the photo. A brief description of the stream flow measurements will also be recorded with the electronic collection device. Flow measurement data will be stored in the individual Flow Tracker unit and downloaded within two weeks of collection. The data sheets from the data download will be printed and scanned copies will be included in the SAR. Field notebooks, chain-of-custody forms, bench sheets, photographs, and other forms used for the site investigation will be stored at the Region 8 EPA ESAT Suite for five years. After five years, project information will be retained at the EPA Record Center for archive.

Electronic data collection device or field notebook will have the following entries for each sampling site when and where applicable:

□ Date
□ Time
□ Sample location
□ Sampler/Scribe
□ Team members
□ Weather conditions
□ Water quality measurements
□ Measurement/sample collection identification and method
□ Well depth and static water level
□ Equipment that was used to collect samples/measurements
□ Camera and photo details to be used in the photolog
□ Conditions that may adversely impact the quality of measurements/samples
□ Maps/sketches if applicable
□ Physical description of sample matrix

If a field notebook is used, the field team manager will retain original copies of all field data generated under this effort. Data stored on electronic data collection devices will be backed up on a dedicated computer or network after each day's sampling activities. At the end of each sampling day, or as soon as possible thereafter, all field notebook entries will be backed up via photocopy or PDF.

COC forms will be used to relinquish samples from sample collectors to ESAT Region 8 laboratory staff. A blank copy of a COC form is provided in Attachment 1. The original COC form will accompany all respective samples when they are sent to the analytical laboratory for analysis. The ESAT Region 8 laboratory will retain all original hard-copy COC forms in a dedicated and secure location in perpetuity or until advised to discard.

The ESAT Region 8 laboratory will submit a data report to EPA containing all the analytical results for this sampling effort. The report will contain a case narrative that briefly describes the number of samples, analyses, and any analytical difficulties or QA/QC issues associated with the samples. The data report will also include signed COC forms, analytical data, a QA/QC package, and raw data. Additional reporting requirements are outlined in the ESAT laboratory contract and the EPA (2017d) QMP.

Peer review of the data package at a 100% frequency for verification of reported versus raw data, will be performed by the analytical laboratory. The final report of the abbreviated data validation of 10% of the data will be in a standard Contract Laboratory Program (CLP) format by a third party, including all laboratory and instrument Quality Control (QC) results.

The documentation of the data evaluation efforts will be in the form of the worksheets prepared during validation. The SAR will be prepared to identify problems that may affect data usability or require that the data be qualified. The SAR will discuss all precision, accuracy, representativeness, completeness, comparability, and sensitivity parameter results from the data validation and overall usability of the data for project objectives.

Lastly, a final version of this SAP/QAPP will be distributed to all personnel listed in Section A.3 and Tables A.7-1 and A.7-2. The final version will be a PDF file distributed by e-mail. The ESAT laboratory will retain all tangible project data in perpetuity or until the EPA Site Assessment/Project Manager or their designee directs otherwise.

B. DATA GENERATION AND ACQUISITION

This section describes data generation and acquisition activities associated with these events, including process design, sampling and analytical methods, sample handling and custody, QC, equipment, and data use and management.

B.1 Sampling Process Design

The following sections describe the sampling methods to collect groundwater, adit/seeps/springs and surface water samples to be analyzed for O18/deuterium, tritium, total/dissolved metals and select anions analyses. Section A.7 provides the rationale for the sampling process outlined in this section. Appendix A provides copies of the applicable SOPs, outlining how field activities will be performed (including documentation protocols). Attachment 2 provides the field equipment checklist.

Two field events will be completed in order to collect representative high flow and low flow conditions and are scheduled for June 18, 2020 and September 17, 2020 (respectively). It is anticipated that all samples will be collected over the course of 1 full day for each of the events. This includes travel/mobilizing of the field sampling teams and equipment to the site, sample collection, demobilizing field sampling teams and equipment, and submitting samples to the EPA Region 8 ESAT laboratory in Lakewood, CO. Samples will be held in chain of custody and managed by the ESAT field personnel and at the ESAT Lab, then analyzed or shipped as appropriate to the scheduled CLP laboratory in accordance with this SAP/QAPP.

The CDPHE, DRMS and EPA Site Assessment Project Managers will be responsible for directing CAs if problems are encountered in the field which would impact the way this SAP/QAPP is implemented, or if sampling locations are inaccessible. Jeff Graves (DRMS) and Jean Wyatt (EPA) are the Project Managers for this sampling effort.

B.1.1 Perigo Mine Area – Water Media Sampling

Water media to be collected includes groundwater from existing monitoring wells, groundwater that discharges to the surface as seeps/springs, and surface water above and below the Perigo mine adit discharge. The objective of the water sampling is to: 1) obtain water age (via isotope analyses), total/dissolved metals, anions, and field parameters from water media known to be mine-impacted or considered background/upstream or downstream of mine impacts. The locations presented on Table A.7-3 have been established in order to establish and complete the conceptual site model related to mine-impacted groundwater adit discharge; and, 2) assess adit discharges into Gamble Gulch contributing to water quality degradation by compare total/dissolved metals concentrations in surface water to human and environmental WQS.

A total of four (4) groundwater samples will be collected from existing monitoring wells associated with the different underground aspects of the Perigo mine. Groundwater samples from monitoring wells P-4 and P-6 and the Perigo draining adit samples (PG-02 through PG-04), will be collected in order to assess differences in water age and field parameters and variability in metals/anions concentrations of mine-impacted water. Groundwater samples from monitoring wells P-5 and P-8 and natural groundwater seeps/springs represent unimpacted groundwater in the vicinity and will be collected to compare results to the mine-impacted samples. A total of two (3) surface water samples and analytical data will be collected from the adjacent Gamble Gulch, 2 samples will be collected form upstream or background Gamble Gulch tributaries (GG-01-trib and GG-03, respectively) and in Gamble Gulch downstream of the Perigo mine discharge (GG-04) and compared to the groundwater in order to better understand the conceptual flow model for the site. In addition, four (4) groundwater seeps/springs that have been previously observed in the vicinity of the Perigo mine will also be collected and results compared to other groundwater in order to better understand the conceptual flow model for the site. One (1) additional opportunity seep/spring sample has been included in the event that previously unidentified groundwater seeps are observed to be discharging in the vicinity of the Perigo mine project area.

B.1.2 Nature of Data Collected

As indicated in Section A.7, a variety of data will be collected during these events, some of which are critical to achieve the established DQOs and project objectives, and some of which are primarily for informational purposes or which will be used to supplement critical data. The following chart specifies each type:

Data Type	Purpose
Groundwater and corresponding analytical laboratory results	Critical
Draining mine adit discharge/springs/seeps/surface water and corresponding analytical laboratory results	Critical
Geospatial data for each sample that is collected	Critical
Deviations documented in field notebooks or electronic data collection devices	Critical
Photolog	Informational
General field observations noted in electronic data collection device or notebook	Informational

B.1.3 Data Variability

Environmental data is inherently variable. However, sampling, sample handling, and sample analysis methods described herein are designed to reduce data variability. Data and samples will be collected in the field and samples processed in the laboratory according to approved SOPs to minimize variation, errors and inconsistencies. Efforts to reduce variability include using the same type of sampling equipment and methods throughout the project and sending samples to the laboratory as soon as possible. Samples will also be collected within a discrete window of time by the same experienced field personnel. This is particularly important when collecting field duplicate samples.

An assessment of the variability associated with sample collection and laboratory analyses will be conducted using methods described in Section A.7.4. The final SAR will report results from accuracy and precision criteria testing analyses. Any uncertainties biases, or data limitations or usability issues that are identified will also be reported and discussed in the final SAR.

B.2 Sampling Methods

This section describes groundwater, seeps/springs, and surface water sampling methods that will be employed during the course of this project, as well as necessary equipment and support facilities. Table A.6-1 specifies sample containers, volumes, and preservatives needed for all media to be sampled. Information provided herein, will supplement requirements stated in the *General Field Sampling Protocols* SOP FLD-12.00, *Groundwater Sampling Protocols* SOP FLD-04.00, *Surface Water Sampling Protocols* SOP FLD-01.00, and *Water Quality Measurements with the In-Situ® Multi-Parameter Meter* SOP FLD-09.00, as provided in Appendix A. Field personnel conducting this event have been trained in and are responsible for adhering to sample collection and handling requirements described in this section.

B.2.1 Equipment and Support Facilities

Specific field equipment necessary for execution of the SAP/QAPP is included in Attachment 2. During field deployment, it is anticipated additional support facilities and vehicles outside of the sampling vehicle will not be needed.

B.2.2 Monitoring Well Groundwater Sampling

Groundwater from existing monitoring wells will be sampled in accordance with the U.S. Environmental Protection Agency (2012) *Groundwater Sampling (*SOP FLD-04.00), and as indicated on Table A.6-1.

Insitu Field Parameter Measurements: In-situ water quality field measurements, including temperature, pH, dissolved oxygen, and specific conductance, will be collected at all monitoring wells during purging and at the time of sample collection. Field water quality measurements will be collected from purged groundwater by submerging the multi-meter field probe instrument into groundwater immediately after collection into a clean bucket and as in accordance with U.S. Environmental Protection Agency (2012) *Water Quality Measurements with the In-Situ® Multi-Parameter Meter* (SOP FLD-09.00). Recordings will be entered into the electronic field collection device (iPad) and entered into a dedicated field logbook for consecutive purge measurements as needed.

Monitoring well GPS location coordinates have been previously documented, however, GPS coordinates will be collected to verify and document the location of each groundwater sample that is collected. The sample and locations will also be photographed.

Three of the four groundwater samples at P-4, P-5, and P-6, will be collected using a new, dedicated, disposable Teflon bailer. One monitoring well, P-8, will be collected with a pre-cleaned submergible pump. A new bailer will be used to collect each sample at a monitoring well and discarded before moving to the well. Equipment is not expected to be re-used between monitoring well locations.

Groundwater samples to be submitted for laboratory analysis will be collected directly from the bailer or pump directly into the designated, pre-cleaned sample container as specified on Table A.6-1. The sample containers will be labeled as described in Section B.3.1.

All samples will be immediately stored in a hard-sided cooler with ice gel packs or bagged wet ice in the field. Sampling equipment are not anticipated to be decontaminated since the Teflon bailers will not be re-used across sampling locations. If there are instances that reusable sampling equipment is needed, it will be decontaminated as indicated in Section B.2.4 prior to sampling each monitoring well.

