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Acronyms

ABCA Analysis of Brownfield Cleanup Alternatives
ANP acid neutralizing potential
APN Assessor’s Parcel Number
APP acid producing potential
bgs below ground surface
BLM Bureau of Land Management
Burleson Burleson Consulting Inc.
CAM California Assessment Manual
CEC cation exchange capacity
CFR Code of Federal Regulation
CHHSL California Human Health Screening Levels
CSM conceptual Site model
DI WET deionized waste extraction test
DQO data quality objectives
EPA Environmental Protection Agency
ESA Environmental Site Assessment
GPS global positioning system
mg/kg milligram per kilogram
mg/L milligram per liter
mg/m³ milligram per meter cubed
mm millimeter
MS/MSD matrix spike/matrix spike duplicate
ng/m³ nanogram per meter cubed
OSHA Occupational Safety and Health Administration
PEL permissible exposure limit
PPE personal protective equipment
QAPP quality assurance project plan
QA/QC quality assurance/ quality control
REC recognized environmental concern
RMC risk management criteria
RSL Regional Screening Levels
SAP Sampling and Analysis Plan
STLC soluble threshold limit concentration
TCLP Toxicity Characteristic Leaching Potential
TDS total dissolved solids
TTLC total threshold limit concentration
TOC total organic carbon
TSS total suspended solids
USGS U.S. Geological Survey
1.0 Introduction and Purpose

Burleson Consulting, Inc. (Burleson) performed a Phase II Environmental Site Assessment (ESA) of the Plymouth Mine, Middletown, California (target property) at the request of McCord Environmental, Inc. This study was performed under Grant No. 99T30301. A Phase I ESA for the same site and under the same grant was completed on June 30, 2017.

1.1 Overall Project Objective

The purposes of this Phase II ESA were to document whether a release has occurred from the historic Plymouth Mine; to evaluate the magnitude of the release with respect to risk based screening benchmarks; and to support an Analysis of Brownfield Cleanup Alternatives (ABCA) if necessary.

1.2 Project Planning

This Phase II ESA incorporates the relevant provisions of the Quality Assurance Project Plan (QAPP) for Cooperative Agreement No. 99T3031 as they apply to collection and analysis of environmental data, provided in Appendix A. This Phase II ESA was conducted in compliance with the safety procedures outlined in the Site Specific HSP Checklist for Site Surveys and Sampling Activities included in Appendix B.

2.0 Site Description and Environmental Setting

2.1 Site Description and Location

The Site is located on the target property, which consists of one parcel, assessor’s parcel number (APN) 01302817 of partially developed rural land totaling about 117 acres. The target property is located about 4 miles south of Middletown, and about 0.2 mile east of Highway 29, Lake County, California. A regional map is provided on Figure 1, and a Site map is provided on Figure 2.

2.2 Geology and Soil

The Site is located in the Coast Range geomorphic province. The area is underlain by the Franciscan Complex, which has been severely folded and faulted in the region. The specific component of the Franciscan Complex occurring on site is Mesozoic ultramafic rocks, specifically serpentinite and peridotite (Figure 3). The main geologic hazards that are likely to affect the Site in the event of an earthquake are ground motion and landslides. Soils likely to occur on Site include loamy to coarse loamy serpentinite sand and clay (Figure 4).
2.3 Hydrology

The Site is located in a westward sloping valley that is drained by Hoffman Creek into Saint Helena Creek. Site specific groundwater level or flow data were not available for the target property; however, groundwater flow often mimics the topography with flow from areas of higher elevation toward lower elevations. Based on this principle, groundwater in the northeast portion of the target property is expected to flow from surrounding slopes westward. Groundwater in the southern part of the target property is expected to flow toward Hoffman Creek, which drains into Saint Helena Creek. If active residential or agricultural supply wells are present in the area, then pumping of these wells could result in changes from these inferred flow directions.

2.4 Climate

The Site is in a region with a Mediterranean climate and experiences hot and dry summers, and cool wet winters. Average summer monthly temperatures are above 97°F and average winter temperatures are around 56°F. Average annual rainfall for the area is 31 inches, mostly occurring between October and April.

3.0 Background and History

The Site is a former mercury mine located in the northwest central portion of the target property.

3.1 Operational History of Plymouth Mine

The property was developed with the Plymouth Mine prior to 1945, when mining ceased. No mining activity is known to have occurred on the property since at least 1945.

3.2 Description of Mining Operations

The mine was developed via driving adits and a shaft. Two adits were observed approximately 420 feet south of the residential house. There is a shaft and associated waste rock pile approximately 300 feet uphill of the adits to the east. There are exploration cuts uphill from the adits, and the road across Hoffman Creek from the adits is covered with waste rock.

3.3 Current Use

A single-family residence was built at the northern edge of the target property in 1998. The single-family residence is occupied by the current land owner. Agricultural development is ongoing at the Site. The parts of the target property south of Hoffman Creek remain undeveloped rural land (Figure 2).
3.4 Previous Studies

In June 2017, Burleson conducted a Phase I ESA of the Plymouth Mine (Burleson, 2017). One potential recognized environmental concern (REC) was identified and is associated with the historical mining at Plymouth Mine on the target property. Waste rock from mining was identified as a potential source for mercury to surface water.

4.0 Conceptual Site Model and Data Quality Objectives

A conceptual Site model (CSM) for the Plymouth Mine was prepared to address the potential migration pathways for metals from sources at the Site to human and ecological receptors and Hoffman Creek (Figure 5). The CSM was used to develop data quality objectives (DQO). The DQOs guided preparation of the Sampling and Analysis Plan (Burleson, 2018). The CSM and DQOs are described below.

4.1 Conceptual Site Model

The CSM addresses waste rock and naturally occurring mercury-enriched rock as the primary metal sources; and groundwater, surface water, soil, sediment, and air as secondary sources and pathways. Waste rock was observed at the Plymouth Mine distributed at the surface by mining activity. Potential receptors include both human and ecological receptors. Human exposure scenarios at the Site potentially include residents, trespassing recreational users, and site workers. Ecological receptors include aquatic life and other wildlife including birds and mammals.

The CSM describes the primary source, fate and transport, pathways to secondary sources, exposure pathways, and receptors.

4.1.1 Primary Source and Release Mechanism

Waste rock may contain concentrations of metals such as aluminum, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium, zinc, and sulfur and sulfide minerals that may pose a threat to water quality, or to human and ecological receptors due to ingestion or adsorption through direct contact. In addition, the waste rock may be capable of creating metal-containing drainage when exposed to water and oxygen.

Primary release mechanisms that could release chemicals from the waste rock include infiltration/percolation of water, runoff of water, and erosion by wind and water. Mining-related disturbances including road building, excavation, and placing waste rock at the surface may have increased transport of mercury into the watershed.
4.1.2 Secondary Sources and Pathways

Drainage. Drainage formed through oxidation of sulfide minerals in waste rock through interaction with infiltrating/percolating water cause metals to become mobilized by drainage interactions with in-situ rock, waste rock, and/or soil.

