PORTAGE

PLN-5065
Rev. 0

Field Sampling Plan for Empire Mine Preliminary Assessment/Site Inspection

Applicability: Empire Mine	Effective Date: 9/3/14	Owner: Project Manager; John Beller
For most recent revision or additional information: https://www.portageinc.com/PNet/PDS		Signature:

History of Revisions

Revision	Issue Date	Action	Description
0	9/3/14	New Document	Initial Issue.

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ACRONYMS

AA	alternative action
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AEGM	Alaska Empire Gold Mining Company, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
CSM	conceptual site model
DQA	data quality assessment
DQO	data quality objective
DRO	diesel range organic
DS	decision statement
EPA	U.S. Environmental Protection Agency
ESH&Q	environment, safety, health, and quality
FSP	field sampling plan
GRO	gasoline range organic
HCL	hydrochloric acid
HDPE	high-density polyethylene
MDL	method detection limit
PAH	polynuclear aromatic hydrocarbon
PA/SI	preliminary assessment/site inspection
PCB	polychlorinated biphenyl
PL	project lead
PSQ	principal study question
PVC	polyvinyl chloride

QA	quality assurance
QAO	quality assurance objective
QAP	quality assurance plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RRO	residual range organic
SC	sample custodian
SOP	standard operating procedure
SOW	statement of work
SPLP	synthetic precipitation leaching procedure
STL	sampling team leader
SVOC	semivolatile organic compound
TAL	target analyte list
TLC	Teflon®-lined screw caps
TLS	Teflon®-lined septa sonically bonded to screw caps
TRPH	total recoverable petroleum hydrocarbons
USFS	United States Forest Service
VOA	volatile organic analysis
VOC	volatile organic compound

1. INTRODUCTION

This field sampling plan (FSP) describes the sampling, analysis, quality assurance (QA), and quality control (QC) procedures to be used during collection of investigation samples collected in 2014 at the Empire Mine located on Admiralty Island, Alaska.

This FSP includes the elements of both a QA project plan and an FSP in accordance with U.S. Environmental Protection Agency (EPA) guidance (EPA 2001, 2002). The elements of a QA project plan present the activities, organization, and QA/QC protocols to achieve specific data quality objectives (DQOs), while the elements of an FSP describe the sampling, analysis, and QC procedures to be used for the investigation sampling.

This FSP will ensure compliance with the QA/QC requirements of the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program (Title 18 Alaska Administrative Code [AAC], Section 75). This FSP also is based on the requirements stated in the EPA *Guidance for Quality Assurance Project Plans* (EPA 2002a) and ADEC *Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites* (ADEC 2009) and will serve as the governing document for all activities conducted in support of investigation sampling at the Empire Mine sites. This FSP may be augmented with site-specific plans and/or procedures to address site-specific hazards and hazard control; identify additional personnel and authorities; or to include established procedures and protocols at the Site for sample collection, storage, and transport, provided that such site-specific plans and/or procedures are consistent with this FSP.

1.1 Project Objectives

The purpose of this sampling is to perform an investigation and prepare a preliminary assessment/site inspection (PA/SI) report. The intent of the PA/SI is to determine the need or sense of priority for the USDA Forest Service (USFS) to conduct additional site investigation or an engineering evaluation/cost analysis (EE/CA) to reduce the threat or potential threat from a release of hazardous substances at the Site. The Site is being managed by the USFS under the authorities of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq). Sites that are contaminated with petroleum products also are managed under ADEC's Contaminated Sites Program.

1.2 Project Time Table

The sampling activities identified in this FSP will be carried out in accordance with the schedule provided in Table 1.

Table 1. Schedule for completion of sampling activities.

Activity	Start Date	End Date
Field sampling	9/15/2014	9/21/2014
Sample analysis	9/18/2014	10/27/2014
Data validation	10/28/2014	11/17/2014
Report preparation	11/18/2014	1/12/2015
USFS review	1/13/2015	2/16/2015
Incorporate comments	2/17/2015	2/27/2015
ADEC review	2/28/2015	3/30/2015
Incorporate comments and finalize report	3/31/2015	4/16/2015

1.3 List of Qualified Persons Working Onsite

The sampling team will be led by individuals considered qualified persons in accordance with 18 AAC 75.990 (100). John Beller will service as the project lead (PL). Mike Towler will serve as the sampling team lead (STL) with sampling support from Jim Jackson. Their resumes are attached in Appendix A.

2. SITE DESCRIPTION AND BACKGROUND

The Site is relatively remote and fairly rugged and is located approximately 15 mi west-southwest of Juneau, Alaska, on the north and west sides of Hawk Inlet on Admiralty Island (Section 3, Township 43S, Range 65E of the Copper River Meridian). There is no road to the Site and it must be accessed by boat and/or air, and hiking. The USFS manages lands within/around the Site above mean high tide. The Site encompasses an area with an elevation differential of approximately 1,000 ft.

The Empire Mine was first located by Charles Williams in 1891 as part of a block of 96 claims. Mr. Williams actively prospected the property until 1926. From 1923 to 1929 the claims were owned by Hawk Inlet Mining Company. Available documentation did not indicate the reason for the overlap (E&E 1995). In 1931, Mr. W. S. Pekovich took controlling interest in the property and incorporated it as the Alaska Empire Gold Mining Company, Inc. (AEGM) (as cited in E&E 1995). A small on-site mill (40 tons per day) was operated by AEGM until 1942. Approximately 6,350 troy ounces of gold were produced during this time (as cited in E&E 1995). Only small scale exploration and assessment work has occurred on the Site since 1942.

Empire Mine was a former gold mine and is located several miles north of currently permitted and operational Greens Creek Mine located within Admiralty Island National Monument. Greens Creek Mine, operated by Hecla Mining Company (Hecla), is one of the largest silver mines in the world. Sediment samples collected in Hawk Inlet by Hecla for their marine monitoring program, required per their

National Pollutant Discharge Elimination System permit (AK-004320-6), suggests that marine sediment at the head of the inlet contains naturally elevated concentrations of metals (Hecla Greens Creek 2013). Hecla abandoned their reference monitoring site (Site #S-3) near the head of Hawk Inlet in 2005 due to contamination concerns from natural metals loading nearby, as their samples consistently showed greater concentrations of metals observed elsewhere in the inlet, and the source apparently could not be linked to the mine's marine discharge.

The Empire Mine consists of two sites. This includes the mine site (upper) where the mine and mill were located. The second site (lower) is located on Hawk Inlet near the beach. Processed concentrates were transported from the mine to this location where they were loaded on a boat for transport. The upper site is located at 2473447.815 US ft E, 2321191.988 US ft N. The lower site is located at 2472710.299 US ft E, 2315470.240 US ft N. Figure 1 shows the location of the Empire Mine. Figures 2 and 3 provide aerial photographs of the area in 1979 and 2006, respectively.

2.1 Interviews with Previous Land Owners, Responsible Parties, or Others

2.2 Previous Investigations

The Empire Mine was investigated by the USFS in June 1994 (as cited in E&E 1995). As part of the USFS investigation, mining related structures and debris and potential waste and waste containers (drums) were inspected and photographed. As a result of the investigation, the USFS instructed the claimant, Mr. Pekovich, to remove domestic waste from the rubbish pit at the lower mine sites and to remove abandoned containers with contents (e.g., 55-gal drums) located around the Site. The USFS also recommended to Mr. Pekovich that a plan be prepared to cleanup petroleum-contaminated soil from two leaking 55-gal drums at the lower mine site. In August of 1994, Mr. Pekovich removed the 55-gal drums with content and the domestic waste noted by the USFS in the small pit at the lower mine site and then partially backfilled the pit with beach sand (as cited in E&E 1995).

The USFS contracted Ecology and Environment, Inc., in 1994 (E&E 1995) to perform an initial site investigation. The results indicated elevated levels of CERCLA hazardous substances including lead, arsenic, barium, and mercury (E&E 1995). However, the report concluded that no reportable quantity releases of hazardous substances were observed at the Site and that the Site should be considered a low priority for further evaluation under CERCLA.

2.3 Location of Site Structures/Utilities/Potable Water Sources

Figures 4 and 5 show the existing structures at the upper mine area and the lower area, respectively. There are no existing utilities or wells within the area. There are two floating recreation cabins anchored within a ¼ mile of the lower area. One of the recreation cabins appears to collect water from a small creek to the west of the bunk house. The majority of the structures are either collapsed or in disrepair. The bunk house at lower area appears to be used occasionally, possibly by the claimant or hunters. The Mill House appears to be structurally sound but does not presently appear to be used.

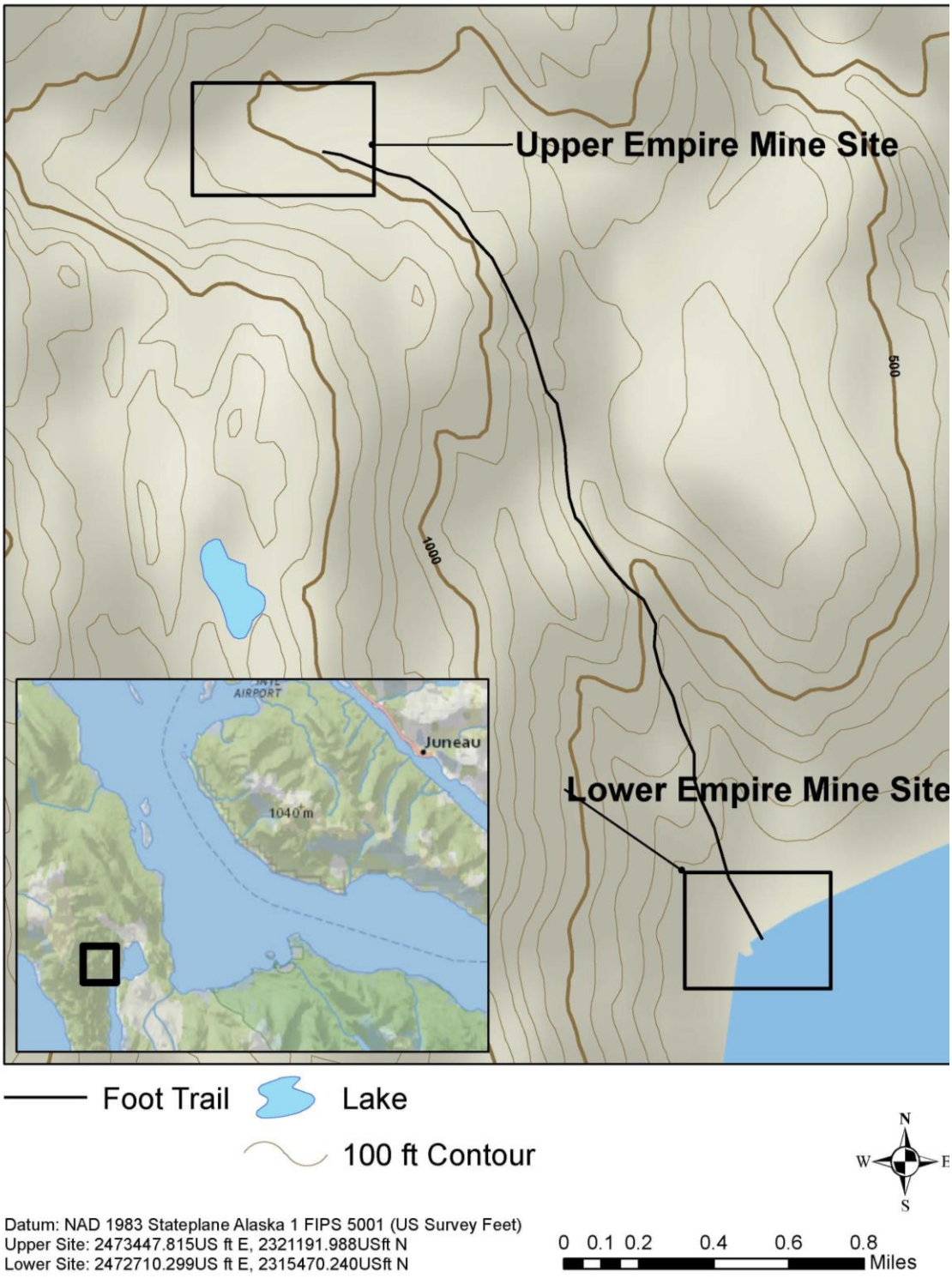

Figure 1. Empire Mine site map.