B.2.3 Seeps/Springs/Draining Adit/Surface Water Sampling

In-situ water quality field measurements, including temperature, pH, dissolved oxygen, and specific conductance, will be collected at all applicable locations using a multi-meter field instrument as in accordance with U.S. Environmental Protection Agency (2012) *Water Quality Measurements with the In-Situ® Multi-Parameter Meter*. SOP FLD-09.00. Water samples will be collected in accordance with the U.S. Environmental Protection Agency (2012) *Surface Water Sampling (*SOP FLD-01.00) and as indicated on Table A.6-1. It is specifically required that sampling progress in a manner that will eliminate the potential for sediment disturbance in the draining mine adit channel or stream bed that could result in cross- contamination of water samples. Whenever possible, draining mine adit and surface water samples will be collected by immersing the sample bottle several inches beneath the water surface with the mouth of the sample bottle facing upstream. To collect such a sample, the sample container will be inverted, lowered to the approximate sample depth and held at approximately a 45-degree angle with the mouth of the bottle facing upstream. The bottle will be rinsed three times with stream water from the sample location prior to collecting the sample. If draining mine adit or surface water samples cannot be collected directly into the sample container, dedicated, pre-cleaned Teflon tubing and syringe will be placed in the discharge stream ensuring the tubing does not touch the bottom sediment. The syringe will be discharged and emptied into the sample container and repeated until the sample volume is obtained.

B.2.4 Equipment Decontamination

Although it is anticipated that sampling equipment should not need to be decontaminated, a situation may arise that warrants decontamination. Methods provide herein will be used when decontamination is required. All reusable sample collection and preparation equipment will be decontaminated before and after collecting samples between each location. Decontamination will follow the requirements and procedures described in the *Sample Equipment Decontamination* SOP FLD-02.00 (Appendix A) and this SAP/QAPP section.

This project will use a three-step field decontamination procedure when field decontamination is necessary. Note that the nitric acid rinse step specified in the attached SOP FLD-02.00 will not be used in the field because nitric acid is highly corrosive, can easily cause chemical burns to skin and eyes, and is unsuitable for field decontamination. However, this step will be included when decontaminating field equipment or laboratory equipment in the ESAT laboratory or other controlled locations.

Before starting decontamination, personnel will don a new pair of nitrile gloves. The first decontamination step involves using a phosphate-free detergent such as Alconox or Liquinox to thoroughly clean all residues off sampling equipment. A set of dedicated detergent-specific scrub brushes with different sizes and shapes will be used for this step. The next step is a tap water rinse. Rinsing will continue until all traces of detergent are removed. The item should be thoroughly inspected for any signs of remaining contamination. If residues are found, repeat the detergent-cleaning and tap water rinse steps until the equipment has no visible soil residues. The final decontamination step consists of a deionized or reverse-osmosis water rinse. After this final rinse, equipment should be air-dried or at least shaken off to remove as much water as possible before reusing. The decontaminated items should be placed in new, clean plastic bags if they will not be immediately used. The equipment list provides materials and equipment that will be needed to decontaminate sampling equipment (Attachment 2).

B.2.5 Deviations and Corrective Actions

The Field Task Lead or their designee will be responsible for documenting deviations from methods described in the SAP/QAPP and problems encountered in the field which would impact the way this SAP/QAPP is implemented. Deviations from this SAP/QAPP will be documented using an electronic collection devise or project-specific field notebooks. The Field Task Lead will immediately notify the Project Managers to report and discuss major deviations. Major deviations include any changes to this SAP/QAPP that jeopardize usability of sampling data and sample integrity.

CAs will be taken when deviations and problems can be rectified in the field. The Field Task Lead will discuss CAs with the Project Manager or their designee before they are implemented. CAs resulting in modifications to this SAP/QAPP will be incorporated into all related SAP/QAPP addenda and applied, as necessary, to subsequent sampling events. The final SAR will identify all the deviations and CAs and describe why and how they were implemented.

B.3 Sampling Handling and Custody

This section describes sample and data handling procedures, including instructions on how to prepare samples for transport to the EPA Region 8 and contract laboratories for analysis. Specific holding times and sample preservation are identified on Table A.6-1.

B.3.1 Sample Identification and Labeling

Sample labeling is required to uniquely identify each sample and chronicle all sample-handling steps from collection or creation through analysis and/or disposal. Sample containers will be labeled with a permanent marker with the sample ID, date and time of collection, analysis to be performed, and sampler's name or initials. Sample labeling will occur before or at the time of sample collection. Sample ID and labeling will follow the procedures described in the *Sample Custody and Labeling* SOP FLD-11.00 (Appendix A) and as indicated below.

Existing/historical, as well as new, unique locations IDs for all planned locations have been previously designated as listed in Table A.7-3. Sample collection associated with this event includes a series of letters and numbers to identify the location and sample media being collected. Monitoring well, springs/seep, or surface water media type, location, sample number designations are determined based on:

GG 2020-Media Type-Location-sample number

Media Types:

- Groundwater = GW
- Spring/Seep = SW
- Adit = SW
- Surface Water =SW

Location:

- Monitoring Well = P
- Adit = PG
- Seeps/Spring = Spring
- Surface Water = GG

For example:

- Groundwater/Monitoring Well: GG-2020-GW-P4
- Spring sample: GG-2020-SW-Pete's Spring2
- Surface Water sample: GG-2020-SW-GG-03

The specific sample IDs for this project are presented on Table A.7-3.

B.3.2 Sample Custody, Shipping and Receiving

All analytical samples will be collected, stored, transported and shipped following Chain of Custody (CoC) protocols described in the *Sample Custody and Labeling* SOP FLD-11.00 (Appendix A) and this SAP/QAPP section. Sample CoC is required to ensure that sample integrity is not compromised from the time of collection and analysis to destruction. CoC procedures also provide documentation of requested analyses for contract analytical laboratories.

Sample custody begins with the physical collection of a sample. The individual sample collector or field manager supervising the sample collector will be the first person (sample custodian) that has custody of a sample. The sample custodian is responsible for ensuring that the custody of each sample is not jeopardized from when samples are collected to the time they are relinquished to the analytical laboratory. The sample custodian is also responsible for documenting sample collection information on the sample label and CoC form. When samples are delivered to the analytical laboratory, the sample custodian is responsible for relinquishing samples using CoC forms. The laboratory person that receives the samples and their CoC forms will reconcile the samples to the CoC forms and sign the CoC forms to acknowledge receipt. This procedure transfers the custody of the samples from the sample custodian to the analytical laboratory. If additional transfers are needed, the original sample CoC forms will be used to document custody transfers. The same original CoC form will accompany all the samples. However, a new CoC form will be required to clearly document custody transfers that require splitting samples recorded on a single CoC.

Sample CoC forms will be completed as soon after sample collection as possible. A blank copy of the project CoC form is provided in Attachment 1. The CoC form contains sample label and collection information. The sample custodian contact information is required and will be filled out accordingly. Samples are relinquished and transferred using the "Relinquished By" and "Received By" entries.

Samples will be transported to the EPA ESAT laboratory in Denver Colorado, then prepared for shipping to the designated CLP analytical laboratory in hard-sided coolers. All the samples will be carefully packaged with ice packs so that they are maintained at or below 4˚C. Samples will be double bagged with some airspace so that they are cushioned from one another and from the ice packs. The original CoC form will be signed and photocopied before each shipping cooler is sealed. The sample custodian will retain the photocopied CoC form and seal the original in a resealable plastic bag in the shipment cooler. Note that each shipment cooler will only contain samples that are on the CoC forms. As such, CoC forms cannot be split between coolers. Once the original signed CoC form is placed in the cooler, the cooler will be sealed with packaging tape so that the samples inside are not jeopardized during transport or shipment.

Upon receipt, the laboratory staff will inspect the coolers to make sure that the proper temperature was maintained, that the sample containers are intact and sealed, and that the number of samples in the coolers match the information provided on the CoC forms. Any evidence that the cooler was opened or samples may have been jeopardized will be immediately reported to the ESAT Task Lead. Once all of the samples are accounted for, the designated laboratory staff member will sign and date the "Received By" entry on each CoC form. This staff member will also contact the previous sample custodian via email to let them know which samples were received and in what condition. The sample custodian should reconcile what was received with their records and implement any changes that are needed to improve sample condition during shipment.

All samples at the ESAT Region 8 laboratory will be stored in an access-controlled sample refrigerator or freezer. Signed CoC forms will be PDFed and originals stored in a secure location. PDFed CoC forms will be e-mailed to the ESAT Task Lead, Steve Auer (Auer.Steven@epa.gov). An analytical chemist will log the samples in the Laboratory Information Management System (LIMS) upon receipt and will enter all analytical data into the Scribe (Environmental Response Team Software) database for permanent storage and archiving.

The ESAT Region 8 laboratory address and contact information is:

US EPA/NEIC
ESAT – Scott Walker c/o Ben Costales
Bldg. 25 Door E-3
1 Denver Federal Center
Denver, Colorado 80225

Contact Scott Walker (303) 462-9507

B.3.3 Sample Preservation

Samples that need to be preserved are indicated in Table A.6-1. Proper sample preservation procedures will be followed so that samples are maintained in good condition from the time of collection to analysis. These procedures are provided in the *Sample Preservation* SOP FLD-03.00 and this SAP/QAPP section. In the field, all samples will be stored in hard-sided coolers on ice at approximately 4˚C. Ice packs or bagged wet ice will be used so that liquid does not contact sample containers. Samples should also be kept out of direct sunlight. Upon return from the field each day, the samples can be retrieved from the cooler and placed in a standard refrigerator for up to a couple days before delivering or shipping to the analytical laboratory. When received by the ESAT Region 8 laboratory, samples may be frozen and stored at -20˚C prior to analysis.

Sample hold times refer to the maximum length of time from sample collection to chemical analysis. If hold times are exceeded, samples may be compromised and may not be suitable for chemical analysis. Maximum holdings times differ depending on the target analytes (Table A.6-1).

Stable isotopes do not have a holding time. The minimum hold time is 180 days for total and dissolved metals. Although hold times seem long, samples will be delivered to the ESAT Region 8 laboratory as soon after sampling as possible and either shipped or analyzed as soon as possible and within the indicated hold time.