Surface Water. Discharges from waste rock and sediments may degrade surface water in Hoffman Creek.

Hoffman Creek flows past the Plymouth Mine to Saint Helena Creek northwest of the property boundary.

Soil. Soil at Plymouth Mine may be affected by metals through mixing with eroded waste rock, settling of contaminated dust or mercury vapor from the air, and/or deposition of metals from drainage and runoff. Soil affected this way could then become a secondary source for contaminants in the sediment and air. Soil is considered to be addressed herein via consideration of the waste rock and sediment.

Groundwater. The Plymouth Mine is located on serpentinite bedrock. Groundwater from the Plymouth Mine is considered herein to be of limited extent and to discharge to Hoffman Creek through fractures and permeable horizons of the bedrock. Thus, any metals in groundwater related to Plymouth Mine would be present in drainage from underground workings, or in discharge to Plymouth Creek. Groundwater is addressed herein via drainage and surface water sampling in Hoffman Creek.

Sediment. Sediment in Hoffman Creek below Plymouth Mine could contain waste rock eroded from the Site, and in chemical precipitates resulting from mixing of drainage with surface water. Affected sediment could be present along the channel of Hoffman Creek and could enter Saint Helena Creek.

Plants growing in sediment containing chemical precipitates or waste rock could transfer metals to foraging biota or humans. Erosive flow events could suspend waste rock and/or chemical sediments in the water column making metals more available to degrade water quality or affect the food chain.

Air. Wind may entrain metal-containing particles from waste rock and deposit these particles on plant surfaces, soil, and in surface water. Respirable particles could be inhaled by humans or animals. Mercury vapors could be inhaled by humans or animals.

4.1.3 Receptors

The CSM (Figure 3) shows potential migration pathways and potential receptors for Site conditions at the Plymouth Mine area.
Under current land use conditions, residents, recreating trespassers and site workers have access. The area contains suitable habitat for terrestrial and some aquatic receptors, including migratory birds. Under future land use conditions, residents or a recreating trespasser may come in contact with the area. Also, wildlife exposure will continue to occur. Potential exposure pathways include direct contact with and incidental ingestion of surface soil, inhalation of fugitive dust and/or mercury vapors emitted from the waste rock, or from adjacent soil, ingestion of groundwater, and direct contact and incidental ingestion of surface water/sediment. There are currently no known complete groundwater exposure pathways for residents, recreators/trespassers or workers.

**Summary.** The CSM identified one primary source of metals and associated release mechanisms:

- Waste rock or mineralized rock - Metals might be released in airborne dust, mercury vapor, storm water, soil, and groundwater through water-rock interactions.

The CSM identifies six secondary sources of and release mechanisms for metals at Plymouth Mine:

1. Drainage - Metals in drainage may be transported to soil, groundwater, sediment, and surface water at the Plymouth Mine by infiltrating water migrating through the Site.
2. Soil - Metals in soil may be transported to sediment through erosion in runoff, or suspended in air on dust.
3. Groundwater - Metals in groundwater may discharge through drainage or to surface water in Hoffman Creek.
4. Surface Water - Metals might be transported through Hoffman Creek and suspended or dissolved in the water column. Erosive storm events may cause significant increases in the mass of metals in surface water.
5. Sediment - Metals might accumulate as particulates, become suspended in the water column and redeposited, or dissolve from accumulations.
6. Air - metals might be suspended on respirable particulates, and/or mercury may be released as vapor.

The CSM identified four complete pathways for exposure to metals from Plymouth Mine:

1. Soil/waste rock – Exposure routes for humans, terrestrial biota, and aquatic biota might include ingestion and direct contact.
2. Surface Water - Exposure routes for humans, terrestrial biota, and aquatic biota might include ingestion and direct contact.
3. Sediment - Exposure routes for humans, terrestrial biota, and aquatic biota might include ingestion and direct contact.
4. Air-Exposure routes for humans and terrestrial biota might include inhalation, and accumulation on plant tissues with subsequent uptake via ingestion by foraging humans and biota.

Reference Area

Reference areas are those areas that have characteristics similar to Plymouth Mine, but are expected to have not been disturbed by mining activities. Metal concentrations in soil, sediment, and surface water would be compared between a reference area and the Site. This comparison would support evaluation of whether increased risks to human health or the environment are caused by the effects of historical mining at Plymouth Mine. Reference areas are described for evaluating Plymouth Mine, and for comparison with media (surface water, soil, and sediment) affected by Plymouth Mine.

A suitable reference area for comparison with Plymouth Mine would be in similar geologic units and soils not affected by release from the Site. Based on the geologic map provided in Figure 4 and the soil map in Figure 5, the slopes above the Site appear to have similar geology and soils compared with those in site-affected areas, and are not believed to be affected by releases from the Site. Thus, soil, sediment, and surface water (if present) from these areas would likely provide suitable reference information. In addition, sediment and surface water from Hoffman Creek upstream from areas disturbed by mining and Saint Helena Creek upstream from Hoffman Creek would also provide suitable reference samples for sediment and surface water.

4.2 Data Quality Objectives

DQOs were developed in accordance with the seven-step systematic planning process (EPA, 2006) to guide additional investigations at the Plymouth Mine, evaluate potential threats to water quality, and support preparation of an ABCA if necessary. The CSM described above was developed as part of Step 1, and provides a basis for identifying that metals in waste rock at Plymouth Mine may migrate to surface water, sediment, soil, groundwater, and air and may degrade water quality and be available for uptake by humans and ecological receptors. The release of metals, and associated impacts remain uncertain at this time. Reference concentrations for soil, surface water, and sediment, are necessary to assess possible impacts to human and ecological receptors, and to quantify impacts to water quality in Hoffman Creek. Step 2 identifies study goals based on the CSM. Step 3 identifies information inputs including a summary of existing information from Plymouth Mine. Step 4 defines study boundaries. Step 5 develops the analytical approach. Step 6 specifies acceptance criteria. Step 7 develops the plan to obtain data.

Data requirements identified during development of DQOs include:

1. Location and physical properties of waste rock
2. Volume of waste rock
3. Metal content of waste rock
4. Chemistry of waste rock
5. Mobility of metals in waste rock
6. Metal contents and volume of mine related drainage
7. Metal contents and quantity of sediment in Hoffman Creek and tributaries
8. Metal contents and quantity of surface water in Hoffman Creek

4.3 Data Quality

Throughout the data acquisition and site characterization activities, Burleson will implement Quality Assurance/ Quality Control (QA/QC) that includes review of project deliverables by senior staff, review of laboratory documentation by a project chemist, review of completed field documentation, and adherence to the field sampling protocols described in the Sampling and Analysis Plan (SAP) (Burleson, 2018).