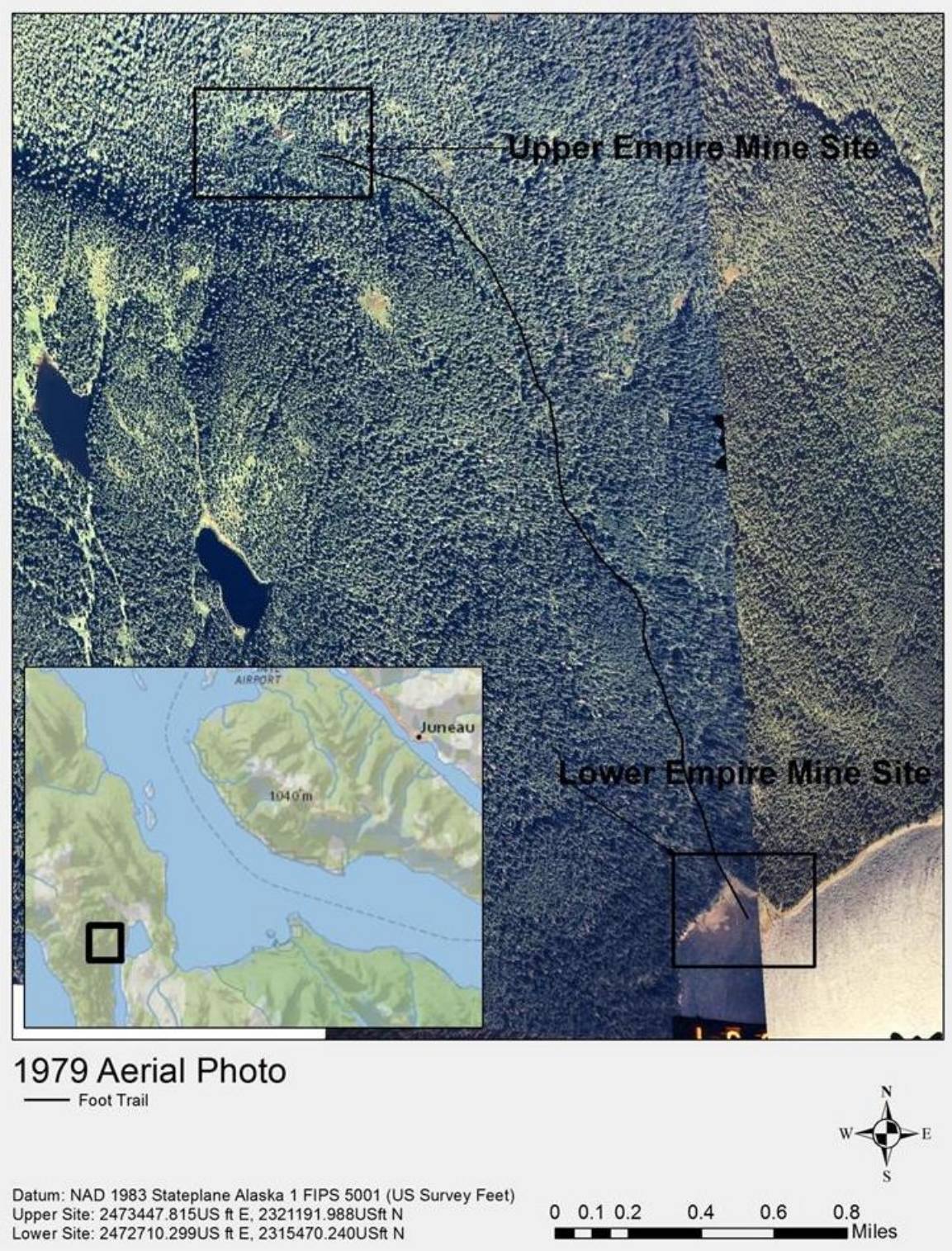

Figure 2. Empire Mine aerial photograph, taken in 1979.

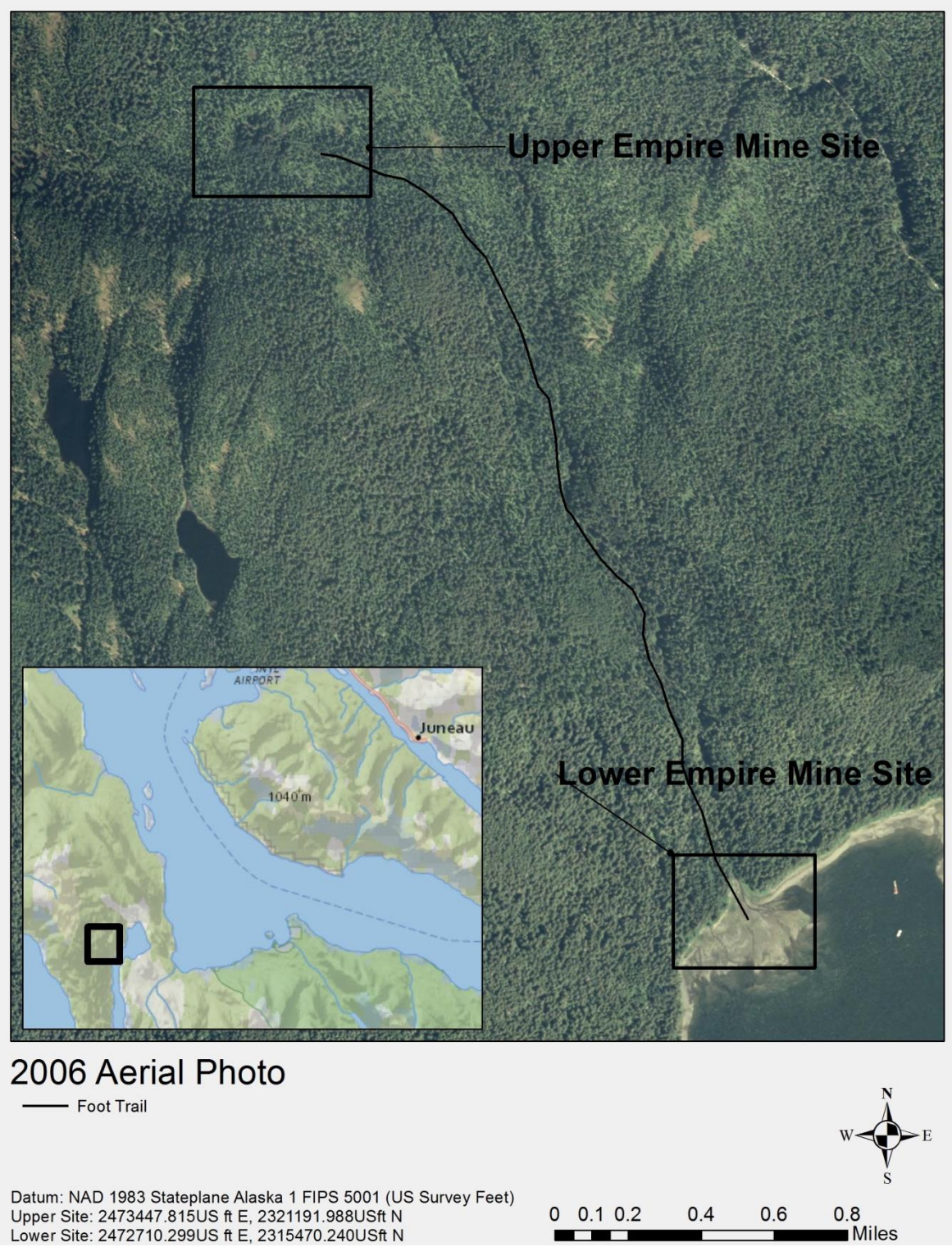

Figure 3. Empire Mine aerial photograph, taken in 2006.

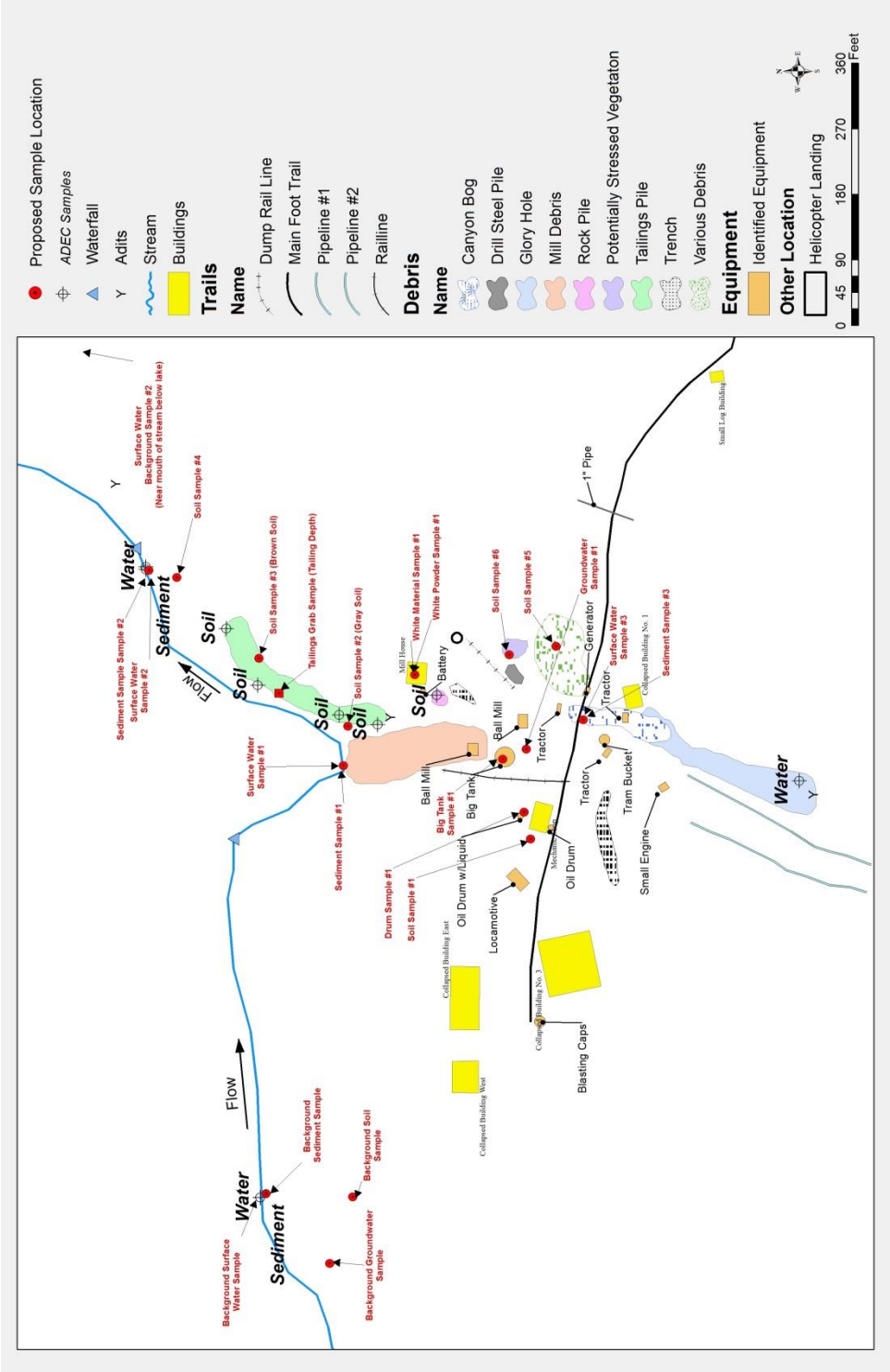

Figure 4.Empire Mine upper area.