B.4 Analytical Methods

This section describes the analytical laboratory methods to analyze water samples for isotopes and metals. Isotope samples will be shipped to University of Arizona, College of Science/Geosciences from the EPA Region 8 ESAT Laboratory in Lakewood, Colorado. Total/Dissolved metals and anions will be analyzed by Region 8 EPA ESAT Laboratory in Lakewood, Colorado. EPA CLP laboratory methods for metals are provided in this section and in the following SOPs available in Appendix A of this SAP/QAPP:

- Craig, H., 1957, *Isotopic standards for carbon and oxygen and correction factors*

for mass spectrometric analysis of carbon dioxide. Geochim. Cosmochim. Acta., 12: 133-149

- Gehre, M., Hoefling, R., Kowski, P. and Strauch, G., 1996, *Sample preparation device for quantitative hydrogen isotope analysis using chromium metal. Anal. Chem. 68, 4414-4417.*
- Theodórsson, P., 1996, *Measurement of weak radioactivity. Singapore, World Scientific, 333 pp.*
- *Determination of Metals by Inductively Coupled Argon Plasma-Mass Spectroscopy (ICP-MS)* – SOP 16-MET-01.02
- *Analysis of Trace Metals Using the Perkin Elmer Optima 4300DV ICP-OE and 8300 ICP-OE* – SOP 16-MET-02.03

Groundwater/surface water will be analyzed for isotopes O18/deuterium/tritium, total/dissolved metals, and anions. Table A.6-1 provides the laboratory analytical instrumentation and methods that will be used to analyze these sample types. Isotope analysis will be conducted as in accordance with University of Arizona Geosciences Laboratory methods and standards as indicated at: https://www.geo.arizona.edu/node/152#overlay-context=node/154.

Total recoverable metals analysis will follow EPA Method *Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry*, Revision 4.4 (EPA, 1994a) or Method *Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry*, Revision 5.4 (EPA, 1994b). Sample digestions will be in accordance with EPA Method 200.2 *Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements* (EPA, 1994c).

Table B.4-1 provides method performance criteria for each metal and metalloid. Table B.4-2 provides the calculations required for QA/QC assessment.

Sample disposal of hazardous waste will follow the protocol defined in *Laboratory Waste Management* SOP 16-LAB-01.02 (Appendix A).

The ESAT laboratory Analytical Task Lead, Scott VanOvermeiren, or the designated CLP laboratory will report any sample analysis problems, failures, and deviations from this SAP/QAPP to the EPA Site Assessment/Project Manager who will coordinate with the CDPHE Project Manager. The Analytical Project Officer, Don Goodrich, and the EPA Site Assessment/Project Manager will be responsible for directing CAs if problems are encountered during sample analyses that may impact the implementation of this SAP/QAPP. Any problems encountered and CAs taken or deviations from this SAP/QAPP will be documented in a laboratory notebook or case narrative.

Specific turnaround times for sample results are not required for this project. However, sample analyses will be conducted in a timely manner that does not interfere with intended uses of sample analytical chemistry data.

B.5 Quality Control

QC sampling and analysis procedures will be implemented during the course of this project to ensure that data are of known quality and repeatability. These procedures include using field duplicates and analytical laboratory QA/QC samples.

Field duplicate groundwater and surface water (including adit/springs/seeps) samples will be collected at a rate of one duplicate per ten samples collected for each of the 2 water matrices. Duplicate samples are shown on Table A.7-3.

The ESAT Region 8 laboratory Analytical Task Lead or designated CLP laboratory lead chemists will be responsible for verifying that PQLs will be at or below those reported in Table A.6-1**.**

Table B.4-1 and Table B.4-2 provide acceptable laboratory QC criteria, procedures, and calculations for the QC statistics used by the ESAT Region 8 or designated CLP laboratory. These criteria and procedures will be used to assess the effectiveness of the analytical QC actions. Sample selection and QC sampling frequency for laboratory QC samples will be determined by laboratory staff as described in Table B.4-1. MS/MSD samples will be randomly selected by laboratory staff. Published analytical method QC requirements will be met or exceeded by ESAT/CLP and EPA's analytical process where a specific QC criteria table is not provided.

QA actions and results will be documented in the narrative section of the analytical data report(s) associated with this project. Sample results will also be flagged with data qualifiers as described in Section D.3 of this SAP/QAPP. Samples flagged as unusable may be reanalyzed if enough sample remains for re-analysis.

B.6 Instrument/Equipment Testing, Inspection and Maintenance

Instruments and equipment that will be used during this project are associated with EPA Region 8 ESAT field teams and laboratory analytical instrumentation. The ESAT Task Lead or Analytical Support Lead will ensure that all required ESAT field and analytical instrument and equipment testing, inspections, and maintenance procedures are up-to-date and working as designed.

The ESAT Region 8 laboratory and CLP laboratory analytical instruments are subject to routine calibration, routine maintenance, and scheduled services. Maintenance/servicing schedules and applicable testing criteria will be followed in accordance with equipment manufacturer's specifications as included in the applicable user's manuals. Most spare parts for each piece of equipment are kept at the ESAT or CLP laboratory. Spare parts are routinely available and are ordered during periodic maintenance activities to ensure they are on-hand when needed. Equipment and instrument calibration requirements and frequencies are detailed in the applicable user's manuals.

Contractor staff members at the EPA ESAT and CLP laboratories knowledgeable of equipment operation and maintenance requirements will inspect, test, and routinely maintain all field equipment before it is deployed in the field. Any equipment deficiencies and maintenance requirements will be identified and mitigated (i.e., parts replaced, alternate equipment deployed, etc.). After mitigation, equipment will be re-inspected and the effectiveness of any repairs will be verified. All repair or maintenance activities will be documented in the designated equipment or instrument logbook.

Backup equipment will be available in case of equipment or instrument failure in the field.

Equipment/Instrument	Requirement	Schedule
In-Situ® Multi-Parameter Troll® 9500/ or other Water Quality Multi-Probe	Calibration, routine maintenance, scheduled service	In accordance with manufacturer's specifications, user's manual and applicable SOPs
Electronic Data Collection Device (Apple iPad™)	Data retrieval/upload, backups, software updates	Before and after each sampling event, and when prompted by the device to take such actions
Laboratory analytical instrumentation	Calibration, routine maintenance, scheduled service	In accordance with manufacturer's specifications, user's manual and applicable SOPs

B.7 Instrument/Equipment Calibration and Frequency

As indicated in Section B.6, some analytical instrumentation and field equipment require periodic calibration to verify function. The Analytical Support Lead or contract laboratory manager will be responsible for ensuring that all required analytical instrumentation and equipment is calibrated prior to analyzing samples. Calibration requirements, procedures, testing criteria and deficiency resolution procedures are discussed in the applicable SOPs and user's manuals. SOPs and user's manuals for laboratory analytical instrumentation are on-file at the ESAT and CLP laboratory. Any variations or inability to calibrate a piece of equipment or instrument will be noted in the relevant logbook and appropriate mitigation procedures will be followed or replacement equipment obtained. Recalibration of any instrument that requires mitigation of a deficiency will be performed prior to use or deployment.

B.8 Inspection/Acceptance of Supplies and Consumables

All supplies will be purchased by the EPA from approved vendors and stored in the field sampling room or storage rooms at the ESAT or CLP laboratory. The week before the start of the sampling event, an EPA or ESAT sampling team member will gather needed supplies and consumables, which will subsequently be verified by another EPA or ESAT sampling team member. Supplies and consumables will be ordered, inspected upon receipt, accepted, tracked, and inventoried. Acceptance of supplies and consumables will be based on the requirements of the end user.

Attachment 2 provides a list of supplies that will be assembled before the start of the field data and sample collection efforts described in this document.

B.9 Use of Existing Data (Non-Direct Measurements)

No non-direct measurements were relied upon for preparation of project implementation.

B.10 Data Management

This section describes how data will be managed from inception to final use and storage. Data will be generated during sample collection, documentation, transport, and chemical analysis. Specific management processes will be followed for data to be collected during field sampling activities: electronically entered and logged data, field notebooks, COC forms, field equipment calibration and maintenance entries, and analytical data.

Electronically entered or logged data – Data may be recorded in the field directly on electronic field forms or using data collection and storage devices. In these cases, upon return to the Region 8 laboratory, all electronic data logs will be downloaded directly to a spreadsheet (or alternate electronic media depending on specific instrument software requirements), verified against the electronic form used in the field, and processed into an electronic form that can be uploaded directly to Scribe. Electronic field forms and data logs will be maintained on the ESAT Region 8 contractor G drive. In cases where information must be manually entered into Scribe, ESAT personnel will perform 100% verification between electronic documents and data logs and data manually entered into Scribe.

Field notebooks – If electronic iPADs are unavailable or are unusable, field notebooks will be used to document observations, notes, SAP/QAPP deviations, CAs, or any other relevant information not otherwise recorded elsewhere. All notebook entries will be factual and objective. Only permanently bound, hard cover notebooks will be used. Notebooks should also be constructed with water resistant paper. The personnel doing the recording will initial and date each notebook. Corrections to notebook entries will be made by drawing a single line through the error accompanied by the date and the initials of the person performing the correction, followed by the proper entry. Upon return to the Region 8 laboratory, all relevant data hand-entered field notebooks entries will be transferred to electronic spreadsheets (such as Microsoft® Excel) by ESAT contract staff to prepare for uploading to a Scribe project (see below). ESAT field personnel will verify 100% of the spreadsheet entries against the hand-entered entries before uploading to Scribe. Original field notebooks will be stored at the Region 8 EPA Laboratory, Suite

A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements.

CoC forms – CoC forms will be used to document sample collection information, relinquish custody of collected samples, and request chemical analyses. A blank CoC form is provided in Attachment 1 of this SAP/QAPP. CoC forms should be copied using water resistant paper. CoC forms will be filled out during the time of sample collection following protocols outlined in *Sample Custody and Labeling* SOP FLD-11.00. However, CoC forms can be partially filled out prior to sample collection using Scribe. Information entered on the forms during investigation activities will be entered into Scribe after returning to the Region 8 laboratory as a part of the Scribe upload process. ESAT personnel will verify 100% of all the data entered into Scribe against the CoC forms completed in the field. Hard copies of these forms will be stored at the Region 8 laboratory, Suite A127 or until samples are relinquished to other laboratories. As described in Section B.3.2, original hard copy CoC forms will accompany any samples being shipped or relinquished to a new sample custodian.