Necessary QA/QC measures are based on the anticipated uses of the data. Data will be used to support objectives identified in Section 4.2 of this Plan. QA/QC samples for the project laboratory will consist of duplicate and matrix spike/matrix spike duplicate (MS/MSD) for 10% of the samples collected in the field. Duplicate samples will be submitted blind to the laboratory. Sampling and analysis will be conducted in accordance with the QAPP provided in Appendix A.

5.0 Field Sampling and Site Characterization

Field activities conducted included site mapping, waste rock sampling, sediment sampling, reference soil sampling, surface water sampling, air particulate measurements, and mercury vapor measurements.

5.1 Site Mapping

Site mapping was completed using a handheld geographic positioning system (GPS) to record the locations of site features and sample locations within 1 to 2 meters accuracy. Point locations were recorded in a field notebook and plotted on an aerial photograph base map in the field. Lines and areas were similarly plotted on the base map in the field. A photo log of field activities is included in Appendix C.

Mapped site features included waste rock, sample locations, adits, and shafts (Figures 6 and 7).

5.2 Waste Rock Sampling

Composite samples consisting of four subsamples collected from random locations identified during mapping at each waste rock pile at 0-6 inches below ground surface (bgs) (Figures 6).
The subsamples were selected to represent the overall composition of the waste rock pile, which consisted mostly of silty sand.

5.2.1 Hand Sampling Procedure for Waste Rock

Waste rock sample processing included a visual description and classification of the soil and sieving using a Number 10 (2 millimeter [mm] opening) sieve. Visual description of the soil and soil classification was conducted in accordance with ASTM D2488. Visual descriptions were documented in the field (Appendix D).

Loose material such as leaves, twigs, and rock were cleared from the surface. An appropriate decontaminated or disposable tool was used to remove the sample volume from the desired depth. The material sampled was described based on visual characteristics. Large rock fragments (> than 0.25 inches in diameter) were removed from the sample. The sample was processed by completing visual description, classification of the soil, and logging soil descriptions on the sampling form. The samples were placed into appropriate sample containers, labeled, recorded on a chain of custody form, and placed on and under ice in an ice chest pending transport to the analytical laboratory. Compositing was performed in the field by mixing equal size splits from each sieved sample in a plastic bag. Mixing was performed by agitating the sample until no visible segregated sample volumes or colors were observed.

5.2.2 Analytes

Waste rock samples were analyzed for:

- Total metals (California Assessment Manual [CAM] 17 list plus aluminum, iron, and manganese),
- Toxicity Characteristic Leaching Potential (TCLP) metals
- CAM 17 Soluble Threshold Limit Concentration (STLC),
- Deionized (DI) Waste Extraction Test (WET),
- Acid base accounting,
- Total organic carbon (TOC), and
- Grain size.

CAM 17 metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc.

5.3 Sediment Sampling

Figures 6 and 7 present the locations of collected sediment samples. Sediment locations were selected to be both upstream and downstream of the mining features in Hoffman Creek, and in Saint Helena Creek upstream and downstream of the confluence with Hoffman Creek. Collected sediment samples consisted of sand with some gravel.
5.3.1 Sediment Sampling Procedure

Sediment samples were collected in the field using decontaminated hand tools. A pre-cleaned disposable trowel was used to collect the samples. Any debris, plant material, or rocks were cleared from the sediment surface prior to sample collection. The sample was collected from the upper 6-inches of the sediment column. Samples were visually inspected, and sealed into the sample container with no/minimal head space to minimize the chance for oxidation. The sample was then labeled, recorded on a chain of custody form, and placed on and under ice in an ice chest pending transport to the analytical laboratory.

5.3.2 Analytes

Bulk sediment samples were analyzed for:

- Total metals (CAM 17 list plus aluminum, iron, and manganese)
- Total organic carbon

5.4 Reference Soil Sampling

Reference soil samples were collected and analyzed to identify ambient concentrations of metals in soil for comparison with site affected samples. Figures 6 presents reference soil sample locations.

The reference areas were selected based on a consideration of the site geology. The reference areas were within areas shown as overlying serpentinite (Figure 4). Locations were selected within serpentinite using professional judgment to avoid areas disturbed by mining. Collected reference samples consisted of silty sand.

5.4.1 Reference Soil Sampling Procedure

Reference soil samples consisting of four subsamples were collected from random locations identified during mapping at each reference location at 0-6 inches bgs (Figure 6). The subsamples were selected to represent the overall composition of the reference soil in each location.

5.4.2 Analytes

Reference soil samples were analyzed for:

- Total metals (CAM 17 list plus aluminum, iron, and manganese)
- Leachable metals using DI WET for CAM 17 list plus aluminum, iron, and manganese),
- Cation exchange capacity, and
5.5 Surface Water Sampling

Surface water sample locations are shown on Figure 6, and were chosen to allow comparison of surface water immediately downstream from the Site as well as upstream to evaluate potential site impacts to Hoffman Creek.

5.5.1 Surface Water Sampling Procedures

Pre-cleaned sample containers provided by the laboratory were used to collect surface water grab samples. Surface water was collected by immersing sample containers directly into the water, with the mouth of the sample container facing upstream, and the samples were collected at the approximate middle of the water column at each sampling location. Care was taken to avoid collecting water with disturbed sediment by collecting samples upstream of sampling personnel and progressing from downstream to upstream sample locations. Preserved sample containers were filled without over flowing to avoid diluting preservatives. Unpreserved containers were rinsed two times with water from the sample location prior to collecting the sample when sufficient water was present.

5.5.2 Analytes

Drainage and surface water samples were analyzed for:

- Total metals (CAM 17 list plus aluminum, iron, manganese, and boron)
- Calcium, magnesium, potassium, and sodium
- Nitrate, sulfate, chloride
- TOC
- Alkalinity
- pH
- Hardness
- Total dissolved solids (TDS)
- Total suspended solids (TSS)

Field parameters collected included:

- pH
- Temperature
- Specific conductance
- Oxidation Reduction Potential
5.6 Air Particulate Measurements

Burleson measured the particulate mass in the air using a handheld air particulate measuring device. Visual observations were also performed to evaluate sources of dust at the Site. These measurements and observations were collected during mapping of mine features. Particulate mass in the air was measured near the residence, in the open area in front of the adit, the adit opening, the waste rock pile, and the fire break road. Particulates were detected in air only in the area in front of the adit at 0.015 milligrams per cubic meter (mg/m$^3$).

5.7 Mercury Vapor Measurements

Burleson conducted a mercury vapor survey to evaluate whether mercury vapors from waste rock exceed levels of concern, and to assess personal protective equipment (PPE) requirements during waste rock sampling.