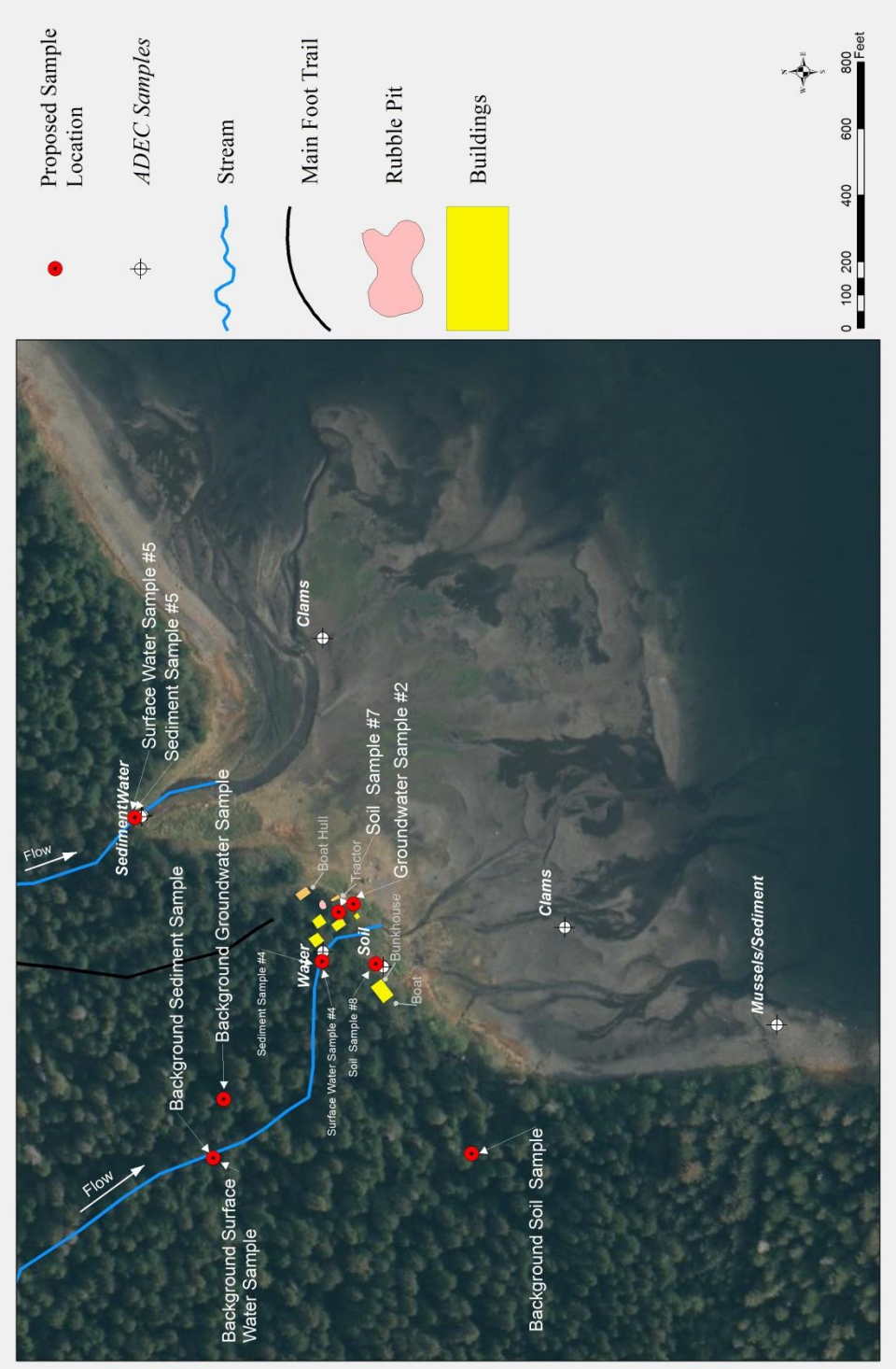

Figure 5. Empire Mine lower area.

2.4 Evidence of Leaks or Stained Soils

An area has been noted near the upper mine site with stained soil that appears to be petroleum contamination. A sample was collected at this location during the 1995 sample event. The sample was analyzed for total recoverable petroleum hydrocarbons (TRPH) and semi-volatile organic compounds (SVOCs). The results show TRPH of 310,000 ppm and several polycyclic aromatic hydrocarbons (PAHs). No other obvious stains or leaks have been identified.

2.5 Known Contaminant Sources

Based on the results of the Ecology and Environment 1994 investigation (E&E 1995), several areas are suspected of being contaminant sources. This includes the oil-stained soil (suspected source for TRPH) and the tailings pile (suspected source for metals) at the upper site. There were also batteries (one each) at the upper and lower sites around which the soil showed elevated levels of lead.

3. PROJECT ORGANIZATION AND RESPONSIBILITIES

To ensure that project objectives, data gathering and reporting, and data evaluation and interpretation meet applicable requirements, the investigation must have a clearly defined project organization. The following sections outline the specific duties of key project positions throughout the investigation effort. Project personnel and job assignments will be assigned prior to sample collection.

3.1 Project Lead

The PL will ensure that activities conducted comply with EPA guidance and ADEC requirements. The PL coordinates project document preparation and field, laboratory, data evaluation, and investigation activities. The PL is responsible for the overall work scope, schedule, and budget associated with these sampling activities.

The PL is responsible for field activities, field personnel, and other personnel assigned to support investigation sampling activities. The PL will serve as the interface between operations and project personnel and will work closely with the sampling team to accomplish the objectives of the project in a safe and efficient manner. The PL will work with other identified project personnel to accomplish day-to-day investigation activities and identify and obtain additional resources if necessary.

The PL, or designee, will conduct daily pre-job briefings. The PL, or designee, is responsible for ensuring that all preparatory activities (e.g., analytical laboratory contract in place, sampling equipment available, and sampling personnel identified) are performed prior to sampling of the investigation area. The PL, or designee, is also responsible for ensuring that any additional information not specifically addressed in this FSP is addressed/resolved with sampling personnel prior to commencement of sampling activities.

3.2 Sampling and Data Quality Assessment Personnel

Sampling personnel report directly to the PL and are responsible for the collection of samples in accordance with the requirements of this FSP. Data quality assessment (DQA) personnel report directly to

the PL. The DQA personnel evaluate and assess the data in accordance with EPA guidelines to demonstrate that the investigation data quality objectives have been met. Sampling, field, and DQA activities include:

- Identification and reporting of sampling activities (sampling personnel)
- Oversight of laboratory analysis and data reporting activities (DQA personnel)
- Oversight and reporting of data validation (DQA personnel)
- Oversight and reporting of DQA (DQA personnel who are familiar with the project-specific DQOs)
- Identification and reporting of any deviations from project requirements (sampling personnel, field personnel, and DQA personnel)
- Identification and implementation of any necessary corrective actions (sampling personnel, field personnel, and DQA personnel in consultation with the PL and other project personnel).

3.3 Job Site Supervisor

The job site supervisor is responsible for interfacing with the PL to coordinate required tasks.

3.4 Sampling Team Leader

The STL is responsible for the safe and successful completion of investigation sampling of the sites at the Empire Mine where questions remain. The STL works with the job site supervisor and the sampling team to manage field sampling-related operations and to execute the FSP. The STL enforces site control, documents activities, and may conduct daily safety briefings at the start of the work shift. Any team member may bring health and safety issues to the attention of the STL.

If the STL leaves the Site, an alternate will be appointed. The identity of the acting STL will be conveyed to site personnel and communicated to the facility representative, as appropriate.

3.5 ESH&Q Oversight

The environment, safety, health, and quality (ESH&Q) oversight personnel provide environmental, QA, industrial safety, and industrial health support to the project. Project environmental support personnel assist the PL in complying with applicable laws and regulations and this FSP. Quality personnel monitor quality-significant activities (e.g., laboratory contracts) and identify and report deviations from the project quality assurance objectives (QAOs). By participating in site characterization, ESH&Q oversight personnel assess and recommend hazard controls for the protection of site personnel, and they operate and maintain monitoring equipment. The ESH&Q oversight personnel also recommend and assess the use of personal protective equipment in relevant work control documentation.

3.6 Sampling Team Members

The sampling team will consist of individuals who are trained and skilled in the standard sampling procedures for soils, sediment, seep liquids, and surface water collected during investigation activities. The team will be responsible for collecting samples that meet the requirements defined in this FSP.

Sampling team members will have experience sampling media similar to those that will be collected during the investigation activities. A pre-job briefing will be conducted to address the job scope and hazards specific to the area being sampled. Each member of the sampling team will have up-to-date training regarding site hazards.

3.7 Document Control

Document control consists of the clear identification of all project-specific documents in an orderly form, secure storage of all project information, and controlled distribution of all project information. Document control ensures controlled documents of all types related to the project will receive appropriate levels of review, comment, and revision, as necessary.

The PL is responsible for properly maintaining the records relating to analysis, validation report, and the chain of custody. Copies of all analytical data and/or final reports will also be retained in the laboratory files and, at the discretion of the laboratory manager or QA officer, will be stored on computer disk and in hard-copy form for a minimum of 5 years from point of generation. Data will be made available for retrieval by authorized project staff from the project, and the laboratory archives will be available upon request.

4. PRELIMINARY CONCEPTUAL SITE MODEL

Figures 6 and 7 provide pictorial representations of the preliminary conceptual site models (CSMs). These depictions identify the environmental system; and the biological, physical, and chemical processes that determine the transport of contaminants from potential release sites through environmental media to environmental receptors. An ecoscoping form will be prepared in accordance with the *Ecoscoping Guidance, A Tool for Developing an Ecological Conceptual Site Model* (ADEC 2014).

The investigation will identify any potential sources of contamination at the upper and lower Empire Mine sites. The primary release mechanisms at the Site include leaks, spills, and leaching. Most primary sources of contamination may have been originally located at the ground surface. After release to surface soils, constituents may partition onto soil particles or exist in the pore space between soil particles. Surface water (such as rainwater) may percolate through contaminated soil and dissolve the contaminants, creating leachate that may be released to groundwater, or, as surface water seeps, it may collect in drainages and major water bodies and impact sediments. Secondary releases may include fugitive dust generation, infiltration and percolation into soil, and overland flow. Any contamination historically released to surface soils could have then been transported to other surface soils by erosion or runoff (overland flow).

Surface water and sediments could have been impacted by direct disposal of materials or overland flow from adjacent areas. Additionally, contaminated groundwater may migrate from the source areas and

be released into nearby freshwater or marine water surface water bodies and sediments if groundwater is in hydraulic communication.

Airborne dispersion of some contaminants through volatilization is a secondary release mechanism.

Potential receptors include future residents, visitors, workers, and biota. Visitors to the area include hunters, fisherman, and—to some extent—hikers. Bio-uptake may occur by terrestrial and aquatic ecological receptors. Higher trophic level species may then be exposed during foraging or other activities. These species may include humans involved in subsistence activities.

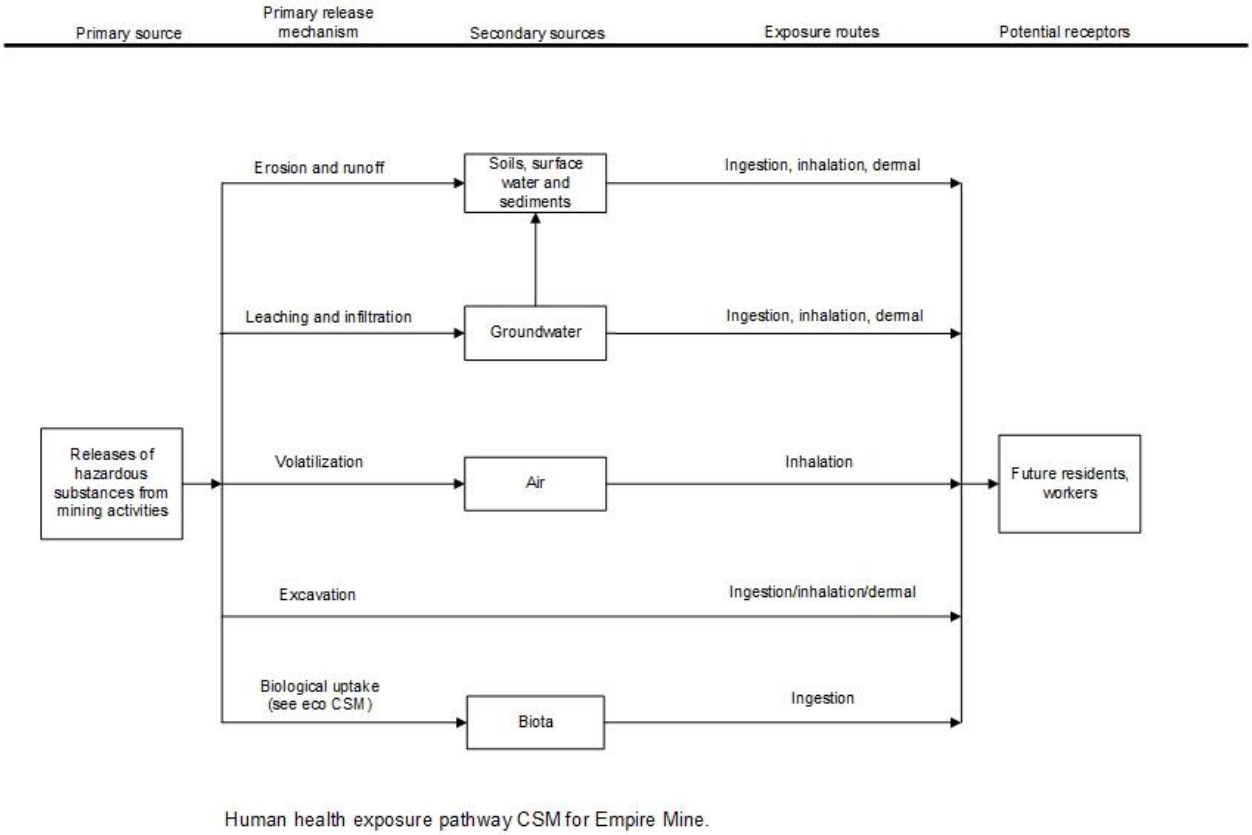

Figure 6. Preliminary human health conceptual site model for the Empire Mine Site.