Field equipment calibration and maintenance logs – Field equipment calibration and maintenance activities will be documented in a logbook dedicated to each piece of equipment. Logbook entries will be signed and dated by the individual performing calibration or maintenance, or the individual responsible for coordination (such as the Field Task Lead) if equipment is shipped to a manufacturer for repair or maintenance. Equipment logbooks will be stored with the appropriate piece of equipment. When new logbooks are needed, the former logbook will be stored at the Region 8 EPA laboratory, Suite A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements.

Analytical Data – An analytical chemist will log all the samples into LIMS upon receipt at the Region 8 laboratory. All analytical results will be uploaded into the LIMS in accordance with the *Sample Receipt, Custody, Storage and LIMS Data Entry* SOP 16-LAB-05.04. Peer review of the data package, at a 100% frequency of reported versus raw data, will be performed by the analytical laboratory before a final report is released. The final report will be in a standard CLP format, including all laboratory and instrument QC results. The laboratory electronic data deliverable will immediately be uploaded into a Scribe project for permanent electronic storage and archiving after the final report is generated. Hard copies of data reports (including bench sheets) will be stored at the Region 8 Laboratory, Suite A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements.

Scribe project generation – As indicated above, all relevant and required data generated as a part of field investigation activities will be uploaded into a Scribe project (or update to a Scribe project) and subsequently published to Scribe.net in accordance with the *Data Management for Field Operations and Analytical Support,* SOP 16-DAT-01.00. It is anticipated that more data may be collected in the field that supersedes existing or historical data that has already been published (such as GPS locations, etc.) for a specific sampling site. Therefore, before data are published or updated to Scribe projects, ESAT personnel will verify 100% of each Scribe project against data collected in the field (hand-entered datasheets, notebooks, and logbooks) prior to publishing the project on Scribe. Verified Scribe projects will be published within one week of delivery of the analytical electronic data deliverable when possible. The EPA project manager will be immediately notified and an alternate publication date will be established. In the event that conditions preclude publication within that time period, the TOPO will be notified and a new publication date will be established.

C. ASSESSMENT AND OVERSIGHT

C.1 Assessment and Response Actions

This section describes assessment and oversight associated with these events, including field sampling assessments, laboratory assessments, field CAs, and reports to management.

C.1.1 Field Sampling Assessments

Assessment and oversight of field sampling activities and implementation of the SAP/QAPP will include the following:

- Oversight of field sampling activities
- Oversight of sample handling and chain of custody procedures

The Field Task Lead will provide the above oversight roles. Assessment of field activities may occur at any time and without prior notice. The Field Task Lead will be proficient in and understand all of the sampling and sample handling requirements and suggestions provided in this SAP/QAPP. The Field Task Lead will address minor problems prior to beginning work or anytime when in the field. They also have the responsibility to stop work and communicate any issues with the Project Manager to resolve any issues associated with sample collection and handling. Minor problems will be addressed on-site prior to resuming work. Alternatively, a stop work order can be issued by the TOPO when more significant problems are identified. In these situations, work would stop until the Field Task Lead and the Site Assessment Project Manager can resolve the problem.

C.1.2 Laboratory Assessments

System assessments of the designated laboratory may be performed by ESAT's Quality Assurance Officer (QAO), Bill Fear or a designee. CAs required as a result of the data analysis phase is initiated by the ESAT QAO or a designee when analytical data are found to be outside the limits of acceptability, as specified in the laboratory SOPs.

Routine assessments will be conducted at least once a year, in accordance with ESAT's QMP. However, the frequency of the laboratory system assessments will also be based on the level of use and performance of individual designated laboratories. A member of the ESAT team will perform the assessment in accordance with the assessment checklist and *Field Procedures - Analytical Support and Laboratory Selection* SOP 02-06-08 (Appendix A). The checklist requires examining the laboratory documentation on sample receiving, sample log-in, sample storage, CoC procedures, sample preparation and analysis, instrument operating records, etc. Routine assessments will also be performed before a laboratory is added to the approved laboratory list. Should one-time specialty analysis be requested, the need for on-site assessments will be evaluated and discussed with EPA before such assessment is conducted.

Performance assessments will require preparing blind QC samples and submitting them along with project samples to the laboratory for analysis. The analytical results of the QC sample analyses are evaluated by the QAO or a designee to ensure that the laboratory maintains acceptable QC performance. Performance assessments may be requested by ESAT or EPA. Performance Evaluation (PE) samples will be prepared by and obtained from vendors. The QAO or a designee will designate if a PE sample shall be submitted. PE samples should be submitted if a laboratory has not recently passed an outside PE sample or as requested by EPA.

C.1.3 Field Corrective Actions

It is the responsibility of Field Task Lead to provide assessment and oversight of field sampling activates that follows this SAP/QAPP. If issues are identified in the field, the field team manager will contact and describe them with the Project Manager. CA required as a result of the field data collection phase is initiated by the Field Task Lead and may result from log reports or field assessments. CAs are initiated by ESAT if weaknesses or problems are uncovered as a result of field activities. The CAs will depend on the nature or severity of the problem and the level where the problem is detected, and may include, but shall not be limited to:

- Modifications to sampling procedures
- Recalibration (or replacement) of field instruments
- Additional training of field personnel
- Reassignment of staff personnel
- Re-sampling

C.2 Reports to Management

The results of all laboratory assessments will be submitted to the appropriate ESAT project manager, task order manager, and laboratory assistance team, as well as the EPA Contracting Officer Representative and EPA QA personnel, if requested. An external assessment of the designated laboratory may also be conducted by EPA at the Region's discretion.

D. DATA VALIDATION AND USABILITY

D.1 Data Review, Verification, and Validation

Laboratory data validation and verification will begin at the sample log-in stage where a sample log-in technician or chemist will compare received samples with CoC forms and document sample condition (damage, temperature, etc.). Validation and verification of data will be performed by QA/QC personnel following EPA *National Functional Guidance for Inorganic Superfund Methods Data Review*, (EPA, 2017a) in order to determine if the DQOs were met. Sample data deemed outside the expected range will be investigated, communicated to the analytical chemistry staff, flagged (if needed) and potentially re-sampled to verify or discredit the data. Data that are proven incorrect may be flagged, further reviewed, or invalidated. The cause of incorrect data will be investigated and appropriate response actions will be taken, including communication of any issues to the user in the data report.

Uncertainty of validated data will be evaluated by the Project Manager to determine if the DQOs were met. In the event that the DQOs were not met, they will be reviewed to determine if they are achievable, and if not, DQOs may be revised if necessary. Additionally, the data may be further evaluated to determine its impact to the project. Data usability and limitations will be evaluated by the Project Managers.

Abbreviated verification will be completed on ten percent of the analytical results for data that is electronically uploaded directly from the analytical instrumentation into the ESAT LIMS. This will be performed to ensure that data were produced in accordance with procedures outlined in this project plan. The following elements will be reviewed for compliance as part of the abbreviated data validation:

- Holding Times
- Calibration
- Blanks
- Spikes
- Duplicates
- LCSs
- Reporting Limits
- Analyte Quantification

Peer review of the data package, at a 100% frequency of reported versus raw data, will be performed by the analytical laboratory prior to releasing a final analytical report.

D.2 Verification and Validation Methods

The analytical data will be validated for ten percent of the results by either the acting EPA ESAT Region 8 Laboratory QAO or by a designated TechLaw, Inc. QAO outside of the Region 8 ESAT office. The validation will include reviewing ten percent of the samples for 100% of the analytical analysis performed and reported.

The following elements will be reviewed for compliance as part of the abbreviated data validation:

- Holding Times
- Calibration
- Blanks
- Spikes
- Duplicates
- LCSs
- MS/MSDs
- Post-digest Spike
- Internal Control Standard
- Dilution Sample
- Reporting Limits
- Analyte Identification
- Analyte Quantification
- Comparison of hard-copy results to the electronic data deliverable package

Data validation will conform to the EPA *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2017a) and will use standard data qualifiers as described below in Section D.3.

D.3 Reconciliation with User Requirements

The following definitions provide brief explanations of the national qualifiers assigned to results in the data review process. If the regions choose to use additional qualifiers, a complete explanation of those qualifiers should accompany the data review.

U	The analyte was analyzed for, but was not detected above the level of the reported sample Quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the results may be biased high.
J-	The result is an estimated quantity, but the results may be biased low.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be presented in the sample.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise

D.4 Reconciliation with DQOs

Information obtained from the field investigation will be evaluated through the Data Quality Assessment (DQA) process to determine if the data obtained are of adequate quality and quantity to support their intended use. The DQA process consists of five steps, as summarized below (EPA, 2006):

1.) *Review the project's objectives and sampling design*: Review the objectives defined during the systematic planning to assure that they are still applicable. If objectives have not been deployed, specify them before evaluating the data for the project objectives. Review the sampling design and data collection documentation for consistency with the project objectives observing any potential discrepancies.

2.) *Conduct a preliminary data review*: Review QA reports (when possible) for the validation of data, calculate basic statistics, and generate graphs of the data. Use this information to learn about the structures of the data and identify patterns, relationships, or potential anomalies.

3.) *Select the statistical method*: Select the appropriate procedures for summarizing and analyzing the data based on the review of the performance and acceptance criteria associated with the project objectives, the sampling design, and the preliminary data review. Identify the key underlying assumptions associated with the statistical tests.

4.) *Verify the assumptions of the statistical method*: Evaluate whether the underlying assumptions hold, or whether departures are acceptable given the actual data and other information about the study.

5.) *Draw conclusion from the data*: Perform the calculations necessary to draw reasonable conclusions from the data. If the design is to be used again, evaluate the performance of the sampling design.

Uncertainty of validated data will be evaluated by the Project Manager to determine if the DQOs were met. In the event that the DQOs were not met, they will be reviewed to determine if they are achievable and may be revised if necessary, and the data may be further evaluated to determine the impact to the project. Data usability and limitations will be evaluated by the Project Manager.