The mercury vapor survey was completed using a Lumex RA-915+ mercury vapor detector. Vapor measurements on waste rock piles were made at ground level and about four feet above the ground, vapor measurements at adits were made at accessible openings. Mercury vapor measurements were recorded on a field form (Appendix D). The mercury vapor measurement locations are shown on Figure 6. Table 1 summarizes the measured mercury vapor concentrations.

6.0 Analytical Results and Data Evaluation

Analytical results are used to evaluate the presence of a release at the Site and support appropriate classification of waste rock. Risk evaluations to human and ecological receptors are provided to contribute to decision making at areas that may require mitigation of potential chemical hazards due to historic mining operations. Background conditions, water quality assessment, and risk evaluation are described in the sections below.

The Bureau of Land Management (BLM) has developed risk management criteria (RMC) for heavy metals as they relate to recreational use and wildlife on BLM lands (BLM, 2004). BLM suggests that exceedances of risk management criteria be characterized as follows:

- Less than criteria: low risk
- 1-10 times the criteria: moderate risk
- 10-100 times the criteria: high risk
- >100 times the criteria: extremely high risk

The risk evaluations herein are consistent with these BLM characterizations.
6.1 Background Conditions

Many of the metals found in waste rock are also present in native soils around the Plymouth Mine. Separating background conditions from the former mining residues is a critical issue for making risk management decisions; therefore, local background concentrations for metals in soil were established by sampling from areas not affected by mining (Figure 6). Analytical results for these reference samples is presented on Tables 2 and 4.

Additionally, the U.S. Geological Survey (USGS) has estimated average concentrations of metals in soil in Lake County and these USGS estimates are also presented for comparison on Tables 2 and 4 (USGS, 2008). Site background metal concentrations are similar to the USGS estimates.

The range of concentrations detected in reference soil indicate that mining activities have not affected the reference areas, and that the soil in these areas represents background conditions.

6.2 Reference Soil

Reference samples were analyzed for CAM 17 metals plus aluminum, iron, and manganese, DI-WET, cation exchange capacity (CEC), and grain size. Analytical results are presented in Tables 2, 3, and 5.

CEC of reference soils was 30.15 meq/100g (R1) and 10.8 meq/100g (R2). CEC is a measure of the soil ability to adsorb cationic metal species from solution and is useful for evaluating fate and transport of metals. Grain size for reference samples ranged from silty sand to sandy silt.

6.3 Waste Rock

Waste rock samples were analyzed for CAM 17 metals list plus aluminum, iron, and manganese, TCLP metals, STLC metals, DI WET metals, acid base accounting, TOC, and grain size. Analytical results for waste rock are summarized below, and presented in Tables 2, 3, 5, 6, 7, and 8.

Comparison with reference concentrations: Waste rock total metals were compared with reference soil total metals. This comparison determined that all metals analyzed except for mercury in waste rock are similar to or within reference concentrations. Mercury concentrations from waste rock samples were 38 milligram per kilogram (mg/kg) and 1,600 mg/kg, exceeding the 0.86 mg/kg and 1.9 mg/kg mercury concentrations from the two reference soil samples and the 5.4 mg/kg USGS background concentration for Lake County soil.

Comparison with Risk-Based Screening Criteria: For human health, mercury exceeds the most conservative screening criteria by 35 times, indicating high risk. For wildlife, mercury exceeds the screening criteria by 200 times, indicating extremely high risk.

Water Quality Assessment. Aluminum, iron, and nickel concentrations in DI WET extracts from waste rock exceeded water quality criteria, but were below background concentrations,
and are thus not considered a risk to water quality in Hoffman Creek. Mercury was reported at 0.0023 mg/L and 0.0015 mg/L in DI WET extracts from waste rock samples. These concentrations exceeded the background concentrations and are roughly 50 times the screening criteria of 0.00005 mg/L. Zinc was reported at 0.89 mg/L, roughly 3 times the screening criteria of 0.26 mg/L. Mercury and zinc in waste rock at the Plymouth Mine appear to be mobile at concentrations that could degrade surface water quality.

The Shaft Waste Rock sample was collected 275 feet from Hoffman Creek and 100 feet up in elevation from the creek. This distance is expected to allow for sufficient attenuation of migrating leachate to protect water quality in Hoffman Creek. The Adit Waste Rock is on the bank of Hoffman Creek, is exposed, and not well vegetated. The mercury from this waste rock pile will likely not be sufficiently attenuated to protect water quality criteria.

**Waste Rock General Chemistry and Acid Generating Tests:** General chemical parameters analyzed for waste rock included acid generating/neutralizing tests and TOC. Acid generating tests included acid producing potential (APP) (also known as acid generating potential [AGP]), and acid neutralizing potential (ANP). TOC was analyzed in both waste rock samples and ranged from 52,000 mg/kg to 86,000 mg/kg. The APP was reported as less than the detection limit in both samples and the ANP was 70 for both samples. These results indicate that waste rock is not expected to generate acid drainage and may remain near neutral or alkaline indefinitely (DTSC, 1998).

**Comparison with Waste Classification Criteria:** Analyses of WET and TCLP extracts from waste rock were compared to the STLC and TCLP metal thresholds. No waste rock sample extract concentrations exceeded the STLC or TCLP thresholds. Total metals concentrations were compared with the total threshold limit concentrations (TTLC) (Table 8). Mercury exceeded the TTLC in both waste rock samples, and nickel exceed the TTLC in the slope waste rock and both reference soil samples.

Based on these results, mining activities resulted in deposition of waste rock containing elevated mercury at the Site. This includes the waste rock pile outside the adit along Hoffman Creek (Adit Waste Rock), and the waste rock pile at the shaft (Shaft Waste Rock). The adit waste rock pile exceeded all human health and ecological screening criteria for mercury at a high to extremely high risk, but the slope waste rock pile only exceed the risk-based ecological screening criteria for mercury at moderate risk. Mercury and zinc in Shaft Waste Rock, and Mercury in Adit Waste Rock also may pose a threat to water quality in Hoffman Creek. However, attenuation of metals in leachate from the Shaft Waste Rock is believed to be sufficient to protect water quality in Hoffman Creek based on the distance from the waste rock to the creek and the vegetative cover prevalent on the intervening slopes.
6.4 Sediment

Sediment samples were analyzed for CAM 17 metals plus aluminum, iron, and manganese, TOC, and grain size. Sediment samples were collected at 4 locations, one upstream of known mining activities in Hoffman Creek, one downstream of mining activities in Hoffman Creek (Figure 6), one upstream of Hoffman Creek in Saint Helena Creek, and one downstream of Hoffman Creek in Saint Helena Creek (Figure 7). Analytical results are presented on Tables 3 and 4.

**Comparison with Risk-Based Screening Criteria:** Mercury and arsenic were the only metals in sediment to exceed risk-based screening criteria for human health. Mercury and arsenic were the only metals to exceed the wildlife or livestock risk-based screening criteria, however; all arsenic concentrations were below background soil levels, and are therefore not considered a risk associated with mining activities.