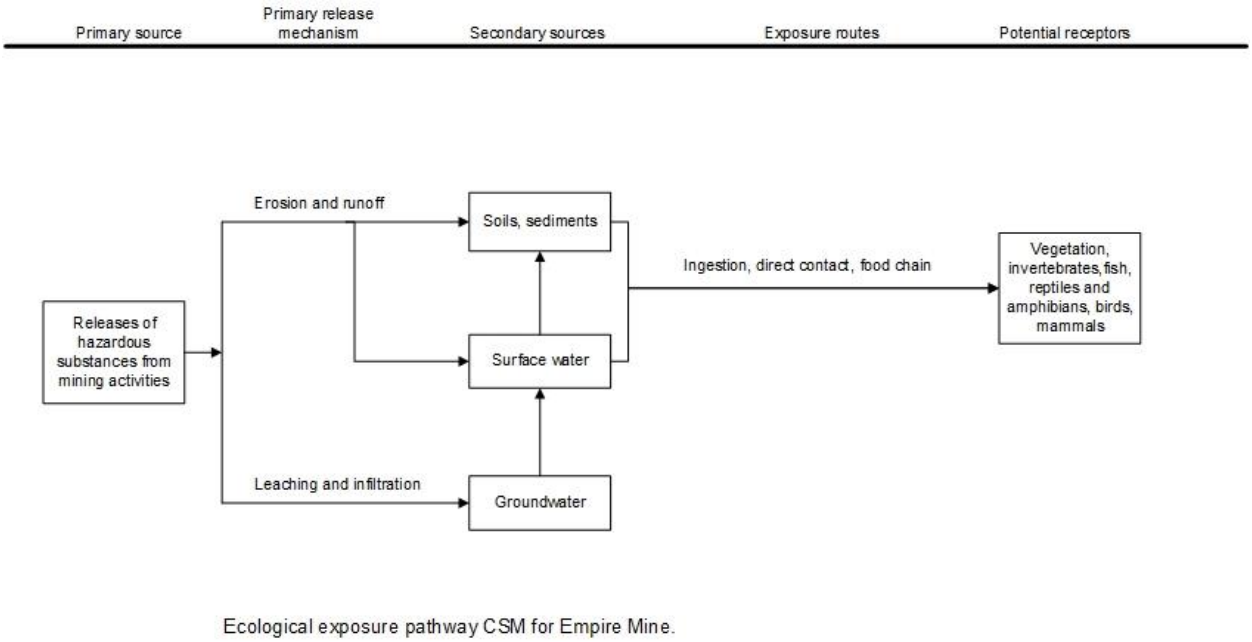

Figure 7. Preliminary ecological exposure pathway conceptual site model for the Empire Mine Site.

5. DATA QUALITY OBJECTIVES

The DQOs are qualitative and quantitative statements derived from the steps of the DQO process that:

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

The criteria for measurement data are expressed as QAOs. The measurement QAOs are specifications that data must meet to comply with the project needs specified by the DQOs. The specific QA parameters of interest are defined as quantitative QA parameters (e.g., precision, accuracy, method detection limit [MDL], and completeness) and qualitative QA parameters (e.g., representativeness and comparability).

5.1 Step 1: Problem Statement

The first step in the DQO process is to clearly state the problem to be addressed. The intent of this step is to clearly define the problem so that the focus of the sampling and analysis will be unambiguous. The appropriate outputs for this step are a concise description of the problem, a list of the planning team members, identification of the decision-maker(s), a summary of available resources, and relevant deadlines for the study. The roles of key project personnel are described in Section 3 of this FSP.

The problem statement is as follows: Data is required to determine if the hazardous substances at the Empire Mine Sites pose a threat or potential threat to human health and the environment, and if so, whether the threat requires further investigation.

5.2 Step 2: Decision Statement

This step in the DQO process is used to identify the decisions and the potential actions that will be affected by the data collected. Crafting a decision statement is performed by specifying a principal study question (PSQ), alternative actions (AAs) that could result from resolution of the PSQ, and combining the PSQ and AAs into a decision statement (DS).

Analytical data samples collected from each of the sampled areas at the Empire Mines site will be used to answer the following PSQ:

PSQ: Are contaminants of concern (COCs) present at concentrations in the sampled media such that they exceed the associated media-specific screening levels?

The AAs to be taken depending on the resolution to PSQ are as follows:

AA1: If concentrations of COCs in the sampled media exceed the media-specific screening levels, then further investigation of the Site may be required.

AA2: If concentrations of COCs in the sampled media do not exceed the media-specific screening levels, then no further investigation will be required.

Combining the PSQ and the AAs results in the following DS:

DS: Determine if concentrations of COCs in the sampled media do not exceed the media-specific screening levels or if further evaluation of the Site may be required.

5.3 Step 3: Decision Inputs

The purpose of this step is to identify informational inputs that are required to resolve the DS and to determine which inputs require measurement.

The inputs needed to address the DS are the concentrations of COCs present in the sampled media for each area investigated. During this step of the DQO process, the basis for a screening level is established. The screening level is the threshold value that provides the criterion for choosing among

AAs. The screening levels for sampled media are presented below. If concentrations for all constituents meet or are less than the screening levels, no further evaluation of the Site will be necessary.

Soil–Maximum detected concentrations in soil will be compared to the background values and ADEC Method 2 cleanup levels for direct contact and outdoor inhalation and groundwater protection in a non-artic, "over 40-inch" rainfall zone climate, specifically Table B1 of 18 AAC 75.341(c) for chemicals other than petroleum hydrocarbons and Table B2 of 18 AAC 75.341(d) for petroleum hydrocarbons.

Groundwater–Maximum detected concentrations in groundwater will be compared to the ADEC cleanup levels listed in 18 AAC 75.345.

Surface Water–Maximum detected surface water concentrations will be compared to background and Alaska water quality criteria (18 AAC 70) and drinking water criteria (18 AAC 80).

Sediment–ADEC does not have published screening values to address human contact with sediment. As such, concentrations in sediment will be compared to the threshold effects level (TEL) and probable effects level (PEL) Sediment Quality Guidelines (SQGs), as published in NOAA's Screening Quick Reference Tables (SQuiRTs).

5.4 Step 4: Study Boundaries

This step in the DQO process defines the spatial and temporal boundaries of the study covered by the DS. The spatial boundaries define the physical extent of the study area and may be subdivided into-specific areas of interest. The temporal boundaries define the duration of the study or specific parts of the study. The appropriate outputs of this step are a detailed description of the spatial and temporal boundaries of the study and a discussion of any practical constraints that may interfere with the study. The spatial boundaries of the study are the boundaries of the sites being sampled as described in Section 7. The vertical extent of the investigation is 0–16 ft below ground surface or the ground/bedrock interface for groundwater.

Defining the temporal boundaries of the study involves specifying the timeframe in which the decision applies and determining when to collect data. The time period within which to collect data is scheduled between September and October of 2014. The temporal extent of the investigation is through the completion of the final report.

The conceptual design of the sample collection activities is not anticipated to create practical constraints on collection of inorganic samples. Data limitations are possible, however, for volatile organic analytes due to the sample collection system that will be employed. Any limitations to data quality/usability introduced by sample collection constraints (e.g., limitations based on the low bias) will be discussed in the final report.

5.5 Step 5: Decision Rule

The objective of this step is to define the parameter(s) of interest in the population being characterized and integrate previous DQO outputs into statements defining conditions that direct decision-

makers to choose among AAs. The decision rule, like the AA, typically takes the form of an "*If…then*" statement describing the action to take if one or more conditions are met.

Decision rules are specified in relation to a parameter that characterizes the population of interest. The parameter of interest is the concentration of each COC.

If the concentration of at least one constituent in the media sampled in an investigated area exceeds its screening level, *then* further evaluation of the Site may be necessary.

If the concentrations of all constituents in the media sampled of an investigated area do not exceed their screening levels, *then* no further evaluation of the Site will be required.

5.6 Step 6: Decision Error Limits

The purpose of this step is to minimize data uncertainty by specifying tolerable limits on decision errors that are used to establish performance goals for the data collection design. It is necessary to determine the possible range for the parameter of interest and to define both the types of decision errors and the potential consequences of the errors.

The two types of decision errors for the characterization of sample data are either (a) determining that the concentrations of all COCs for a sampled area are less than the corresponding screening levels when, in fact, at least one exceeds the screening level, or (b) determining that the concentration of at least one COC of a sampled area exceeds its screening level when, in fact, none of them do. The consequences of each decision error must be considered. Concluding that the concentrations of all COCs in the sampled media are below the screening levels when they are not would result in the assumption that the sites do not pose a threat or potential threat to human health and/or the environment when they may. The consequences of this conclusion are that additional investigation required to determine the risk associated with contaminants would not be performed.

Concluding that at least one COC concentration in the media sampled is above the screening level when it is not would result in additional investigation. The consequences of this conclusion would be the further expense of project resources to complete unnecessary activities and stakeholder perception issues as the project schedule may be unnecessarily lengthened.

The decision error that has the more severe consequences as the concentrations approach the screening level must be specified, as it is the basis for establishing the null hypothesis. The decision error that has the more severe consequences as the true concentration approaches the screening level is used because the data are much more likely to lead to an incorrect decision in this situation than when the parameters are far above or below the screening level.

In problems that concern regulatory compliance, human health, or environmental, the decision error that has the most adverse consequences will be favored as the null hypothesis. In statistical hypothesis testing, the data must conclusively demonstrate that the null hypothesis is false. Therefore, setting the null hypothesis to the condition that exists when the more adverse decision error occurs guards against making the more severe decision error by placing the burden of proof on demonstrating that the most adverse consequences are not likely to occur.

For the Empire Mine investigation, the more adverse decision error occurs when it is determined that hazardous substances at the Empire Mine Sites do not pose a threat to human health and the environment when, in fact they do. Therefore, the null hypothesis (H_0) will be set as:

"the concentration of at least one COC in the media sampled at an investigated area is greater than its screening level." The alternative hypothesis (H_a) then becomes: "the concentrations of all of the COCs in the media sampled at an investigated area are equal to or less than their respective screening levels."

Based on these null and alternative hypotheses, the false-positive and false-negative decision errors for the Empire Mine investigation can now be identified. The false-negative decision error corresponds to the more severe decision error. The false-negative decision error would be to conclude that the concentration of none of the COCs in the media sampled for an investigated area exceed the screening level, when, in fact, at least one does. The false-positive decision error would be to conclude that the concentrations of at least one of the COCs in the media sampled from an investigated area exceeds the screening level when, in fact, none do.

5.7 Step 7: Design Optimization

The purpose of design optimization in the DQO process is to identify the best sampling and analysis approach that satisfies all of the previous steps in the process. The activities involved in design optimization include:

- Reviewing the outputs of the first six steps and existing environmental data
- Developing general data collection design alternatives
- Selecting the most resource-effective data collection design that satisfies all of the DQOs.

Samples will be collected according to the sample locations identified in Section 6, Sampling Process Design. Additional samples may be collected from biased areas with the highest likelihood of contamination based on field observations.

5.8 Measurement Performance Criteria

The DQOs provide the basis for setting criteria for the performance of the measurements to be made in the field and analytical laboratory. These criteria are specified as data QAOs. Quantitative QAOs are developed by data users to specify the quality of data from field and laboratory data collection activities. The QAOs are established to ensure that all project DQOs are met and the resulting data support the decision-making activities that will ultimately occur at the Site.