D.5 REFERENCES

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Tables

Table A.6-1: 2020 Perigo Mine/Gamble Gulch – Site Inspection Addendum - Surface Water Analytes and Contaminants of Potential Concern, Detection Limits, Methods, Sample Container/Holding Time Requirements

Target Analytes	EPA Method[1]	Instrument	Fraction Evaluated	Required Sample Volume (ml)	Preservative	Holding Time	Laboratory MDL (TU or ug/L)	Laboratory PQL for water (TU or ug/L)	CDPHE Surface Water Regulations for Chronic Aquatic Life[3] (ug/L)
O18 Deuterium	Delta O18 Delta Deuterium	VG602C VG602C	Total	40 mL (for both)	None	None	0.11 - 0.08 TU 0.9%	0.11 - 0.08 TU 0.9%	NA
Tritium	Tritium/3H	Quantulus 1220	Total	1 Liter	None	None	0.6 - 0.9 TU	0.6 - 0.9 TU	NA
Aluminum (Al)	200.7	ICP-OE	TR & Diss	Diss - 250ml TR - 250ml	nitric acid to pH <2	180 days	20	50	87 or e^(1.3695[ln(hardness)] -0.1158 (tot.rec.)[11]
Beryllium (Be)	200.7	ICP-OE	TR & Diss				2	5	-
Calcium (Ca)	200.7	ICP-OE	TR & Diss				100	250	NA
Iron (Fe)	200.7	ICP-OE	TR & Diss				100	250	1,000(tot.rec.) (A)
Chromium (Cr)	200.7	ICP-OE	TR & Diss				2	5	e^(0.819[ln(hardness)]+ 0.5340)
Magnesium (Mg)	200.7	ICP-OE	TR & Diss				100	250	NA
Manganese (Mn)	200.7	ICP-OE	TR & Diss				2	5	e^(0.3331[ln(hardness)] +5.8743)
Strontium (Sr)	200.7	ICP-OE	TR & Diss				2	10	NA
Silica (SiO_2)	200.7	ICP-OE	TR & Diss				250	1000	NA
Zinc (Zn)	200.7	ICP-OE	TR & Diss				10	20	0.986*e^(0.9094[ln(hardness)]+0.6235) (sculpin)[15] = e^(2.140[ln(hardness)]-5.084)
Calculated Hardness	2340B[2]	Calculated from 200.7, Ca & Mg	TR & Diss	-			-	-	(25)
Antimony (Sb)	200.8	ICP-MS	TR & Diss	Diss - 250ml TR - 250ml		180 days	0.5	1	-
Arsenic (As)	200.8	ICP-MS	TR & Diss				0.5	2	150
Cadmium (Cd)	200.8	ICP-MS	TR & Diss				0.1	0.2	(1.101672-[ln(hardness) x(0.041838)] x e^0.7998[ln(hardness)]-4.4451
Copper (Cu)	200.8	ICP-MS	TR & Diss				0.5	1	e^(0.8545[ln(hardness)] -1.7428)
Lead (Pb)	200.8	ICP-MS	TR & Diss				0.1	0.2	(1.46203-[(ln(hardness)*(0.145712)])*e^(1.273[ln(hardness)]-4.705)
Nickel (Ni)	200.8	ICP-MS	TR & Diss				0.5	1	e^(0.846[ln(hardness)]+ 0.0554)
Selenium (Se)	200.8	ICP-MS	TR & Diss				1	2	4.6
Silver (Ag)	200.8	ICP-MS	TR & Diss				0.5	1	e^(1.72[ln(hardness)]-9.06) (Trout) = e^(1.72[ln(hardness)]-10.51)
Thallium (Tl)	200.8	ICP-MS	TR & Diss				0.5	1	15

Diss = Dissolved metals fraction, i.e. source water filtered through 0.45 um filter prior to preservation (acidified).
TR = Total recoverable metals, source water, acidified (preserved).
MDL: Method Detection Limit, statistically determined from the deviation in a series of seven low level (3-5x the anticipated MDL) analyses, treated exactly as unknown samples for
PQL: Practical Quantitation Level. Target analyte concentrations between PQL and MDL qualified as estimated, 'J', due to potential high variability. 40 CFR Parts 9, 141 and 142 [WH-
NA: Not Available

[6] FRV means Final Residue Value and should be expressed as "Total" because many forms of mercury are readily converted to toxic forms under natural conditions. The FRV value of 0.01 ug/liter is the maximum allowed concentration of total mercury in the water that will present bioconcentration or bioaccumulation of methylmercury in edible fish tissue at the U.S. Food and Drug Administration's (FDA) action level of 1 ppm. The FDA action level is intended to protect the average consumer of commercial fish; it is not stratified for sensitive populations who may regularly eat fish. A 1990 health risk assessment conducted by the Colorado Department of Public Health and Environment indicates that when sensitive subpopulations are considered, methylmercury levels, in sport-caught fish as much as one-fifth lower (0.2 ppm) than the FDA level may pose a health risk.

[11] Where the pH is equal to or greater than 7.0 in the receiving water after mixing, the chronic hardness-dependent equation will apply. Where pH is less than 7.0 in the receiving water after mixing, either the 87 µg/l chronic total recoverable aluminum criterion or the criterion resulting from the chronic hardness-dependent equation will apply, whicheve

[15] The chronic zinc equation for sculpin applies in areas where mottled sculpin are expected to occur and hardness is less than 102 ppm CaCO3. The regular chronic zinc equation applies in areas where mottled sculpin are expected to occur, but the hardness is greater than 102 ppm CaCO3.

[1] EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994 (Series 200 Methods).

[2] *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992.

[3] *Colorado Department of Public Health and Environment Water Quality Control Commission, Regulation 31, The Basic Standards and Methodologies for Surface Water* (5 CCR 1002- 31) Effective September 11, 2012.

[4] EPA's *Methods for Chemical Analysis of Water and Wastes*, June 2003.

Table A.7-3: Perigo Mine/Gamble Gulch – 2020 Groundwater and Surface Water Sample Locations – Location Description and Analyses to be Performed

Sample ID	Latitude	Longitude	Description / Rationale	QC* Field Duplicate Sample	Field Parameter	Flow Water Level Depth	Metals TM/DM	Alkalinity & Anions	O18/ Deuterium	Tritium
Adit Drainage										
GG-2020-SW-PG-02	39.8798999	-105.53032	Perigo adit flow, downstream of foot bridge, ~80 feet downstream of collapsed adit, before flow braids. Drainage/impacts of entire adit flow.	No	X	Flow	X	X	X	X
GG-2020-SW-PG-03	39.8797599	-105.52959	Perigo adit flow, upstream of Gamble Gulch Road crossing (Co Rd 15N) and culvert, at confluence of all adit flow. Drainage/impacts of Perigo adit flow after flowing over wetlands.	No	X	Flow	X	X	X	X
GG-2020-SW-PG-04	39.8798111	-105.52901	Perigo adit flow, majority of flow, before confluence into Gamble Gulch. Drainage flow and contributions/impacts of Perigo adit flow across second wetlands.	Yes	X	Flow	X	X	X	X
Seeps and Surface Water										
GG-2020-SW-GG-04	39.88106	-105.526717	Gamble Gulch, immediately downstream of confluence with Perigo adit flow and downstream of tailings piles. Drainage impacts of Perigo adit flow into Gamble Gulch (across from residence).	No	X	Flow	X	X	X	X
GG-2020-SW-GG-01-Trib	39.87543055	-105.532633	Gamble Gulch, upstream of Perigo, downstream of Tip Top, upstream of Gamble Gulch Road (Co Rd 15N) crossing and culvert. Drainage of Gamble Gulch before Perigo adit flow inputs.	No	X	Flow	X	X	X	X
GG-2020-SW-GG-03	39.8744072	-105.532522	Gamble Gulch, upstream of Perigo, downstream of Tip Top, upstream of Gamble Gulch Road (Co Rd 15N) crossing and culvert. Drainage of Gamble Gulch before Perigo adit flow inputs.	No	X	Flow	X	X	X	X
GG-2020-SW-Pete's Spring	39.879313	-105.532446	Water comes out of hillside at slope along old overgrown mine road. Outflow from 4-5 discreet locations within 20'. Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	No	X	Flow	X	X	X	X
GG-2020-SW-Pete's Spring2	39.879329	-105.532451	Groundwater spring downgradient of Perigo mine waste area. Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	No	X	Flow	X	X	X	X
Lower Spring	39.882350	-105.524779	Groundwater seep located below residence, six feet off the north side of road in marshy area. Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	No	X	Flow	X	X	X	X
GG-2020-SW-New Spring1	TBD	TBD	Opportunity seep/spring in vicinity of project area if observed during field event. Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	No	X	Flow	X	X	X	X

Table A.7-3: Perigo Mine/Gamble Gulch – 2020 Groundwater and Surface Water Sample Locations – Location Description and Analyses to be Performed

Sample ID	Latitude	Longitude	Description / Rationale	QC Field Duplicate Sample	Field Parameter	Flow Water Level Depth	Metals TM/DM	Alkalinity & Anions	O18/ Deuterium	Tritium
Monitoring Wells										
GG-2020-GW-P4	39.880668	-105.5316324	Perigo Mine – Intercept of Mine Pool in lower adit crosscut. Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	No	X	Water Level	X	X	X	X
GG-2020-GW-P5	39.880568	-105.5318305	Perigo Mine - Adjacent Geology (bedrock well). Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	No	X	Water Level	X	X	X	X
GG-2020-GW-P6	39.879300	-105.536100	Upper Perigo Crosscut adit void between approximate depths of 83 and 90 feet bgs. Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	No	X	Water Level	X	X	X	X
GG-2020-GW-P8	39.880500	-105.534200	Above workings of the Perigo Mine between 200 and 300 feet bgs. (bedrock well). Determine characteristics for use in conceptual site model/natural groundwater vs mine impacted water.	Yes	X	Water Level	X	X	X	X

TM/DM = Total Metals/Dissolved Metals

*QC Field Duplicate Sample to be collected at a minimum of 10% per water matrix-type = 1 surface water; 1 groundwater