The highest mercury concentration was detected in the sediment sample from St. Helena Creek located downstream from Hoffman Creek. Based on these results, mining activity at Plymouth Mine may have resulted in increased mercury in sediment in Saint Helena Creek downstream of its confluence with Hoffman Creek. Elevated mercury was not detected in Hoffman Creek sediment downstream of waste rock and other mine features. Additional sampling is necessary to resolve this issue.

6.5 Surface Water

Two water samples were collected in Hoffman Creek, one upstream of mining activities, and one downstream of the area affected by mining activities (Figure 6). Surface water samples were analyzed for total metals, and general chemistry (Tables 9 through 11).

**Total Metals:** Aluminum and chromium exceeded water quality criteria in the upstream surface water sample, and aluminum, copper, manganese, and molybdenum exceeded the water quality criteria in the downstream surface water sample. Copper, manganese, and molybdenum may pose a threat to water quality in Hoffman Creek.

**40 CFR 440 Subpart D:** All surface water samples were analyzed for mercury, nickel, pH, and TSS to provide information for comparison with effluent criteria from Code of Federal Regulations (CFR) Title 40, Part 440—Ore Mining and Dressing Point Source Category, Subpart D—Mercury Ore Subcategory. Title 40 analysis is presented on Table 10. TSS for surface water was <0.5 mg/L downstream and 16 mg/L upstream. Nickel was 0.0052 mg/L upstream and <0.0029 mg/L downstream. Mercury was <0.00015 mg/L up and downstream. pH was 7.79 upstream and 8.14 downstream. All of these concentrations and parameters fall below the maximum one-day effluent limitation.
6.6 Mercury Vapor

The measured mercury vapor concentrations ranged from 10 ng/m$^3$ to 103 ng/m$^3$. Each of the measurements were collected at the ground surface, and at chest height. There was a tendency for the ground-level mercury vapor concentrations to be slightly higher than the chest-height mercury vapor concentrations.

Mercury vapor survey results were all below the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) 8-hour time weighted average of 100,000 nanograms per cubic meter (ng/m$^3$). The OSHA PEL represents the maximum mercury vapor concentration that a worker should be exposed to in the workplace for no more than 10 hours in one day and no more than a total of 40 hours per week.

Mercury vapor survey results at eight locations were below the suggested 1,000 ng/m$^3$ level acceptable for occupancy of any structure after a spill (residential occupancy level).

7.0 Conclusions and Recommendations

Based on the results from this Phase II Site Investigation, mining activities at the Plymouth Mine resulted in two waste rock piles that contain mercury concentrations posing a high risk to human health and an extremely high risk to ecological receptors; the Adit Waste Rock may release mercury to surface water, and may have affected Saint Helena Creek sediment with mercury downstream of Hoffman Creek at very high levels.

Human Health. Arsenic and mercury in waste rock and sediment were the only metals to exceed the California Human Health Screening Levels (CHHSL) and EPA regional screening levels (RSL) for commercial/industrial screening criteria. All reported concentrations of arsenic were below background concentrations and are thus not considered a risk to human health associated with mining activities. Mercury from the Adit Waste Rock pile (1,600 mg/kg) was 42 times the most stringent screening criteria, indicating high risk to human health. While mercury was reported at 0.79 mg/kg in the sediment sample collected in Hoffman Creek downstream of the adit, mercury was reported in the downstream sediment sample in Saint Helena Creek at 750 mg/kg, 16 times the most stringent screening criteria for human health, indicating a potential high risk. While it is possible that there is another source for this mercury in Saint Helena Creek, a likely source is the Plymouth Mine. Additional sampling is necessary to resolve this.

Ecological Receptors. Mercury in waste rock and sediment was the only metal to exceed the wildlife or livestock risk-based screening criteria provided in BLM Technical Note 390 (BLM, 2004) (see Table 2). The mercury exceedances in waste rock were 5 times to 200 times the screening criteria, indicating moderate to extremely high risk (BLM, 2004). The waste rock is not well vegetated, and one waste rock pile (Adit Waste Rock) is adjacent to Hoffman Creek.
**Water Quality.** Aluminum, copper, manganese, and molybdenum exceeded the water quality criteria in the downstream surface water sample in Hoffman Creek, and were all higher than the upstream surface water sample concentrations. Based on this observation, the Plymouth Mine may be contributing these metals to surface water in Hoffman Creek. However, the downstream sample location may also reflect the ongoing effects of agriculture and residential use of the property.

**Recommendations.** Burleson recommends that consideration be given to removing the Adit Waste Rock along Hoffman Creek to a location where the material can be stabilized, covered, and vegetated. This would reduce the impact from mercury and other metals to Hoffman Creek and Saint Helena Creek.

Burleson recommends that if concern exists regarding potential sediment impacts, additional sediment sampling be conducted along Hoffman Creek downstream from Plymouth Mine. Additional sampling is warranted because the existing data set is limited and metal concentrations in stream sediments are known to be extremely variable (Axtman and Luoma, 1991). More thorough characterization is necessary before a decision regarding the need and method to control a potential release to sediment can be made.
8.0 References


Burleson. 2018. Sampling and Analysis Plan Phase II Environmental Site Assessment Plymouth Mine.


EPA. 2014. Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites. November.


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Tables
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## Table 1: Mercury Vapor Concentrations

<table>
<thead>
<tr>
<th>Feature</th>
<th>Measured Range of Hg Vapor (ng/m³)</th>
<th>Comparison Criteria Hg Vapor (ng/m³)</th>
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<td>Breathing Zone</td>
<td>Current levels of mercury in outdoor air (except for regional hot spots)</td>
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Notes:

Hg = mercury
ng/m³ = nanogram per meter cubed
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Table 2: Total Metals In Waste Rock and Reference Soil

Notes:
1 = California human health screening levels for Commercial/Industrial Scenario, September 2010, Office of Environmental Health Hazard Assessment.