The overall goal of the Empire Mine investigation QAOs is to ensure that acceptable data are gathered to support decisions regarding determination of whether the hazardous substances at the Empire Mine Sites pose a threat to human health and the environment and if they do pose a threat, acceptability of the proposed plan for each area. The following sections outline the specific parameters that will be used to evaluate the quality of data obtained during the investigation sampling of the Empire Mine.

5.8.1 Precision

Precision is a measure of agreement or reproducibility among individual measurements for the same property under the same conditions. Precision is expressed as relative percent difference (RPD), which is defined and shown in Equation (1), as the absolute value of the difference divided by the mean, expressed as a percentage.

$$RPD = \frac{\left| \left(MS - MSD \right) \right|}{\left(MS + MSD \right) / 2} \times 100 \quad (1)$$

where

RPD = relative percent difference

MS = measured concentration of parameter in matrix spike sample

MSD = measured concentration of parameter in matrix spike duplicate sample.

The analytical laboratory will report the precision of their measurements in the sample matrix based on the results obtained from the matrix spike and matrix spike duplicate analyses conducted for most inorganic analyses. For some inorganic measurements, precision will be calculated using duplicate measurements of the same sample. Replicate measurements are used for total metals after sample preparation, during instrumental analysis, and for mercury determinations post-digestion.

Acceptable laboratory precision will be determined by method-specific criteria outlined in SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (EPA 2012). The SW-846 functions primarily as a guidance document setting forth acceptable, although not required, methods for the regulated and regulatory communities to use in responding to Resource Conservation and Recovery Act (42 USC § 6901 et seq.) (RCRA)-related sampling and analysis requirements. During validation activities, precision of the environmental measurements will be assessed to determine if there are any impacts on data use due to the precision of the data.

5.8.2 Accuracy

Accuracy is the relative agreement or nonagreement between a measured value and an accepted reference value. Accuracy reflects the measurement error associated with a measurement and is determined by assessing actual measurements in the sample matrix during the analysis of matrix spike samples. Accuracy is assessed by means of determining analyte recovery from matrix spikes, samples, or laboratory reference samples, and is expressed as percent recovery (*%R*), defined as the measured value divided by the true value expressed as a percent, as shown in Equation (2).

$$\%R = \frac{\left| C_{ss} - C_{us} \right|}{C_{as}} \times 100 \quad (2)$$

where

$\%R$ = percent recovery

C_{ss} = measured analyte concentration in spiked sample

C_{us} = measured analyte concentration in nonspiked sample

C_{as} = calculated analyte concentration added to sample.

The analytical laboratory will report the accuracy of their measurements in the sample matrix based on the results of the matrix spike data. Acceptable laboratory accuracy will be determined by assessing the results against the method-specific criteria outlined in SW-846 (EPA 2012). During the DQA process, accuracy of the environmental measurements (in the form of bias that may be indicated by the measure discussed above) will be assessed to determine if there are any impacts of hypothesis testing due to the accuracy of the data.

5.8.3 Detection Limits

The laboratory will use guidance found in SW-846 (EPA 2012) or 40 Code of Federal Regulations (CFR) 136, Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit – Revision 1.11," to aid in determining MDLs and the requirements established in laboratory contracts. The MDLs are defined as the minimum concentration of a substance that can be reliably measured and reported by a particular analytical method. Matrix effects, sample size, or other analytical interferences may increase MDLs. The effects of these conditions on the laboratory's MDLs, if determined, will be documented.

Chemical methods for all total metals analyses typically use the standard deviation of replicate measurements of standards multiplied by a factor specified by the method or 40 CFR 136, Appendix B, to determine minimum MDLs. Estimated detection limits are provided in each of the appropriate analytical methods for chemical determinations. The laboratory will use standard chemical analysis practices to ensure that the MDLs approach those prescribed in the analytical laboratory statement of work (SOW). Any significant deviations will be identified in the reported data.

Laboratory analysts will follow the SW-846 (EPA 2012) methods as closely as possible to ensure that the data are compliant with project requirements. Any deviations will be noted in the laboratory case narrative. The MDLs and analytical methods will be selected to ensure that COC concentrations in the sampled media can be adequately quantified at the concentrations (screening levels) established in Section 3. Final MDLs and analytical methods will be defined in the laboratory contract(s).

5.8.4 Completeness

Completeness is the measure of the amount of valid analytical data obtained compared to the total number of data points planned. Valid analytical data are those generated when analytical systems and the resulting analytical data meet all of the quantitative measurement QAOs outlined for the project (i.e., all calibration verification, interference, and other checks not affected by the sample matrix meet acceptance criteria). It is important to understand that data that are flagged during the data validation process are not

necessarily invalid data. Part of the DQA process is the review of flagged data to determine whether the validation flags impact the intended use of the data. Therefore, the definition of "valid data" in the context of calculating completeness is: "data that are acceptable for their intended purpose." Completeness [*C(%)*] of the reported data (expressed as a percentage) is calculated as shown in Equation (3).

$$C(\%) = M_v / Mt \times 100 \quad (3)$$

where

$C(\%)$ = completeness

M_v = number of measurements determined to be valid per analyte

Mt = total number of measurements performed per analyte.

A completeness of 95% is a common goal. All data obtained from this project should meet the quality requirements and reporting protocols unless irregularities in the matrix (also known as matrix effects) impede contaminant recovery or a broken, spilled container results in a loss of sample materials. The completeness goal for the project is to obtain enough valid data to satisfy the DQOs. Project-specific data needs will be defined on an individual batch basis and will consist of data for which all QC criteria were met.

Rejection of data due to severe matrix interference is sometimes unavoidable. Project chemists will work with the project laboratories to minimize these problems, if possible, and will document any steps taken to alleviate the problem(s).

Rejection of data due to laboratory performance issues typically is unacceptable. Project laboratories are expected to pay careful attention to analytical procedures and method requirements, and to implement corrective actions to avoid rejection of results.

5.8.5 Comparability

Comparability is the degree to which one data set can be compared to another, obtained from the same population using similar techniques for data gathering. Comparability will be achieved through the use of consistent sampling procedures, experienced sampling personnel, the same analytical method for like parameters, standard field and laboratory documentation, and traceable laboratory standards.

5.8.6 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative term that should be evaluated to determine whether in situ and other measurements are made, and physical samples are collected, in such a manner that the resulting data appropriately reflect the population parameter of interest in the media and phenomenon measured or studied.

The sampling process design discussed in Section 6 of this FSP is the basis for obtaining data that will be representative of the investigation effort samples. A final determination of the representativeness for the initial data set will be made by the PL and other project personnel following the return of the chemical analysis data from the analytical laboratory and completion of DQA activities.

5.8.7 Data Quality

The data generated from the sampling effort for the investigation of areas in question at the Empire Mine will be used to evaluate parameters that are pertinent to the remediation process. Each parameter to be evaluated requires data of specific quality. To demonstrate compliance with the DQOs, the data obtained must be of high quality. Laboratory analytical procedures and laboratory data reporting will follow the QA/QC protocols described in SW-846 (EPA 2012) and the task-specific laboratory SOW prepared by the project for these analyses.

The laboratory staff and their experience will be relied upon, in conjunction with the PL, to make the best decisions for analyses where deviations may arise. The laboratory will flag nonconforming data and notify the project as appropriate and as required in the analytical laboratory SOW.

6. SAMPLING PROCESS DESIGN

The following sections outline the specific sampling process design for investigation sampling of the Empire Mine sites. A judgmental sampling design (EPA 2002b) is primarily being used and biased to target locations that are potential and/or known sources of COCs and locations and media potentially impacted by migration of COCs. All sampling-related activities will comply with EPA SW-846 protocols (EPA 2012) for inorganics. Additional work control documentation may be developed, but will be consistent with this FSP and the DQOs specified herein.

6.1 Pre-Sampling Meeting

A pre-job briefing will be conducted prior to sampling activities. The sampling team will meet to assess readiness for the sampling activity and will discuss each project member's responsibilities, health and safety concerns during the sampling events, and sampling objectives and procedures. Sampling team members will be experienced in collecting the type of samples required for this project. Sampling team members must be familiar with the specific objectives, sampling design, and sample collection requirements specified in this FSP.

6.2 Sample Collection

This section provides general information regarding the methods that will be employed for sampling of soil, sediment, surface water, and groundwater during the investigation. Sample locations are provided in Figures 1 and 2 and the types of analysis to be performed for each sample collected are presented in Table 2. A summary of analytical methods, sample containers, preservatives, and holding times for soil and sediment samples is provided in Table 3. Table 4 contains a summary of analytical methods, sample containers, preservatives, and holding times for water samples.

The following subsections provide project-specific instruction regarding sampling for analyses and investigation at the Empire Mine.

Table 2. Sampling locations and planned analysis.

Location/Description	Sample Type/Depth	Analyses/Estimated Number of Samples								
		RCRA Metals	PCBs	VOCs	SVOCs	DRO/ RRO	Pest.	Herb.	Cyanide	GRO
Upper Site										
4 × 14-ft tank	Liquid	1	1	1	1	1	1	1	1	1
55-gal drum	Liquid	1	1	1	1	1	1	1	1	1
Mill House white block material	Solid	1	–	–	–	–	1	1	1	–
Mill House white powder material	Solid	1	–	–	–	–	1	1	1	–
Mechanic's shop stained soil	Soil/Near surface	1	1	1	1	1	1	1	1	1
Potentially stressed vegetation location	Soil/Near surface	1	1	1	1	1	1	1	1	1
Debris location	Soil/Near surface	1	1	1	1	1	1	1	1	1
Tailings pile (composite)	Soil/Near surface	2	–	–	–	–	–	–	1	–
Trench downgradient from tailings pile	Soil/Near surface	1	–	–	–	–	–	–	1	–
Creek bed downgradient from tailings pile	Sediment	1	1	–	1	–	–	1	1	1
Creek downgradient from tailings pile	Water	1	1	–	1	1	1	1	1	1
Creek bed below mill debris	Sediment	1	1	–	1	1	1	1	1	1

Table 2. (continued.)

Location/Description	Sample Type/Depth	Analyses/Estimated Number of Samples								
		RCRA Metals	PCBs	VOCs	SVOCs	DRO/ RRO	Pest.	Herb.	Cyanide	GRO
pile										
Creek below mill debris pile	Water	1	1	–	1	1	1	1	1	1
Pond below glory hole	Water	1	–	–	1	1	–	–	1	1
Pond below glory hole	Sediment	1	–	–	1	1	–	–	1	1
Monitoring well above mill debris	Groundwater	1	1	1	1	1	1	1	1	1
West of collapsed building	Soil background	1	1	1	1	1	1	1	1	1
Monitoring well west of collapsed building	Groundwater background	1	1	1	1	1	1	1	1	1
West of collapsed building	Water background	1	1	1	1	1	1	1	1	1
West of collapsed building	Sediment background	1	1	–	1	1	1	1	1	1
Creek north tributary	Water background	1	–	–	–	–	–	–	1	–
Lower Area										
Outside of bunk house barn doors	Soil	1	1	1	1	1	1	1	1	1
Storage building	Soil	1	1	1	1	1	1	1	1	1
Empire creek above high tide	Water	1	1	–	1	1	1	1	1	1
Empire creek above high tide	Sediment	1	1	–	1	1	1	1	1	1

Table 2. (continued.)

Location/Description	Sample Type/Depth	Analyses/Estimated Number of Samples								
		RCRA Metals	PCBs	VOCs	SVOCs	DRO/ RRO	Pest.	Herb.	Cyanide	GRO
Lower area creek east of mill house	Water	1	1	–	1	1	1	1	1	1
Lower area creek east of bunk house	Sediment	1	1	–	1	1	1	1	1	1
Lower area creek upstream of lower area	Water background	1	1	–	1	1	1	1	1	1
Lower area creek upstream of lower area	Sediment background	1	1	–	1	1	1	1	1	1
Monitoring well below storage building	Groundwater	1	1	1	1	1	1	1	1	1
Monitoring well above buildings	Groundwater background	1	1	1	1	1	1	1	1	1

DRO = diesel range organics
GRO = gasoline range organic
Herb = herbicides
PCBs = polychlorinated biphenyl
Pest = pesticides
RCRA = Resource Conservation and Recovery Act
RRO = residual range organic
SPLP = synthetic precipitation leaching procedure
SVOC = semi-volatile organic compound
VOC = volatile organic compound

Table 3. Summary of analytical methods, sample containers, preservatives, and holding times for soil and sediment samples.