Table B.4-1: QC Criteria for Metals

QC Check I Symbol	Explanation	Run Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Verification (ICV)	Initial calibration verification (same source as calibration)	Beginning of run, to verify calibration	ICPOE 95-105% ; ICPMS 90-110%	Terminate analysis, restandardize
Secondary Calibration Verification (SCV)	Certified standard or standard from a different lot/source than calibration standards	Verify at least once per quarter	90-110% recovery (%R) of "true value"	Terminate analysis, restandardize
Continuing Calibration Verification (CCV)	Approximate mid-range standard made from working standards stock	Every 10 unknowns and at end of run	90-110%R "True" value	Re-analyze immediately (once). Then: Restandardize and rerun all samples following last "acceptable" CCV. If recovery >110% and <120% and all associated samples (same analyte) show non-detected, no action required.
Spectral/Mass Interference Check for ICP-OE & ICP- MS (ICSA / ICSAB)	Analyze spectral interferents at high concentrations alone (ICSA) and with other target analytes (ICSAB) to evaluate the effect on analyte recovery	Once per analytical run, prior to sample analyses	ICSAB: ± 20%R 'true value' ICSA: ± 20%R 'true value' or < ±PQL whichever is greater	Evaluate the sample analyte levels. Rerun ICSA/AB or use an alternate wavelength. If interferent levels in the samples don't approach ICSA interferent levels, no action is required. If necessary, recalculate IECs & rerun associated samples
Calibration Blanks, Initial & Continuing (ICB & CCB)	Blank with same reagents as working standards; i.e. zero point on curve	Beginning, end, and after each ICV/CCV during analytical run	≤ ±PQL	Re-analyze immediately once. If still unacceptable, terminate analysis & restandardize. Rerun all samples analyzed after last "acceptable" blank. Evaluate interferent level(s) vs samples, use prof judgement for addit'l required sample reruns.
Preparation Blank (PB)	Digested or prepared blank processed identical to samples. Aliquot of clean water prepared using same reagents/volumes as unknown samples.	Once per preparation batch/per matrix, or at 5% frequency, whichever is greatest	≤ ±PQL	PB > PQL: Redigest all samples >MDL and <10x PB value PB < -PQL: Re-calibrate and re-analyze all associated samples
Matrix Spike (MS)	Unknown sample (NOT a field blank) fortified at approximately 10-100x MDL for each target analyte. High concentration samples (spike <25% sample target analyte concentration), no calculation is required	1 per 10 unknowns per matrix, whichever is greatest (One PB Spike per PB)	Spike recovered at: 70-130% (ICP& MS)	Compose 1 post-digest spike (PS) and retest, note in the narrative. (Analyze original sample with PS) Evaluate duplicate reproducibility. Compare results to LFB/PBS for similar trends. If no similar trends observed, assume a matrix effect. Qualify co
Lab Fortified Blank (LFB or BS)	Spike of reagent blank at same level as MS (analyze/prep identical to samples)	Recommend: once/run	85-115%R of expected (for target analytes)	Used for comparison to Matrix Spike. If MS/MSD in-control no corrective action necessary.
Standard Reference Material (SRM) Lab Control Sample (LCS)	For solid & liquid digested samples. A known of similar matrix prepared the same as unknown samples.	1 per prep batch or one per matrix, whichever is greater.	Aq: 80-120%R of "true" published limits SRM varies by manufacturer default 80-120%	Recalibrate & reanalyze. If still unacceptable, check for corresponding high or low results in pre-digest spikes, if similar, redigest all associated samples
Serial Dilution (L)	Sample analyzed at 5x the reported analysis. (for matrix effect evaluation) Applies to analytes >50x MDL (in the original analyzed solution)	1 per 20 unknown	Diluted value 90-110% of original analysis.	Concentrations compared/reported from the analyzed solution only. Check IECs and re-analyze. May re-analyze both sample and 'L' at a higher dilution. Use professional judgement, and discuss outliers in the narrative.
Detection Limit Standard (CRI/CRA)	Low level standard ;:3-5x MDL concentration. Applies to all target analytes except Al, Ca, Fe, Mg, Na, & K	Once per analytical batch prior to unknowns	50-150%R for Sb, Pb, and Tl. 70-130%R for other target analytes*.	1. Rerun 2. If all associated samples ?.CCV for outlier analyte, no action required 3. Correct instrument's sens. problem or else need to redetermine and raise reporting limits *[Al, Ca, Fe, Mg, Na, & K are monitored without corrective actions]
Internal Standard (IS)	IS standard solution added to all samples, blanks, and standards.	All samples and standards corrected for IS response.	60% - 125%R of IS associated with target analyte(s) for ICPMS	[IS recovery determined versus calibration blank response.] Dilute sample by 2, re-analyze. Continue to dilute until IS %R acceptable.
ICP-OE IS	IS standard solution added to all samples, blanks, and standards.	All samples and standards corrected for IS response.	80-120% for ICPOE	[IS recovery determined versus calibration blank response.] Dilute sample by 2, re-analyze. Continue to dilute until IS %R acceptable.

Table B.4-2: QA/QC Calculation Algorithms

Statistical QC Parameter Evaluated	Acronym	Analyses Applied to	Calculation Algorithm
Percent Recovery	%R	Spike recovery determinations	$\%R = ((C_s - S_a) \div (S_a)) \times 100$
Percent Recovery	%R	ICV/CCV, ICSAB, LCS	$\%R = (A_T \div T) \times 100$
Relative Percent Difference	RPD	Variance between duplicates	$RPD = ((C - C_D) / ((C + C_D) \div 2)) \times 100$
Percent Difference	%D	Serial dilution variance	$\%D = ((C - C_L) / C) \times 100$

Notes:

C = Sample extract concentration

C_s = Sample extract, spiked concentration

S_a = Spike amount added

T = True (possibly certified) amount in standard solution

Hardness = (Ca, mg/L)*2.497 + (Mg, mg/L)*4.118

C_D = Duplicate sample concentration

C_L = Sample extract concentration, dilution factor corrected.

A_T = Analyzed concentration for the known standard.

Figures

Figure A.6.1
Perigo Mine/Gamble Gulch

Gilpin County, Colorado

Site Location

- Mines
- Streams
- Secondary Highways
- Roads
- Waterbodies

Date: June 02, 2020

Map Projection: UTM Zone 13N, WGS84, Meters

Data Sources:

Mines: *U.S. EPA* (2016);

Hydrography: *NHDPlus V2 - U.S. EPA & USGS* (2013);

Secondary Highways: *HERE* (2016);

Roads: *HERE* (2016);

Base Map: *Esri World Topographic Web Service* (2020).

0 2 4 Miles

Area Enlarged

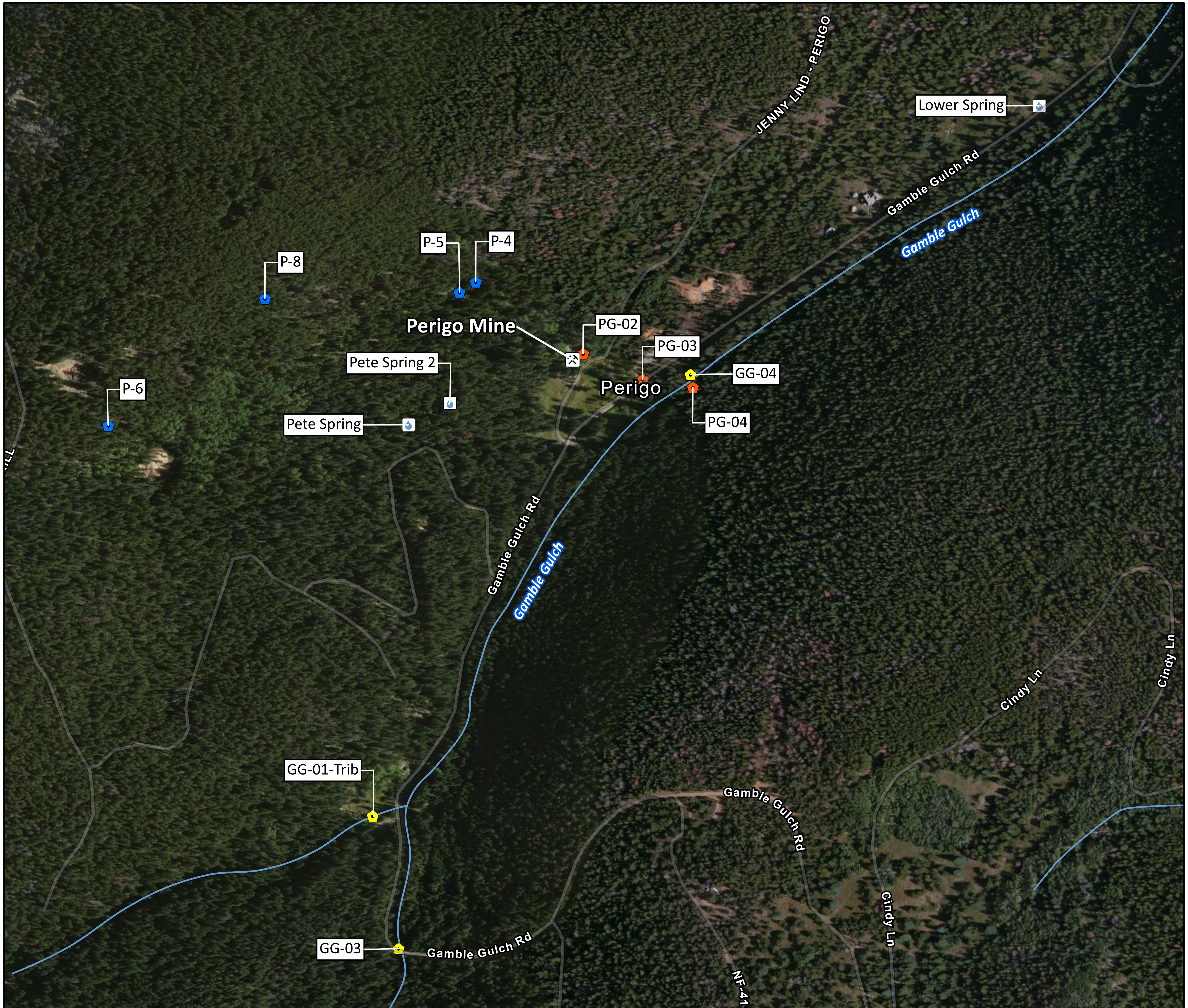

Figure A.6.2
Perigo Mine/Gamble Gulch

Gilpin County, Colorado
2020 Sample Locations

- Mines
- Adit Drainage Sample Location
- Surface Water Sample Location
- Spring/Seep Sample Location
- Monitoring Well Sample Location
- Streams

Date: June 02, 2020
Map Projection: UTM Zone 13N, WGS84, Meters
Data Sources:
Sample Locations: *U.S. EPA* (2020);
Mines: *U.S. EPA* (2016);
Streams: *CDOW* (2004);
Base Map: *Esri World Imagery (Clarity) Web Service* (2020).