- = not provided
BLM = Bureau of Land Management
CEC = cation exchange capacity
CHHSL = California Human Health Screening Levels
EPA = Environmental Protection Agency
lb = pounds
mg/kg = milligrams per kilogram
meq = milliequivalents
NA = not analyzed
RSL = regional screening levels
TOC = total organic carbon

**bold** = exceeded one or more screening criteria
< = less than
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Notes:
- CEC = cation exchange capacity
- meq/100g = Milliequivalents per 100 grams
- mg/kg = milligram per kilogram
- NA = not analyzed
- TOC = total organic carbon
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Notes:
1 = California human health screening levels for Commercial/Industrial Scenario, September 2010, Office of Environmental Health Hazard
2 = EPA Regional Screening Levels Summary Table, Industrial Soil, May 2018, https://www.epa.gov/risk/regional-screening-levels-rsls-generic-
- = not applicable
BLM = Bureau of Land Management
CHHSL = California Human Health Screening Levels
EPA = Environmental Protection Agency
RSL = regional screening levels
mg/kg = milligrams per kilogram
NA = not analyzed
bold = exceeded one or more screening criteria
bold = exceeded one or more screening criteria but below background concentrations
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<td>Ag WQ Limit</td>
<td>MCL</td>
<td>CTR-Fresh AL</td>
<td>CTR-Fresh AL</td>
<td>Ag WQ Limit</td>
<td>CTR-Fresh HH</td>
<td>Ag WQ Limit</td>
<td>CTR-Fresh HH</td>
<td>Ag WQ Limit</td>
<td>CTR-Fresh AL</td>
</tr>
<tr>
<td></td>
<td>0.087</td>
<td>0.006</td>
<td>0.01</td>
<td>1</td>
<td>0.004</td>
<td>0.0058</td>
<td>0.05</td>
<td>0.05</td>
<td>0.027</td>
<td>1</td>
<td>0.0098</td>
<td>0.2</td>
<td>0.001</td>
<td>0.00005</td>
<td>0.15</td>
<td>0.005</td>
<td>0.031</td>
<td>0.0017</td>
<td>0.05</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Notes:
2. AqWQ = Aqueous Water Quality
3. AWQC = Ambient Water Quality Criteria
4. CTR = California Toxic Rule
5. DI WET = Deionized Waste Extraction Treatment
6. HH = Human Health
7. MCL = Maximum Contamination Level
8. mg/L = milligrams per liter
9. < = less than
10. = not applicable
11. bold = exceeded screening criteria
## Table 6: TCLP Metals In Waste Rock

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Arsenic</th>
<th>Barium</th>
<th>Cadmium</th>
<th>Chromium</th>
<th>Lead</th>
<th>Mercury</th>
<th>Selenium</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope Waste Rock</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.1</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.05</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Waste Rock Adit</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.1</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.05</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>TCLP Threshold</td>
<td>5</td>
<td>100</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>0.2</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Notes:
- mg/L = milligrams per liter
- < = less than
- - = not applicable
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Antimony</th>
<th>Arsenic</th>
<th>Barium</th>
<th>Beryllium</th>
<th>Cadmium</th>
<th>Chromium</th>
<th>Cobalt</th>
<th>Copper</th>
<th>Lead</th>
<th>Molybdenum</th>
<th>Mercury</th>
<th>Nickel</th>
<th>Selenium</th>
<th>Silver</th>
<th>Thallium</th>
<th>Vanadium</th>
<th>Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWR</td>
<td>0.11</td>
<td>0.097</td>
<td>3.6</td>
<td>&lt;0.00035</td>
<td>&lt;0.002</td>
<td>1</td>
<td>3.2</td>
<td>0.073</td>
<td>0.14</td>
<td>0.093</td>
<td>0.0015</td>
<td>19</td>
<td>&lt;0.0011</td>
<td>0.013</td>
<td>0.001</td>
<td>0.027</td>
<td>9.3</td>
</tr>
<tr>
<td>WRA</td>
<td>0.06</td>
<td>0.1</td>
<td>1.3</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>0.77</td>
<td>1.2</td>
<td>0.22</td>
<td>0.3</td>
<td>0.035</td>
<td>0.0038</td>
<td>10</td>
<td>&lt;0.5</td>
<td>0.027</td>
<td>0.0005</td>
<td>0.023</td>
<td>1.3</td>
</tr>
<tr>
<td>Soluble Threshold Limit Concentration</td>
<td>15</td>
<td>5</td>
<td>100</td>
<td>0.75</td>
<td>1</td>
<td>-</td>
<td>80</td>
<td>25</td>
<td>5</td>
<td>350</td>
<td>0.2</td>
<td>20</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>24</td>
<td>250</td>
</tr>
</tbody>
</table>

Notes:
- mg/L = milligrams per liter
- < = less than
Table 8: Total Threshold Limit Concentrations

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Aluminum</th>
<th>Antimony</th>
<th>Arsenic</th>
<th>Barium</th>
<th>Beryllium</th>
<th>Chromium</th>
<th>Cobalt</th>
<th>Copper</th>
<th>Iron</th>
<th>Lead</th>
<th>Manganese</th>
<th>Mercury</th>
<th>Molybdenum</th>
<th>Nickel</th>
<th>Selenium</th>
<th>Silver</th>
<th>Thallium</th>
<th>Vanadium</th>
<th>Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Rock</td>
<td>SWR</td>
<td>890</td>
<td>7</td>
<td>&lt;0.77</td>
<td>6.9</td>
<td>&lt;0.1</td>
<td>1.4</td>
<td>350</td>
<td>98</td>
<td>16</td>
<td>40,000</td>
<td>6.1</td>
<td>740</td>
<td>38</td>
<td>&lt;0.4</td>
<td>2,600</td>
<td>1.1</td>
<td>0.81</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>WRA</td>
<td>450</td>
<td>3.3</td>
<td>&lt;0.77</td>
<td>4.2</td>
<td>&lt;0.1</td>
<td>&lt;1.0</td>
<td>160</td>
<td>60</td>
<td>17</td>
<td>32,000</td>
<td>7.9</td>
<td>530</td>
<td>&lt;0.4</td>
<td>1,600</td>
<td>&lt;0.4</td>
<td>1,500</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Background</td>
<td>R1</td>
<td>5200</td>
<td>24</td>
<td>&lt;0.77</td>
<td>33</td>
<td>&lt;0.1</td>
<td>4.2</td>
<td>1,200</td>
<td>240</td>
<td>22</td>
<td>160,000</td>
<td>6.5</td>
<td>1,800</td>
<td>0.86</td>
<td>&lt;0.4</td>
<td>3,800</td>
<td>2.8</td>
<td>7</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>R2</td>
<td>2900</td>
<td>16</td>
<td>&lt;0.77</td>
<td>15</td>
<td>&lt;0.1</td>
<td>1.8</td>
<td>760</td>
<td>120</td>
<td>26</td>
<td>48,000</td>
<td>8</td>
<td>1,000</td>
<td>1.9</td>
<td>&lt;0.4</td>
<td>2,200</td>
<td>0.55</td>
<td>4.1</td>
<td>&lt;0.044</td>
</tr>
<tr>
<td>TTLC</td>
<td></td>
<td>-</td>
<td>500</td>
<td>500</td>
<td>-</td>
<td>75</td>
<td>100</td>
<td>2,500</td>
<td>8,000</td>
<td>2,000</td>
<td>-</td>
<td>1,000</td>
<td>-</td>
<td>20</td>
<td>3,500</td>
<td>2,000</td>
<td>100</td>
<td>500</td>
<td>700</td>
</tr>
</tbody>
</table>