Parameter	Analytical Method[1]	Container Description (Minimum) [Clear glass may be substituted for amber if samples are protected from exposure to light]	Preservation/Holding Time
TAL Metals	6010C/7471B	100mL wide mouth HDPE or amber glass jar[2], TLC	None/6 months
Cyanide	SW 9012B	100mL wide mouth HDPE or amber glass jar[2], TLC	None/6 months
Polychlorinated biphenyls (PCBs)	8082A[3]	4 oz amber glass, TLC	4° ± 2°C /None, 40 days to analysis of extract (recommended)
Volatile organic compounds (VOCs)[4]	8260C or 8021B	4 oz amber glass, TLS	Methanol preservative, 4° ± 2°C/ 14 days
Diesel range organics (DRO)/ Residual Range Organics (RRO)	AK102/103*	4 oz amber glass, TLC	4° ± 2°C/14 days to extraction, 40 days to analysis of extract
Pesticides	8081B	4 oz amber glass, TLC	4° ± 2°C/14 days to extraction, 40 days to analysis of extract
Herbicides	8151A	4 oz amber glass, TLC	4° ± 2°C/14 days to extraction, 40 days to analysis of extract
SVOCs	8270D or 8310	4 oz amber glass, TLC	4° ± 2°C/14 days to extraction, 40 days to analysis of extract
Gasoline range organics (GRO)	AK101*	4 oz amber glass, TLS	Methanol preservative, 4° ± 2°C/ 28 days

Table 3. (continued.)

HDPE = high-density polyethylene.
TAL = target analyte list.
TLC = Teflon® -lined screw caps.
TLS = Teflon® -lined septa sonically bonded to screw caps.
Note: Several of the 7000 Series methods have been deleted from SW846 but these methods may still be approved by ADEC project managers. Check the laboratory's approval status.

1. Unless otherwise noted, all preparation and analytical methods refer to the most current of EPA's Test Methods for the Evaluating Solid Waste, Physical/Chemical Methods, SW-846, adopted by reference in 18 AAC 78.090(i).
2. HDPE or amber glass sample collection bottles, certified clean for trace metals analysis.
3. PCBs must be prepared using extraction method 3540C or 3550C.
4. May be analyzed out of AK101 methanol preserved sample, if not, then sample must be preserved with methanol in the field. Alternate volatile collection methods per SW-846 method 5035A must be approved on a site-specific basis by the ADEC Contaminated Sites Program prior to sample collection.

† Analytical method 6010C may be used for high contaminant level screening. These results can be used for closure only if laboratory reporting limits meet the site-specific cleanup levels. Analytical method 6020A is acceptable for closure.
* ADEC Analytical Methods AK101, AK102, and AK103 are included in Appendix D of the "Underground Storage Tanks Procedures Manual" (ADEC 2002).

Table 4. Summary of analytical methods, sample containers, preservatives, and holding times for water samples.

Parameter	Analytical Method[1]	Container Description	Preservation/Holding Time
TAL Metals	6010C/7471B	min. 100 mL HDPE[2]	HNO_3 to pH less than 2/6 months max. total holding time
Cyanide	SW 9012B	min. 100 mL HDPE[2]	50% sodium hydroxide until the pH is greater than or equal to 12. 14 days to extraction
Polychlorinated biphenyls (PCBs)[3]	8082A	1 L amber glass, TLC	4° ± 2°C/None, 40 days to analysis of extract (recommended)
Volatile organic compounds (VOCs)	8021B or 8260C	Duplicate or Triplicate 40 mL VOA, TLS	HCL to pH less than 2, 4° ± 2°C/14 days
Diesel range organics (DRO)/Residual Range Organics (RRO)	AK102*	min. 100 ml[4] - 1 L amber glass, TLC	HCL to pH less than 2, 4° ± 2°C /14 days to extraction
Pesticides	8081B	1 L amber glass, TLC	4° ± 2°C/7 days to extraction, 40 days to analysis of extract
Herbicides	8151A	1 L amber glass, TLC	4° ± 2°C/7 days to extraction, 40 days to analysis of extract
SVOCs	8270D or 8310	1 L amber glass, TLC	4° ± 2°C/7 days to extraction, 40 days to analysis of extract
Gasoline range organics (GRO)	AK101*	Duplicate or Triplicate 40 mL VOA, TLS	HCL to pH less than 2, 4° ± 2°C /14 days

Table 4. (continued.)

TAL = target analyte list.
HCL = hydrochloric acid.
HDPE = high-density polyethylene.
TLC = Teflon® -lined screw caps.
TLS = Teflon® -lined septa sonically bonded to screw caps.
VOA = volatile organic analysis.
Notes: Several of the 7000 Series methods have been deleted from SW846 but these methods can be approved by ADEC project managers. Check laboratories approval status.

1. Unless otherwise noted, all preparation and analytical methods refer to the most current of EPA's Test Methods for the Evaluating Solid Waste, Physical/Chemical Methods, SW-846, adopted by reference in 18 AAC 78.090(i).
2. HDPE sample collection bottles, certified clean for trace metals analysis.
3. PCBs should be prepared using method 3510C or 3520C.
4. Minimum (100 ml) is listed for the modified "small volume" method. This requires a separate lab approval and is designated AK102-SV or AK103-SV. Verify the laboratory approval status for this method.

† Analytical method 6010C may be used for high contaminant level screening. These results can be used for closure only if laboratory reporting limits meet the site-specific cleanup levels. Analytical method 6020A is acceptable for closure.
* ADEC Analytical Methods AK101, AK102, and AK103 are included in Appendix D of the "Underground Storage Tanks Procedures Manual" (ADEC 2002).

6.2.1 Soil Samples

6.2.1.1 Collection of Soil Samples for Volatile Organic Compound (VOC) Analysis.

Samples for VOC analysis will be collected in accordance with ADEC recommendations using the following steps:

- Collect a minimum of 25 grams of soil with minimum disturbance directly into tared 4-oz or larger jar with a Teflon®-lined septum fused to the lid. Interim storage/containers (e.g., re-sealable polyethylene bags) are not allowed.

- Immediately after collection, carefully add 25-mL aliquot of methanol (methanol must include a surrogate for Method AK101) until the sample is submerged. This step must be completed as quickly as possible, within approximately10 seconds of placing the soil in the sample jar. If an extended time period between soil collection and preservation is necessary due to site conditions or safety concerns, this must be specified in an approved work plan, recorded in the field notes, and documented in the final report.

- Do not place tape, including evidence tape, on the sample container directly.

- Cool and retain samples at 4ºC ± 2ºC.

- Collect a sample of the same material from the same location in an unpreserved jar for percent moisture determination.

6.2.1.2 Collection of Soil Samples for Other Analyses.

Samples for all other analyses will be placed using either a stainless steel spoon/trowel or a disposable scoop directly in laboratory-supplied clean containers with a moisture-tight lid. The sample containers will then be placed into a cooler with ice and cooled to 4ºC unless otherwise noted in Table 4. Lids will be sealed by labels or custody seals to prevent tampering.

Soils sampling collected on tailings area. Two composite samples will be collected from the tailings pile. To collect these, a grid 2-ft grid will be measured over the known area of the tailings pile. A random sampling approach will be employed for soils located in the grid area. Six systematic random sub-samples will be collected from each area (gray and brown soil areas). Each sub-sample will be placed in a stainless steel mixing bowl and thoroughly homogenized using a stainless steel trowel prior to collecting the sample.

6.2.2 Surface Water

Surface water samples may be collected from available standing water sources that may have potential run-off from a source area. With the exception of pre-preserved sample bottles and shallow standing water, surface water samples will be collected by submerging each sample container (with the open end upstream), allowing the container to fill slowly and continuously using the cap to regulate the speed of water entering the bottle. Care will be taken to minimize disturbance of the surface water body. For pre-preserved sample containers and shallow standing water, a decontaminated glass beaker will be submerged in water and used to transfer the sample into the sample bottle. When it is not possible to fill sample bottles by hand directly from the source, a peristaltic pump will be used to gather the sample; the water will then be pumped directly into the bottle.

The sample bottles for VOCs must be filled slowly to prevent the entrapment of air bubbles, splashing, or agitation of the water. Care will be taken to avoid touching the top of the sample bottle, the inside of the cap, or the Teflon septa. A septum that falls out of the cap onto the ground shall not be used. The bottle will be filled completely such that a meniscus forms. The cap will be screwed on and the bottle inverted, tapped firmly, and checked for the presence of air bubbles. Accurate analytical results for VOCs may be compromised if there is any free air trapped in the sample container. Sediment and surface water samples should be co-located and collected in order to minimize siltation by collecting the surface water sample first and then the sediment.

6.2.3 Sediment

Sediment sampling will be performed in creeks, seep areas, or other areas where standing water is normally present. Grab samples will be collected from the sediment surface to a depth of approximately 4 in. or from just above the contact with the underlying soil. If dry conditions exist at the time of the sampling, the procedures for surface soil sampling outlined above will be followed. Sediment and surface water samples should be co-located and collected in order to minimize siltation by collecting the surface water sample first and then the sediment.

6.2.4 Groundwater Samples

Groundwater samples from newly installed and developed monitoring wells will be taken during the field investigation. An AMS, Inc., groundwater sampling kit consisting of a manually driven stainless steel piezometer drive point with 1 ¼-in. diameter stainless steel extensions will be used. Groundwater grab samples will be collected using a low-flow peristaltic pump. If sufficient water is available, an effort will be made to purge the water from the boring until a relatively clear (non-turbid) sample can be obtained. Field measurements (i.e., pH, conductivity, and temperature) will be recorded at the time of sample collection. Groundwater monitoring well sampling procedures are described below, including sample container preparation, well purging, field measurements and equipment, and sample collection at each installed well. Where possible, sampling of the wells will require a field team consisting of at least two people. This will expedite the sample collection process and promote safety at the well site.

Groundwater samples collected from monitoring wells will be analyzed for organic and inorganic constituents as required for each sampling and analysis task. The groundwater sampling log will be used to record well purging and sampling measurements. The objective of the groundwater sampling protocol is to obtain samples that are representative of the aquifer in the well vicinity so the analytical results reflect the composition of the groundwater as accurately as possible. In order to achieve this objective, all factors that may affect the physical and chemical integrity of the sample must be controlled before, during, and after sample collection. The following subsections present the procedures for groundwater sampling.

6.2.4.1 Sample Container and Trip Blank Preparation.

Prior to leaving for the monitoring well sites, trip blank samples will be prepared as required. The purpose and preparation of trip blank samples are discussed in Section 6.10. When possible, sample containers will be prepared with preservative at this time.

6.2.4.2 Well Purging.

Well purging is an integral step in recovering samples that are representative of in situ groundwater chemistry. Each monitoring well will be purged immediately prior to sample collection. This ensures that the sample consists of fresh formation water rather than stagnant water that has been stored in the well casing. At least three well volumes shall be removed from the well before it is sampled. The well volume is defined as the volume of submerged casing and screen. Wells with yields too low to produce three well volumes before the well goes dry shall be purged to dryness.

Wells will be purged with low-flow pump per EPA low-flow sampling procedures (EPA 1996). Low-flow-rate purging and sampling induces laminar (nonturbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing groundwater directly from the sampled aquifer, horizontally through the well screen, and into the sampling device. Low-flow pumping rates are in the approximate range of 0.2 to 2.0 L/minute.

Purged groundwater will be collected in temporary storage containers, such as 55-gal drums, prior to disposal or on-site treatment. Purge water will be run through carbon filters prior to disposal onsite.

To determine when stabilization has occurred, pH, temperature, and conductivity are monitored on a regular basis until two successive readings of all three parameters do not vary by more than ±0.1 pH unit, ±1°C, and ±5% change in micromhos, respectively. If stabilization does not occur, samples may be collected after a total of six well casing volumes have been removed from the well. Turbidity will also be measured regularly during well purging. To promote consistency in the field data, one person will collect all water parameter data during well purging and will conduct water level and total depth measurements.

In low-yield wells that are purged dry before parameters stabilize or three well casing volumes have been removed, the sample(s) shall be collected as soon as a sufficient amount of water has reentered the well. The time at which the well was purged dry will be recorded on the groundwater sampling log, as well as the volume of water removed prior to sampling. A calibrated container will be used to measure the amount of water being removed from the well during the purging process. Elapsed time will be noted as the container is filled, thereby allowing the calculation of the discharge rate. The total amount of water purged from each well will be recorded on the groundwater sampling log.