0 500 1,000 Feet

Area Enlarged

Attachment 1

Perigo Mine – Gamble Gulch
2020 Site Inspection Addendum
Sampling and Analysis Plan/Quality Assurance Project Plan

Blank Chain of Custody Form

CHAIN OF CUSTODY RECORD

Site # ____________________

Organization Collecting Samples: ____________________

Region: ____________________

Address: ____________________

City, ST Zip: ____________________

Analytical Lab:

Lab name: ____________________

Andress: ____________________

City, ST Zip: ____________________

Location	**Sub_Location**	**Sample Type**	**Collection**	**Matrix**	**Analyses**	**Preservation**	**Sample Date**	**Sample Time**	**Sampler**

Relinquished by (Organization and Signature)	Date/Time	Received by (Organization and Signature	Date/Time

Attachment 2

Perigo Mine – Gamble Gulch
2020 Site Inspection Addendum
Sampling and Analysis Plan/Quality Assurance Project Plan

Equipment List

Table B.1-1 Sampling Checklist

1. Make sure the necessary paperwork is in place for a field event: Approved LSR, SAP, and QAPP.

2. Coordinate sampling dates and times with members of the field team and talk with chemists involved in the project to see if your plans work for them. Coordinate sample delivery with outside laboratories.

3. Fill out the necessary paperwork: Comp Time forms and TAs if travel will be more than 50 miles from the laboratory. Be sure to have reservations made for airlines and hotels if necessary.

4. Make necessary arrangements with people outside of the Region VIII laboratory that are involved with the project. Arrange meeting times and places, vehicle needs, sampling teams, additional equipment needs, etc.

5. Inform any volunteers outside of the EPA laboratory group what will be involved with sampling - physical stressors, equipment to bring, lunch, water, etc.

6. Calibrate meters needed for fieldwork well-before leaving. Make sure:
    a. pH probes are filled.
    b. DO membranes are intact.
    c. Spare batteries, calibration logs, and pens are available for each meter.
    d. Replace pH and conductivity calibration standards with fresh solution.
    e. Condition new probes and replace damaged ones as needed. Buy new equipment from a scientific vendor if necessary.

7. Lay out needed sampling equipment in the field room (see attached list).

8. Check vehicles: fill with gas, top off windshield wiper fluid, equip with cell phones, walkie-talkies, and chargers.

9. Charge batteries for needed sampling equipment one or two nights before leaving: iPads, digital camera, XRFs, hydrolabs, GPS units, walkie-talkies, etc.

10. Pack vehicles the night before leaving. In the event of hot or cold weather, leave meters and deionized water in the field room and pack the day you leave.

11. In the event of a day-trip, calibrate meters the morning you leave.

Gamble Gulch – 2020 Equipment List

Sample Containers:

250 ml HDPE containers
ml HDPE containers
Gallon cubitainers
oz plastic jar (sed. ABA , SPLP)
4 oz glass jar (sed. metals)
Gallon Ziplock

60 ml plastic syringe
2 oz plastic teflon scoop (sed.)

Filter Apparatus:
250 or 500 ml filters
.45 micron syringe filter
Filter Stands
Vacuum pump with spare
Teflon Tweezers

Preservatives:
HNO3 Ampules or dropper - metals
CaCO3 Acid Waste container
Ice/Snow

Paperwork:
Flow forms with clipboard
SAP / HSP
Maps/Gazeteer
Chains and Labels
Tags
Field Notebook(s)
Pens
Permanent Markers
Custody Seals
Well Sampling Equipment
Peristaltic Pump
Bailers
Measuring Tape
Bailer rope

Field iPads/Other Units

iPad (charged, and loaded with sites)-
GPS Units (charged, and loaded with sites)-
Compass
Distance meter
Digital Camera w/batteries
XRF Unit
Water Quality Multimeters (charged)-
Cal standards
Cage
Cables (long/short)
Cap & cal. cup
Membranes
Fill solutions
Control unit (handheld)
Sondes
Calibration Logbook
Car power adapter (DO bubbler)

Field Meters (when not using multimeters):
logbooks
pH- buffers
probe solutions batteries
DO- Spare membranes filling solution
Barometer

Calibration equip:
Winkler Bottle
Starch
0.035N Na Thio
Buret/Pipet
Buret Holder
Flask w/ stir bar
Powder Pillows
MnSO4
Conductivity-
calibration stds

Misc:

Battery charger
pH test strips
Latex/ Nitrile gloves (S,M,L,XL)
Neoprene gloves
Safety glasses
Kimwipes

Trash bags
Plastic Ziplock Bags
Tape
Bucket
Coolers
DI rinse bottles
Cell Phones w/ charger
Walkie-Talkies w/batteries
Shovel
Spare car keys
Vehicle log & credit card
Govt. purchase card
DI water for blanks (e-pure)
DI rinse bottles

DI water
3 to 2 prong electrical
Car power adapter
Generator- gas, ext. chord
Well Bailors
String or chord
Long multimeter cable
Bucket Groundwater
forms Clipboard
with calculator
Metric hex keys

Summer Field Gear:

Backpacks 500
Hiking Boots/ Steel Toe Boots
Hat 8
GorTex Waders
Wading Boots
Rain Parka

Wool Socks
Layered Clothing
Sunscreen
Chapstick
Bug Spray
Sun Glasses
Water/Food
Pocket Knife

Winter Field Gear:
Shovel/Ice Breaker
Backpacks
Snowshoes Hiking Poles
Insulated Water Gloves
Hat
Gloves
Balaclava
Neoprene Waders
Wading Boots
Wool Socks
Layered Clothing
Sunscreen
Chapstick
Sunglasses
Water/Food
Pocket Knife

Equipment List (cont)

Flow Equipment
Flowtracker-

Field Meters (when not using multimeters)

Tape measure (tag line)
Wading rod
D batteries
Rebar
Calculator
Stopwatch
Bucket
Flumes (1", 2",4",8")-
Flume Kit (bubble level, tools, nuts and bolts) logbo
Shovel
Flume Table (reference)

pH- buffers
probe solutions batteries
DO- Spare membranes filling solution
Barometer

Attachment 3

Perigo Mine – Gamble Gulch
2020 Site Inspection Addendum
Sampling and Analysis Plan/Quality Assurance Project Plan

EPA Region 8 Quality Management Program Crosswalk

EPA REGION 8 QA DOCUMENT REVIEW CROSSWALK

QAPP/FSP/SAP for: *(check appropriate box)*	**Entity** *(grantee, contract, EPA AO, EPA Program, Other)*	**Regulatory Authority and/or Funding Mechanism**	___**40 CFR 31 for Grants** ___**48 CFR Part 46 for Contracts** ___ **Interagency Agreement** ___ **EPA Administrative Order** ___ **EPA Program Funding** ___ **EPA Program Regulation** ___ **EPA CIO 2105**
[ ] **GRANTEE** [ ] **CONTRACTOR** [ ] **EPA** X **Other**	Colorado Division of Reclamation, Mining and Safety		
Document Title *[Note: Title will be repeated in Header]*	Perigo Mine – Gamble Gulch, Site Inspection Addendum Sampling and Analysis Plan/Quality Assurance Project Plan –		
QAPP/FSP/SAP Preparer	Jeff Graves - DRMS		
Period of Performance *(of QAPP/FSP/SAP)*	**June 2020 – October 2020**	**Date Submitted for Review**	5/20/2020
EPA Project Officer **EPA Project Manager**	Victor Ketellapper Jean Wyatt	**PO Phone #** **PM Phone #**	303/312/6578 303/312-6258
QA Program Reviewer or Approving Official	Kyle Sandor, CDPHE	**Date of Review**	June 3, 2020

Documents to Review:

1. QAPP written by Grantee or EPA must also include for review:
   Work Plan(WP) / Statement of Work (SOW) / Program Plan (PP) / Research Proposal (RP)

2. QAPP written by Contractor must also include for review:
   a) Copy of signed QARF for Task Order
   b) Copy of Task Order SOW
   c) Made available hard or electronic copy of approved QMP
   d) If QMP not approved, provide Contract SOW

3. For a Field Sampling Plan (FSP) or Sampling & Analyses Plan (SAP), the Project QAPP must also be provided.
   OR
   The FSP or SAP must be clearly identified as a stand-alone QA document and must contain all QAPP required elements (Project Management, Data Generation/Acquisition, Assessment and Oversight, and Data Validation and Usability).

Documents Submitted for QAPP Review:

1. **QA Document(s) submitted for review:**

QA Document	**Document Date**	**Document Stand-alone**	**Document with QAPP**
QAPP		Yes	
FSP		No	NA
SAP		Yes	Yes
SOP(s)			Yes

2. **WP/SOW/TO/PP/RP Date: NA**
   WP/SOW/TO/RP Performance Period: NA
3. **QA document consistent with the:**
   WP/SOW/PP for grants? Yes
   SOW/TO for contracts? NA
4. **QARF signed by R8 QAM** NA
   Funding Mechanism NA
   Amount ______________

Summary of Comments *(highlight significant concerns/issues)*:
1. Comment #1: NOTE: No significance comments were identified since all comments on previous Amendments were incorporated.
2. Comment #2
3. **The** Colorado Division of Reclamation, Mining and Safety**must address the comments in the Summary of Comments, as well as those identified in the Comment section(s) that includes a "Response (date)" and Resolved (date)".**