Notes:
- = not provided
mg/kg = milligrams per kilogram
NA = not analyzed
TTLC = total threshold limit concentration
**bold** = Result exceeded total threshold limit concentration
< = less than
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Bicarbonate</th>
<th>Carbonate</th>
<th>Chloride</th>
<th>Hydroxide</th>
<th>Nitrate</th>
<th>Sulfate</th>
<th>Alkalinity</th>
<th>TDS</th>
<th>Hardness</th>
<th>TOC</th>
<th>TSS</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWUS</td>
<td>280</td>
<td>&lt;0.5</td>
<td>3.4</td>
<td>&lt;0.5</td>
<td>&lt;0.4</td>
<td>4.8</td>
<td>280</td>
<td>290</td>
<td>240</td>
<td>4.5</td>
<td>16</td>
<td>7.79</td>
</tr>
<tr>
<td>SWDS</td>
<td>310</td>
<td>&lt;0.5</td>
<td>3.8</td>
<td>&lt;0.5</td>
<td>&lt;0.4</td>
<td>2.4</td>
<td>310</td>
<td>310</td>
<td>19</td>
<td>7.6</td>
<td>&lt;0.5</td>
<td>8.14</td>
</tr>
</tbody>
</table>

Notes:
- mg/L = milligrams per liter
- NA = not analyzed
- < = less than
Table 10: CAM 17 Metals In Surface Water

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Mercury</th>
<th>Nickel</th>
<th>TSS</th>
<th>Antimony</th>
<th>Arsenic</th>
<th>Barium</th>
<th>Beiumlum</th>
<th>Cadmium</th>
<th>Chromium</th>
<th>Cobalt</th>
<th>Copper</th>
<th>Lead</th>
<th>Molybdnum</th>
<th>Selenium</th>
<th>Silver</th>
<th>Thallium</th>
<th>Vanadium</th>
<th>Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SWUS</td>
<td>&lt;0.00015</td>
<td>0.0052</td>
<td>16</td>
<td>&lt;0.0022</td>
<td>&lt;0.00027</td>
<td>0.058</td>
<td>&lt;0.00018</td>
<td>&lt;0.0018</td>
<td>0.0052</td>
<td>&lt;0.0025</td>
<td>&lt;0.0031</td>
<td>&lt;0.00023</td>
<td>&lt;0.0036</td>
<td>&lt;0.0011</td>
<td>&lt;0.000070</td>
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<td>&lt;0.0039</td>
<td>&lt;0.0019</td>
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<tr>
<td>SWDS</td>
<td>&lt;0.00015</td>
<td>&lt;0.0029</td>
<td>&lt;2.8</td>
<td>&lt;0.0022</td>
<td>&lt;0.00027</td>
<td>0.017</td>
<td>&lt;0.00018</td>
<td>&lt;0.0018</td>
<td>0.012</td>
<td>0.007</td>
<td>0.28</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ag WQ</td>
<td>0.000005</td>
<td>0.01</td>
<td>-</td>
<td>0.0006</td>
<td>0.001</td>
<td>0.1</td>
<td>0.0004</td>
<td>0.0012</td>
<td>0.005</td>
<td>0.0032</td>
<td>0.025</td>
<td>0.001</td>
<td>0.0005</td>
<td>0.0017</td>
<td>0.018</td>
<td>0.00017</td>
<td>0.01</td>
<td>0.025</td>
</tr>
<tr>
<td>MCL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Day Maximum*</td>
<td>0.002</td>
<td>0.2</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
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<tr>
<td>30 Day Average2</td>
<td>0.001</td>
<td>0.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

* = Code of Federal Regulations Title 40, Part 440—Ore Mining and Dressing Point Source Category, Subpart D—Mercury Ore Subcategory
AgWQ = Aqueous Water Quality
AWQC = Ambient Water Quality Criteria
CTR = California Toxic Rule
DI WET = Deionized Waste Extraction Treatment
HH = Human Health
MCL = Maximum Contamination Level
mg/l = milligrams per liter
< = less than
- = not applicable
bold = exceeded one or more screening criteria
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Aluminum</th>
<th>Boron</th>
<th>Calcium</th>
<th>Iron</th>
<th>Magnesium</th>
<th>Manganese</th>
<th>Potassium</th>
<th>Sodium</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWUS</td>
<td>0.055</td>
<td>0.019</td>
<td>14</td>
<td>&lt;0.001</td>
<td>49</td>
<td>&lt;0.002</td>
<td>&lt;1.0</td>
<td>3.8</td>
</tr>
<tr>
<td>SWDS</td>
<td>0.088</td>
<td>&lt;0.005</td>
<td>5</td>
<td>&lt;0.001</td>
<td>1</td>
<td>0.025</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
</tr>
</tbody>
</table>

Water Quality Numerical Limits¹

Water Quality Numerical Limits¹

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Aluminum</th>
<th>Boron</th>
<th>Calcium</th>
<th>Iron</th>
<th>Magnesium</th>
<th>Manganese</th>
<th>Potassium</th>
<th>Sodium</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWUS</td>
<td>0.0087</td>
<td>0.07</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>0.02</td>
<td>-</td>
<td>6.9</td>
</tr>
<tr>
<td>SWDS</td>
<td>0.088</td>
<td>&lt;0.005</td>
<td>5</td>
<td>&lt;0.001</td>
<td>1</td>
<td>0.025</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
</tr>
</tbody>
</table>

Notes:


AqWQ = Aqueous Water Quality

AWQC = Ambient Water Quality Criteria

EPA = Environmental Protection Agency

mg/L = milligrams per liter

< = less than

- = not applicable

**bold** = exceeded one or more screening criteria

Table 11: Surface Water Total Metals by EPA 200
Figures
Westside Brownfields Coalition Assessment Project - Plymouth Mine Phase II ESA

Figure 1 - Regional Map

Sources: ESRI Data Server 2017.

Burleson Consulting, Inc.

Legend

- Target Property
Legend

- Outline of Parcel Containing Plymouth Mine
- Lake County Parcel Lines

Westside Brownfields Coalition Assessment Project - Plymouth Mine Phase II ESA

Figure 2 - Site Map

Sources: ESRI Data Server 2017.