6.2.4.3 Groundwater Sample Collection

Groundwater samples will be recovered in a prearranged priority, so that all collection and handling takes place as efficiently as possible. Although the actual sample collection protocol will depend on the analytes of interest, it is important to be consistent in general sample collection procedures. Prior to collecting a sample from the discharge line, samplers will don new, clean protective gloves to avoid cross-contamination. Care will be taken to minimize disturbance of the groundwater. Depth to groundwater will be measured and recorded in the sample logbook. Samples are typically taken in the following order to minimize the loss of volatile compounds:

1. VOCs (in petroleum fuels, solvents, etc.)
2. GRO, DRO, RRO
3. Pesticides and PCBs
4. SVOCs
5. Metals (TAL with cyanide).

Field measurements of temperature, pH, specific conductivity, redox, dissolved oxygen, and turbidity are made before and after all samples have been collected. Samples are immediately placed on ice and maintained at 4ºC during their shipment to the laboratory. As required, samples will be pH adjusted prior to shipment.

If low-flow pumps are used, the wells will be sampled directly from the outflow. Once purging is complete, the flow-thru cell will be disconnected from the tubing. Care will be taken to minimize disturbance of the groundwater.

The sample bottles for VOCs must be filled slowly to prevent the entrapment of air bubbles, splashing, or agitation of the water. Care will be taken to avoid touching the mouth of the discharge line, the top of the sample bottle, the inside of the cap, or the Teflon® septa. A septum that falls out of the cap

onto the ground shall not be used. The bottle will be filled completely such that a meniscus forms. The cap will be screwed on and the bottle inverted, tapped firmly, and checked for the presence of air bubbles. Accurate analytical results for VOCs may be compromised if there is any free air trapped in the sample container.

In order to avoid cross-contamination, water-level indicators will be decontaminated prior to use and between samples using the procedures in Section 5.7. Sufficient time will be allowed prior to sampling for the equipment to dry before it is used. Equipment used to collect water samples for organics analysis will not be allowed to come in contact with plastic (e.g., plastic storage bags). All pH and conductivity meter probes and thermometers will be thoroughly rinsed with ASTM Type II reagent grade water between uses. Clean, disposable gloves will be worn during and after decontamination to avoid contamination of equipment.

In the situation where a well is very low producing and it is not practical to collect the volume required for each sample, samples will be collected in the following priority: VOCs, metals, GRO, DRO, RRO, SVOCs, and PCBs.

6.2.5 Other Matrices

6.2.5.1 Solids

Samples will be collected from materials identified with Mill House. These samples will be placed using either a stainless steel spoon/trowel or a disposable scoop directly in laboratory-supplied clean containers with a moisture-tight lid. The sample containers will then be placed into a cooler with ice and cooled to 4 ºC, unless otherwise noted in Table 4. Lids will be sealed by labels or custody seals to prevent tampering.

6.2.5.2 Liquids in Containers

Samples will be collected from several containers. Samples will be pumped through 3/16-in. Teflon® tubing using a peristaltic pump. The sample bottles for VOCs must be filled slowly to prevent the entrapment of air bubbles, splashing, or agitation of the water. Care will be taken to avoid touching the mouth of the discharge line, the top of the sample bottle, the inside of the cap, or the Teflon® septa. A septum that falls out of the cap onto the ground shall not be used. The bottle will be filled completely such that a meniscus forms. The cap will be screwed on and the bottle inverted, tapped firmly, and checked for the presence of air bubbles. Accurate analytical results for VOCs may be compromised if there is any free air trapped in the sample container.

6.3 Sample Documentation

The field logbook serves as the primary record of field activities. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. The writer or knowledgeable reviewer will be considered a qualified person in accordance with 18 AAC 75.990 (100). The field logbook shall be bound, with consecutively numbered, water-repellent pages.

All pertinent information from the sampling event will be recorded in the logbook. At a minimum, the following entries will be made to the logbook:

- Identification of all sampling team members
- References to field methods used to obtain samples, field data, etc.
- Location and description of each sampling point
- Types, numbers, and volumes of samples (when observable)
- Date of sample collection, time of sample collection, and sample identification
- Date and time of sample shipping or transfer of sample custody
- Any field measurements (e.g., pH measurements)
- Any deviations from the standard or expected procedure
- Chain-of-custody form numbers
- Date of entry in logbook and initials of person entering it.

6.4 Sampling Equipment

Sampling equipment and supplies may include the items listed below. Additional required equipment may be specified in the logbook.

- Field logbooks
- FSP table and field guidance forms
- Laboratory address labels
- Return labels
- Work package
- Nitrile gloves
- Absorbent towels
- Appropriate decontamination solutions (as required)
- Deionized water
- Ice chest(s)
- Adhesive tape (e.g., clear, duct, and strapping)
- Pens and markers
- Waste containers/carboys
- Appropriate sample containers
- Custody seals

- Pump and weighted tubing
- Parafilm
- Pipette(s)
- Blue ice
- Appropriate preservative(s); NOTE: Appropriate preservatives may be added to the sample containers prior to mobilization to the field
- Safety glasses with sideshields, safety shoes, and other personal protective equipment, as required by work control documentation
- Litmus paper
- Chain-of-custody forms
- Sample labels
- Sample shipment forms
- Hand auger
- PVC pipe for sediment sample collection
- Groundwater sampling kit.

6.5 Sample Handling

All samples will be collected and shipped in accordance with ADEC recommendations. Sampling personnel will collect samples in the appropriate pre-labeled sample containers. It is important to collect a sufficient amount of sample, as specified in Tables 3 and 4, to allow for the requested analyses to be performed. Insufficient sample amounts could impact detection limits achieved at the laboratory and, therefore, the ability to make decisions using the data.

6.6 Sample Preservation

Sample preservation is conducted to ensure that target analytes do not escape from field samples or become chemically attached to sample containers prior to analysis. Metals samples must be placed in high-density polyethylene or glass containers and preserved prior to transport to the laboratory performing the analyses. Sampling personnel shall inspect the individual samples to determine if each sample container has sufficient material to perform the requested analyses.

6.7 Equipment Decontamination

Decontamination of reusable sampling equipment and personnel will be performed to ensure that chemical analyses reflect actual concentrations at sampling locations by maintaining the quality of samples and preventing cross-contamination. The standard equipment decontamination procedures to be used during completion of soil sampling activities are as follows:

- Sampling equipment will be washed using a bristle brush in potable water to which Alconox® or Liquinox® laboratory detergent has been added. All items will then be thoroughly rinsed with potable water and allowed to air dry.

- The total volume of decontamination water is anticipated to be less than 5 gal per day. Decontamination water from surface soil sampling will be discharged to the ground surface to evaporate.

6.8 Sample Transport

After the appropriate pre-labeled sample containers have been filled and preserved, as appropriate, the samples will be placed in a shipping container(s) (e.g., cooler). The completed chain-of-custody form, prepared by the sampling team member during sample collection, will be placed in a Ziploc bag and taped inside the container to document relinquishment of sample custody. Custody seals will then be taped to the shipping container to safeguard the integrity of the chain of custody between the Empire Mine and the analytical laboratory. All samples will be packaged and labeled according to U.S. Department of Transportation shipping requirements and in a manner that protects the integrity of the sample.

6.9 Health and Safety

Health and safety documentation will follow the *Site-Specific Health and Safety Plan for Empire Mine Sampling Activities* (PLN-5066). The PL (or designee) is responsible for ensuring that the appropriate work control documentation is in place prior to sample collection.

6.10 Field Quality Control Measures

Types of QC samples include field, trip, and equipment blanks introduced at the appropriate point of the sampling event. Table 5 provides a summary of the QC samples required for this sampling activity. Preservation and holding times for each sample type are provided in Tables 3 and 4.

Table 5 Required quality control samples.

Sample Type	Purpose	Collection
Field Duplicate	Field duplicates should be collected from locations of known or suspected contamination, and duplicate soil and water samples must be collected in the same manner and at the same time and location as the primary sample. Field duplicates must be: • Submitted as blind samples to the approved laboratory for analysis, • Given unique sample numbers (or names) and sample collection time, and • Adequately documented in the field record or log book. Field duplicate results must be used to calculate and report a precision value for field sampling quality control.	Minimum frequency of one per every 10 field samples for each matrix sampled; for each target analyte, minimum of one.
Matrix Sample	Matrix samples should be collected so that bias of a method on a given sample matrix can be determined.	1 per 20 samples of each media per method.
Trip Blank	Organic-free water in a vial sent from the laboratory to accompany VOC samples during sampling and shipment processes. This blank is used for checking for cross-contamination during sample handling, shipment, and storage.	Only necessary for VOC samples; minimum frequency of one per VOC cooler.
Methanol Trip Blank - Soil	All soil samples being analyzed for GRO or VOCs using AK101or 5035A/8260B field methanol preservation require a methanol trip blank. This blank consists of the same methanol used to preserve the GRO or VOC soil samples and is used for checking for cross-contamination during sample handling, shipment, and storage.	One trip blank per set of 20; a minimum of one per analysis and cooler.
Equipment Rinsate Blank	Sample obtained by rinsing sample collection equipment with analyte-free water, following decontamination, to evaluate field decontamination techniques.	Equipment blanks to be collected from the same equipment (that is, dipper, mop bucket) used to collect samples. Equipment blanks are not required if dedicated or disposable equipment is used. Minimum frequency of one per 20 similar samples.

6.10.1 Sample Container Labels

Preprinted labels will be affixed to the sample containers before use and will contain the name of the project, sample identification number, location (if available prior to collection), preservative used (if any), and requested analysis. Following collection, the date and time of collection and the sampling team member's initials will be recorded with a waterproof black marker on the sample label. If the location of the sample was determined in the field, the location will also be added following collection. The samples will be placed in containers with blue ice, if required, while awaiting preparation and shipment to the appropriate laboratory.

6.10.2 Sample Numbering Scheme

Each sample will be assigned a unique identification number; sample designations are assigned by the PL. Upon development of an analytical SOW, an FSP table will be developed by the PL. Sample numbers will be comprised of the location designator followed by a three-digit number that will indicate the sample number. A two digit number will be used to indicate duplicate analysis of a particular sample, and the analysis code, as specified by the PL, will be appended to the end of each sample label, as appropriate.

6.11 Investigative Derived Waste Management

Wastes generated as a result of the Empire Mine investigation sampling will include soil from sample borings, purge water, miscellaneous personal protective equipment, and disposable sampling equipment. Soil borings will be placed back in the sample hole. Purge water will be run through carbon filters prior to being discarded onsite. Other sampling wastes in the form of paper towels and other wastes associated with sampling activities will be generated. Sampling-derived waste will be placed in polyethylene trash bags and will be disposed as solid waste. Solid waste will be transported offsite and disposed of appropriately.

6.12 Field Documentation

To ensure that all sampling, analysis, and data reporting activities are conducted in accordance with project DQOs and all appropriate safety procedures, adequate documentation of each event must be completed. Therefore, all field activities related to sample collection, site safety, and sample custody must be recorded by the STL and/or the sampling team members in the field logbook. In addition, all laboratory activities related to sample custody, sample preparation, sample analysis, and data reporting must also be completely recorded to ensure that laboratory data can be confidently assigned to field sample points.

The laboratory will perform all functions regarding the Empire Mine samples in accordance with an appropriate laboratory quality assurance plan (QAP). In addition, the project may contact the laboratory personnel and obtain a copy of the laboratory QAP and/or visit the facility to ensure that laboratory procedures meet the project-specific goals.

6.12.1 Field Operations Records

The following sections provide a summary of requirements for adequate field documentation. All field documentation, document control, and daily updating of field logbooks and field materials will be the responsibility of the STL or designee.

6.12.1.1 Field Logbooks.

Field logbooks are legal documents that are the written record for all field data gathered, field observations, field equipment calibrations, samples collected for laboratory analysis, and sample custody. Logbooks are also maintained to ensure that field activities are properly documented as they relate to site safety meetings and that site work is conducted in accordance with health and safety procedures. Field logbooks will be bound and will contain consecutively numbered pages. All entries to field logbooks will be made using permanent ink pens or markers. All mistakes made as entries will be amended by drawing a single line through the entry, initialing the change (the initials of the person making the correction), and dating the change. Examples of information that will be recorded in the logbook, in addition to the sampling information, include names and affiliation of any site visitors, logs of conversations with coordinating officials, deviations from the FSP, and descriptions of any photos taken.