Element	Acceptable *Yes/No/NA*	Page/ Section	Comments
A. Project Management			
A1. Title and Approval Sheet			
a. Contains project title	Yes	Title pg, and ii	
b. Date and revision number line (for when needed)	Yes	iii	
c. Indicates organizations name	Yes	Title Pg/ii	
d. Date and signature line for organizations project manager	Yes	ii	
e. Date and signature line for organizations QA manager	Yes	ii	
f. Other date and signatures lines, as needed	Yes	ii	
A2. Table of Contents			
a. Lists QA Project Plan information sections	Yes	iv-vi	
b. Document control information indicated	NA	NA	
A3. Distribution List			
Includes all individuals who are to receive a copy of the QA Project Plan and identifies their organization	Yes	ix	
A4. Project/Task Organization			
a. Identifies key individuals involved in all major aspects of the project, including contractors	Yes	x-xi	
b. Discusses their responsibilities	Yes	x-xi	
c. Project QA Manager position indicates independence from unit generating data	Yes	x	
d. Identifies individual responsible for maintaining the official, approved QA Project Plan	Yes	ix-x	
e. Organizational chart shows lines of authority and reporting responsibilities	NA		SAP was prepared in accordance with CDPHE Program QAPP
A5. Problem Definition/Background			
a. States decision(s) to be made, actions to be taken, or outcomes expected from the information to be obtained	Yes	12-13	
b. Clearly explains the reason (site background or historical context) for initiating this project	Yes	12-13	
c. Identifies regulatory information, applicable criteria, action limits, etc. necessary to the project	Yes	12-13	
A6. Project/Task Description			

a. Summarizes work to be performed, for example, measurements to be made, data files to be obtained, etc., that support the project goals	Yes	13-14	
b. Provides work schedule indicating critical project points, e.g., start and completion dates for activities such as sampling, analysis, data or file reviews, and assessments	Yes	13-14	
c. Details geographical locations to be studied, including maps where possible	Yes	13, Figure A.6.1	
d. Discusses resource and time constraints, if applicable	Yes	14	
A7. Quality Objectives and Criteria			
a. Identifies - performance/measurement criteria for all information to be collected and acceptance criteria for information obtained from previous studies, - including project action limits and laboratory detection limits and - range of anticipated concentrations of each parameter of interest	Yes	17, 24-26. And Table A.6.1	
b. Discusses precision	Yes	25	
c. Addresses bias	Yes	25	
d. Discusses representativeness	Yes	25-26	
e. Identifies the need for completeness	Yes	26	
f. Describes the need for comparability	Yes	26	
g. Discusses desired method sensitivity	Yes	26	
A8. Special Training/Certifications			
a. Identifies any project personnel specialized training or certifications	Yes	27	
b. Discusses how this training will be provided	Yes	27	
c. Indicates personnel responsible for assuring training/certifications are satisfied	Yes	27	
d. identifies where this information is documented	Yes	27	

A9. Documentation and Records			
a. Identifies report format and summarizes all data report package information	Yes	27	
b. Lists all other project documents, records, and electronic files that will be produced	Yes	27-29	
c. Identifies where project information should be kept and for how long	Yes	29	
d. Discusses back up plans for records stored electronically	Yes	28	
e. States how individuals identified in A3 will receive the most current copy of the approved QA Project Plan, identifying the individual responsible for this	Yes	29	
B. Data Generation/Acquisition			
B1. Sampling Process Design (Experimental Design)			
a. Describes and justifies design strategy, indicating size of the area, volume, or time period to be represented by a sample	Yes	29-31	
b. Details the type and total number of sample types/matrix or test runs/trials expected and needed	Yes	29-31	
c. Indicates where samples should be taken, how sites will be identified/located	Yes	29-31	
d. Discusses what to do if sampling sites become inaccessible	Yes	29-31	
e. Identifies project activity schedules such as each sampling event, times samples should be sent to the laboratory, etc.	Yes	14	
f. Specifies what information is critical and what is for informational purposes only	Yes	31	
g. Identifies sources of variability and how this variability should be reconciled with project information	Yes	31	
B2. Sampling Methods			
a. Identifies all sampling SOPs by number, date, and regulatory citation, indicating sampling options or modifications to be taken	Yes	31-34	
b. Indicates how each sample/matrix type should be collected	Yes	31-34	

c. If in situ monitoring, indicates how instruments should be deployed and operated to avoid contamination and ensure maintenance of proper data	Yes	31-34	
d. If continuous monitoring, indicates averaging time and how instruments should store and maintain raw data, or data averages	NA	NA	
e. Indicates how samples are to be homogenized, composited, split, or filtered, if needed	Yes	33	
f. Indicates what sample containers and sample volumes should be used	Yes	31 and Table A.6-1	
g. Identifies whether samples should be preserved and indicates methods that should be followed	Yes	31-33 and Table A6-1	
h. Indicates whether sampling equipment and samplers should be cleaned and/or decontaminated, identifying how this should be done and by-products disposed of	Yes	33-34	
i. Identifies any equipment and support facilities needed	Yes	32	
j. Addresses actions to be taken when problems occur, identifying individual(s) responsible for corrective action and how this should be documented	Yes	34	
B.3 Sample Handling and Custody			
a. States maximum holding times allowed from sample collection to extraction and/or analysis for each sample type and, for in-situ or continuous monitoring, the maximum time before retrieval of information	Yes	34 and Table A6-1	
b. Identifies how samples or information should be physically handled, transported, and then received and held in the laboratory or office (including temperature upon receipt)	Yes	35-37	
c. Indicates how sample or information handling and custody information should be documented, such as in field notebooks and forms, identifying individual responsible	Yes	35-37	
d. Discusses system for identifying samples, for example, numbering system, sample tags and labels, and attaches forms to the plan	Yes	34-35	
e. Identifies chain-of-custody procedures and includes form to track custody	Yes	35-36 and Attachment 1	

B.4 Analytical Methods			
a. Identifies all analytical SOPs (field, laboratory and/or office) that should be followed by number, date, and regulatory citation, indicating options or modifications to be taken, such as sub-sampling and extraction procedures	Yes	37-39 and Table B4-1	
b. Identifies equipment or instrumentation needed	Yes	37-41	
c. Specifies any specific method performance criteria	Yes	40	
d. Identifies procedures to follow when failures occur, identifying individual responsible for corrective action and appropriate documentation	Yes	39 and Table B4-1	
e. Identifies sample disposal procedures	Yes	38	
f. Specifies laboratory turnaround times needed	Yes	39	
g. Provides method validation information and SOPs for nonstandard methods	NA	NA	
B.5 Quality Control			
a. For each type of sampling, analysis, or measurement technique, identifies QC activities which should be used, for example, blanks, spikes, duplicates, etc., and at what frequency	Yes	30-31	
b. Details what should be done when control limits are exceeded, and how effectiveness of control actions will be determined and documented	Yes	30	
c. Identifies procedures and formulas for calculating applicable QC statistics, for example, for precision, bias, outliers and missing data	Yes	37-38	
B.6 Instrument/Equipment Testing, Inspection, and Maintenance			
a. Identifies field and laboratory equipment needing periodic maintenance, and the schedule for this	Yes	39	
b. Identifies testing criteria	Yes	39	
c. Notes availability and location of spare parts	Yes	39	
d. Indicates procedures in place for inspecting equipment before usage	Yes	33	
e. Identifies individual(s) responsible for testing, inspection and maintenance	Yes	38-39	
f. Indicates how deficiencies found should be resolved, re-inspections performed, and effectiveness of corrective action determined and documented	Yes	39	

B.7 Instrument/Equipment Calibration and Frequency			
a. Identifies equipment, tools, and instruments that should be calibrated and the frequency for this calibration	Yes	39-40	
b. Describes how calibrations should be performed and documented, indicating test criteria and standards or certified equipment	Yes	39-40	
c. Identifies how deficiencies should be resolved and documented	Yes	39-40	
B.8 Inspection/Acceptance for Supplies and Consumables			
a. Identifies critical supplies and consumables for field and laboratory, noting supply source, acceptance criteria, and procedures for tracking, storing and retrieving these materials	Yes	40-41	
b. Identifies the individual(s) responsible for this	Yes	40-41	
B.9 Use of Existing Data (Non-direct Measurements)			
a. Identifies data sources, for example, computer databases or literature files, or models that should be accessed and used	Yes	41	
b. Describes the intended use of this information and the rationale for their selection, i.e., its relevance to project	NA	NA	Existing data are not being used for this project.
c. Indicates the acceptance criteria for these data sources and/or models	NA	NA	
d. Identifies key resources/support facilities needed	NA	NA	
e. Describes how limits to validity and operating conditions should be determined, for example, internal checks of the program and Beta testing	NA	NA	
B.10 Data Management			
a. Describes data management scheme from field to final use and storage	Yes	41-43	
b. Discusses standard record-keeping and tracking practices, and the document control system or cites other written documentation such as SOPs	Yes	41-43	
c. Identifies data handling equipment/procedures that should be used to process, compile, analyze, and transmit data reliably and accurately	Yes	41-43	
d. Identifies individual(s) responsible for this	Yes	41-43	
e. Describes the process for data archival and retrieval	Yes	41-43	

f. Describes procedures to demonstrate acceptability of hardware and software configurations	Yes	41-43	
g. Attaches checklists and forms that should be used	No	NA	
C. Assessment and Oversight			
C1. Assessments and Response Actions			
a. Lists the number, frequency, and type of assessment activities that should be conducted, with the approximate dates	Yes	43-44	
b. Identifies individual(s) responsible for conducting assessments, indicating their authority to issue stop work orders, and any other possible participants in the assessment process	Yes	43-44	
c. Describes how and to whom assessment information should be reported	Yes	43-44	
d. Identifies how corrective actions should be addressed and by whom, and how they should be verified and documented	Yes	43-44	
C2. Reports to Management			
a. Identifies what project QA status reports are needed and how frequently	Yes	44	
b. Identifies who should write these reports and who should receive this information	Yes	44	
D. Data Validation and Usability			
D1. Data Review, Verification, and Validation			
Describes criteria that should be used for accepting, rejecting, or qualifying project data	Yes	45	
D2. Verification and Validation Methods			
a. Describes process for data verification and validation, providing SOPs and indicating what data validation software should be used, if any	Yes	45-47	
b. Identifies who is responsible for verifying and validating different components of the project data/information, for example, chain-of-custody forms, receipt logs, calibration information, etc.	Yes	45-47	
c. Identifies issue resolution process, and method and individual responsible for conveying these results to data users	Yes	45-47	

d. Attaches checklists, forms, and calculations	Yes	Table B4-2	
D3. Reconciliation with User Requirements			
a. Describes procedures to evaluate the uncertainty of the validated data	Yes	47	
b. Describes how limitations on data use should be reported to the data users	Yes	47	

Appendix A

Perigo Mine – Gamble Gulch
2020 Site Inspection Addendum
Sampling and Analysis Plan/Quality Assurance Project Plan

Standard Operating Procedures (SOPs)
(Available on Request)