6.12.1.2 Chain-of-Custody Record.

All samples collected will be managed via chain of custody. The chain-of-custody procedures will begin immediately after collection of the first sample. Chain-of-custody forms will be completed by the sampling team as the samples are collected. All samples collected will remain in the custody of a member of the sampling team until custody is transferred to the laboratory sample custodian (SC) (i.e., samples shipped to the designated laboratory). Upon receipt at the laboratory, the SC will review sample labels and the chain-of-custody form to ensure completeness and accuracy. If discrepancies are noted during this review, immediate corrective action will be sought with the sampling team member(s) identified on the chain of custody as delivering the samples. If discrepancies cannot be corrected with the sampling team members, the PL will be sought to correct sample labeling or chain-of-custody discrepancies.

Pending successful corrective action, or when no corrective action is required, the laboratory SC will sign and date the chain-of-custody form, signifying acceptance of delivery and custody of the samples. The sampling team will retain a copy of the signed chain-of-custody form. Sufficient copies of the chain-of-custody form will be made at the time of sample delivery to ensure that appropriate personnel have copies.

The laboratory will maintain possession of the original copy of the chain-of-custody form until completion of sample analysis and will maintain one copy of the chain-of-custody form for the term of storage of data at the laboratory. The original copy of the chain-of-custody form will be returned to the project file maintained by the PL along with the final data package deliverable.

6.12.2 Laboratory Records

Laboratory records are required to document all activities involved in sample receipt, processing, analysis, and data reporting. The following sections describe the laboratory records that will be generated for this project.

6.12.2.1 Sample Data.

Sample data are records that contain the times that samples were analyzed to verify that they met holding times prescribed by the analytical methods. Sample data records should include information on the overall number of samples analyzed in a given day, location of sample analysis (i.e., instrument identification number), any deviations from analysis standard operating procedures (SOPs) and/or methods, and time and date of analysis. Corrective action steps taken to rectify situations that did not conform to laboratory SOPs and/or analytical methods (including steps taken to seek additional sample material if required) should also be noted in these records.

6.12.2.2 Sample Management Records.

Sample management records document sample receipt, handling and storage, and scheduling of analyses. The records verify that the chain of custody and proper preservation were maintained, reflect any anomalies in the samples (such as receipt of damaged samples), note proper login of samples into the laboratory, and address procedures used to prioritize samples received to ensure that holding time requirements were met.

6.12.2.3 Test Methods.

In circumstances where analyses are not performed exactly as prescribed in the analytical methods or laboratory SOPs, test methods describe how the analyses were carried out by the laboratory. Items to be documented include sample preparation and analysis, instrument standardization, detection and reporting limits, and test-specific QC criteria. Documentation demonstrating laboratory proficiency with each method used could also be included in this category.

6.12.2.4 QA/QC Reports.

The QA/QC reports will include general QC records, such as initial demonstration of capability of individual analysts to conduct specific analyses, instrument calibration, routine monitoring of analytical performance (e.g., control charts), and calibration verification. Project-specific information from the QA/QC checks such as blanks (e.g., field, reagent, and method), spikes (e.g., matrix, matrix spike duplicate, and surrogate), calibration check samples (e.g., zero check, span check, and mid-range check), replicates, and splits should be included in these reports to facilitate data quality analysis. Specific requirements for the reporting format and quantity and types of QA/QC monitoring will be specified in the analytical SOW to the laboratory.

- Log books and recorded field observations
- Date
- Weather and other salient observations
- Sampling team members
- Documentation of instrument calibration
- Location of activity and site conditions

- Field observations and comments
- Changes to sampling protocol
- Site photographs
- Site sketches
- Survey and location of sampling points
- Global Positioning System (GPS) coordinates.

7. ANALYTICAL METHODS

To ensure that data of acceptable quality are obtained from the Empire Mine investigation samples, standard EPA laboratory methods will be used to obtain project laboratory data. Analytical methods for each sample are provided in Tables 3 and 4.

7.1 Analytical Laboratories

The analytical laboratories chosen for conducting the analyses shall be ADEC approved and will have the appropriate level of qualified personnel, appropriate instrumentation, an approved QAP, approved analytical methods, and appropriate internal SOPs to perform the required analyses. The QAPs and SOPs for the selected laboratory (or laboratories) will be available (at the laboratories) for review by project personnel and shall be provided upon request. The selected laboratory will analyze the samples in accordance with project requirements.

7.1.1 Laboratory Manager

The laboratory manager will serve as the principal point of contact for coordinating receipt of samples. The responsibility of coordination may be delegated to a laboratory project manager within the laboratory organization. The laboratory manager will have ultimate responsibility for the technical quality of the laboratory deliverables, cost control, laboratory personnel management, and for analyzing the samples and reporting the data on schedule.

7.1.2 Laboratory Quality Assurance Officer

The laboratory QA officer will evaluate laboratory-generated data prior to release in order to:

- Determine if instrument calibrations were performed in accordance with (a) the analytical SOW that was provided to the laboratory and (b) prescribed analytical methods
- Determine if method QC analyses comply with the requirements of the SOW and analytical methods
- Determine if the data reporting format complies with the requirements stipulated by the project in the SOW.

The laboratory QA officer will notify the PL of noncompliances or conditions adversely affecting sample analysis and data quality.

7.1.3 Laboratory Sample Custodian and Record Coordinator

The laboratory SC will be responsible for maintaining sample custody, assigning laboratory identification numbers, and storing samples. The SC will review chain-of-custody forms and sample container identifications. In the event of field sampling errors, the SC will notify the STL and seek to rectify the error immediately. Identified discrepancies will be documented in the laboratory logbook and copies will be supplied to the laboratory QA officer and the PL to verify that appropriate corrective actions have been developed. Discrepancies in sampling documentation are documented in the chain of custody or on a sample-receiving checklist, which becomes part of the data package. The SC will report directly to the analytical operations supervisor who, in turn, reports to the laboratory manager.

8. INSTRUMENT CALIBRATION PROCEDURES

To ensure that sampling and analysis activities obtain the most accurate and precise information possible, field equipment and laboratory instrumentation must be calibrated according to both the manufacturer's specifications and the appropriate analytical method specifications.

8.1 Laboratory Instrument Calibration

Laboratory instrumentation will be calibrated in accordance with each of the specified analytical methods. The laboratory QAP shall include requirements for calibrations when specifications are not listed in analytical methods. Calibrations that are typically not called out in analytical methods include those for ancillary laboratory equipment (e.g., analytical balances, pipettes, and pH meters) and verification of reference standards used for calibration and standard preparation. Laboratory documentation will include calibration techniques and sequential calibration actions, performance tolerances provided by the specific analytical method, and calibration dates and frequency. In addition, records for all laboratory-prepared standards will be maintained and provided with each data deliverable. Standard reference materials used to perform calibration checks associated with inorganic target analytes will be prepared using an independent source for the standard materials from that used for preparation of the calibration standards. The results of these calibration checks will be reported with each data deliverable.

All analytical methods prescribed have specifications for equipment checks and instrument calibrations. The laboratory will comply with all method-specific calibration requirements for all requested parameters. If a failure of instrument calibration or equipment is detected, the instrument will be recalibrated, and all affected samples will be analyzed using an acceptable calibration.

8.2 Field Equipment Calibration/Setup

The required pre-sampling inspections will evaluate sampling equipment to ensure that they are functioning properly prior to sample collection. Corrective actions for the repair or maintenance of sampling equipment will be immediate and will be confirmed by the PL prior to sample collection.

9. DATA VALIDATION AND REPORTING

To ensure that all data are acceptable, and that data end users receive information in a form that is usable, a series of evaluations and data reduction steps must be performed. Data generated by the laboratory and in the field are only the first step in evaluating conditions at any project site.

9.1 Data Reduction

Data reduction is the process of converting raw data or instrument data into a usable form for evaluation by project personnel. Reduction of environmental data will be performed at the laboratory. The data reduction activities performed at the laboratory convert the data into a form that is used for interpretive purposes for environmental risk assessment and verification of closure design.

Laboratory data reduction involves converting the outputs of the analytical instruments into sample and QC results. Laboratory data reduction will be performed as defined in the analytical method. Laboratory deliverables include raw data and reduced data. This form of laboratory deliverable will ensure complete documentation of all aspects of laboratory analysis, allow for an independent verification of reported results, provide a form of data that is technically and legally defensible, and ensure that data end users can be completely confident in the results.

Further data reduction may be necessary for use at the project level. When this is necessary, project management will determine the final data uses and parameter needs, and provide data sets in the form that project personnel require to complete their tasks.

9.2 Data Validation

Analytical data validation is the comparison of analytical results versus the requirements established by the analytical method. Validation involves evaluation of all sample-specific information generated from sample collection to receipt of the final data package by the PL. Data validation is used to determine if the analytical data are technically and legally defensible and reliable. The SW-846 QC guidelines will be used to validate the data. Data validation is a portion of the DQA process that is used to determine if the data meet the project DQOs.

The final product of the validation process is the validation report, which communicates the quality and usability of the data to the decision-makers. The validation report will contain an itemized discussion of the validation process and results. Copies of the data forms, annotated for qualification as discussed in the validation report, will be attached to the report.

9.3 Reporting

The laboratory may use its standard report forms when assembling the standard plus raw data deliverable documentation. The standard plus raw data deliverable includes all pertinent raw data, extraction notes, standard preparation, and instrument printouts and identifiers for all samples and QC solutions prepared.

9.4 Data Quality Assessment

The DQA process is used to determine whether the collected data meet the project DQOs in accordance with the EPA's DQA guidance document, *Data Quality Assessment: Statistical Tools for Practitioners* (EPA 2006). Data quality is evaluated, assumptions are made, and DQOs are verified in performing this FSP.

10. INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

To adequately assess (a) the quality of sampling techniques, (b) the cleanliness of sampling and shipping methods, and (c) laboratory accuracy and precision, field QA/QC samples are submitted with samples at the time of custody transfer to the laboratory. The following sections outline specific QC checks that will be conducted for this project.

10.1 Laboratory Quality Control

Compliance with laboratory QA/QC procedures and strict adherence to analytical method tolerances will be critical to obtaining high-quality laboratory data. Each analysis conducted for the Empire Mine investigation will strictly adhere to all QA/QC procedures, QA/QC control limits, and method-specific corrective actions. An ADEC Laboratory Data Review Checklist should be completed for each laboratory data package and submitted along with the data package.

10.2 Field Quality Control

Field QC requirements are addressed in Section 6.10.

11. PERFORMANCE AND SYSTEMS AUDITS AND FREQUENCY

It is not a requirement of this FSP that a formal audit of the analytical laboratory be performed prior to commencing with the sampling effort. If deviations from the procedures outlined in this FSP are suspected during analysis, the PL should review the laboratory procedures that were used to obtain project data.

11.1 Corrective Action

Corrective action procedures are implemented whenever sampling, field monitoring, or laboratory analysis results do not meet the required QA/QC standards. The types of corrective action applicable to environmental analysis are laboratory corrective action(s) and field corrective action(s).

11.1.1 Laboratory Corrective Action

The laboratory manager, laboratory QA officer, laboratory analysts, and sampling and data quality personnel will be responsible for ensuring that all laboratory QA/QC procedures are followed. Situations requiring corrective action, and the type of correction required, will be as stated in the analytical method or the laboratory SOW. The laboratory will utilize internal QAPs and SOPs to complete all corrective

actions identified both internally and externally. Completion of corrective actions will require notification to the PL of any laboratory situation that may impact the usability of the data. If notified of a laboratory nonconformance for which the laboratory seeks the project's required corrective action, sampling and data quality personnel will:

- Notify the PL of the situation
- Devise a reasonable corrective action in conjunction with the laboratory staff
- Request, formally, that the laboratory implement the corrective action.

All sampling and data quality personnel and the laboratory QA officer will be responsible for monitoring the effectiveness of all corrective actions. The sampling and data quality personnel will report directly to the PL regarding problems or deviations observed, corrective actions proposed, and the effectiveness of ongoing corrective actions.

11.1.2 Field Corrective Action

The STL and PL are responsible for ensuring all field sampling procedures are completely followed and that field sampling personnel are adequately trained. The STL and the PL must document situations that may impair the usability of the samples and/or data in the field logbook. The STL will note any deviations from the standard procedures for sample collection, chain of custody, sample transport, or any other monitoring that occurs. Ultimately, the PL or the STL (at the discretion of the PL) will be responsible for communicating field corrective action procedures, for documenting all deviations from procedure, and for ensuring that immediate corrective actions are applied to field activities.

12. REFERENCES

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