Burleson Consulting, Inc.
Westside Brownfields Coalition
Assessment Project - Plymouth Mine Phase II ESA

Figure 4 - Soils Map

Legend

- **Target Property**

**Soil Type**
- Alfisols - Fine-loamy, well drained, mixed
- Inceptisols - Loamy, well drained, mixed
- Mollisols - Coarse-Loamy, well drained, sespentinitic
- Ultisols - Fine, clayey, well drained, oxidic

Sources: ESRI Data Server 2017.
Primary Source | Primary Release Mechanism | Secondary Source | Secondary Release Mechanism | Exposure Media | Exposure Route | Receptors
---|---|---|---|---|---|---
Mine Waste or Mercury-Enriched Silica Carbonate Rock | Infiltration/Percolation | Surface Water | Surface Water Methylation | Surface Water | Ingestion X X X X X ° X | Resident X X X X X X X
Mine Drainage | Groundwater | | | | Contact X X X X X | Worker X X X X X X X
Surface Water Runoff | Surface Water | Dissolution | Surface Water | | Ingestion X X X X X ° X | Ecological Avian X X X X X X X
Erosion & along County Road 40 | Sediment | | Sediment | | Ingestion X X X X X ° X | Ecological Mammal X X X X X X X
| Soil | | | | | Ingestion X X X X X ° X | Ecological Plant X X X X X X X
Aerial Suspension/Volatilization Dispersion | Dust/Vapor | Air | | | Inhalation X X X X X X ° |

° = Exposure route not complete or not significant
X = Exposure route complete

FIGURE 5
Plymouth Mine Conceptual Site Model
Burleson Consulting Inc.
Figure 6 - Sample Locations 1 of 2

Legends:
- Surface Water Sample Locations
- Mercury Vapor Sample Location
- Reference Sub Sample Location
- Sediment Sample Location
- Waste Rock Sub Sample Location

Westside Brownfields Coalition Assessment Project - Plymouth Mine Phase II ESA

Sources: ESRI Data Server 2017.

Burleson Consulting, Inc.
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Appendix A
Quality Assurance Project Plan
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Draft Quality Assurance Project Plan (QAPP)

For

Cooperative Agreement #: 99T30301

For

Abandoned Mine Sites in the Cache and Putah Creek Watersheds in the Counties of Lake, Napa, Solano, and Yolo

February 2018

Prepared by:
Greg Reller, Burleson Consulting, Inc.
Beth Kelly, Burleson Consulting, Inc.
Christopher Scudder, Burleson Consulting, Inc.

For:
McCord Environmental, Inc.
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Acronyms

°C degrees Centigrade
% percent
CCR California Code of Regulations
COC Chain-of-Custody
DQO Data Quality Objectives
EDD electronic data deliverable
EPA Environmental Protection Agency
GPRA Government Performance and Results Act
HSP Health and Safety Plan
ID identification
LCS laboratory control samples
MDL method detection limit
MS/MSD matrix spike/matrix spike duplicate
ORP oxidation reduction potential
QA quality assurance
QAPP Quality Assurance Project Plan
QC quality control
RPD relative percent difference
SOP standard operating procedure
TDS total dissolved solids
TSS total suspended solids
1.0 PROJECT/TASK ORGANIZATION

This project supports the Work Plan for Grant Number 99T30301 (Grant), an agreement with the U.S. Environmental Protection Agency (EPA), under their Brownfields Assessment Program. This project supports the EPA’s Strategic Plan and Government Performance and Results Act (GPRA) Goal 3: Cleaning up Communities and Advancing Sustainable Development, Objective 3.1 Promote Sustainable and Livable Communities.

This project is distinct from typical brownfields in that the targeted sites are predominantly abandoned mine sites in rural areas. This project provides a unique opportunity to address our region’s mining legacy of contamination holistically, consistently, and collectively. Mercury is our state’s leading cause of water quality impairment, and abandoned mine sites in our two watersheds were—and continue to be—major sources of that contamination. Within the 1,500-square mile planning area, there are approximately 100 abandoned mine features. Mercury monitoring in sediments, water, and fish downstream of these features has led to the listing of five reservoirs and many miles of streams as mercury-impaired.

The mining legacy is often associated with the Gold Rush in the late 1800’s, but mining also occurred sporadically to supply munitions for the world wars, and industrial products (thermometers, hearing aids, fluorescent light bulbs) into the early 1970’s. The upper watersheds were exploited by miners during each era with no regard to environmental protection. Now, several of the rural communities are economically disadvantaged and separated from the economic development experienced in the valleys below. The target community has over 10% unemployment and nearly 40% of people live below poverty levels. This project will connect these communities to downstream water users and to significant regional development plans.

1.1 Involved Parties and Roles

Chris Lee, Solano County Water Agency, is the Grant Manager and Project Lead. Elisa Sabatini, Yolo County, Tom Smythe, Lake County, and Chris Silke, Napa County, roles are Project Support. Stephen McCord of McCord Environmental, Inc. is the project manager. Danielle Dolan, local Government Commission, is the Project Facilitator. Greg Reller, Burleson Consulting, is the Site Assessor and Cleanup Planner. Erik Ringelberg and Kurt Balasek, BSK Associates, are Land Use Planners.

1.2 Organizational Chart and Responsibilities

Please see Table 1 for QAPP responsibilities. The Grant project organizational chart and personnel responsibilities are shown below in Figure 1.
1.3 Quality Assurance Officer Role

Beth Kelly is the Quality Assurance (QA) Officer. She is a chemist with over 25 years of environmental and chemical analytical experience, including data validation. Her role is to oversee the quality assurance/quality control (QA/QC) procedures found in this Quality Assurance Project Plan (QAPP) as part of the sampling, field analysis, and in-house analytical procedures.

The QA Officer will also review and assess all procedures during the life of the contract against QAPP requirements. She may stop all actions if there are significant deviations from required practices or if there is evidence of a systematic failure and will report all findings to Stephen McCord, Project Manager, including all requests for corrective action. Personnel responsible for implementing the QAPP are listed in Table 1.

Table 1: QAPP Personnel Responsibilities

<table>
<thead>
<tr>
<th>NAME</th>
<th>ORGANIZATIONAL AFFILIATION</th>
<th>TITLE/ ROLE</th>
<th>CONTACT INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christopher Lee</td>
<td>Solano County Water Agency (SCWA)</td>
<td>Project Lead</td>
<td>707-455-1105 <a href="mailto:clee@scwa2.com">clee@scwa2.com</a></td>
</tr>
</tbody>
</table>
1.4 Problem Statement

Chemicals of potential concern in mine waste at the sites might migrate to surface water, sediment, soil, groundwater, and air and may be available for uptake by humans and wildlife. The impacts from release of these chemicals remain uncertain at this time. Reference concentrations for soil, surface water, and sediment are used to evaluate possible impacts to water quality, human and ecological receptors, and to quantify impacts to local creeks. Site characterization is used to characterize the mine waste, surface water, mine drainage, and provide information to support design of mitigation measures.

1.5 Decisions or Outcomes

This project will obtain information to: characterize and classify mine waste, evaluate whether there is environmental contamination requiring a response to protect human health and the environment, and evaluate cleanup alternatives as needed.

If analytical data obtained under this QAPP exceed regulatory criteria, an analysis of Brownfields Cleanup Alternatives (ABCA) will be prepared to describe a remediation strategy based on the anticipated site use. The ABCA is prepared to identify a recommended cleanup alternative if necessary to protect human health and the environment under the anticipated site use.

1.6 Regulatory Criteria

Regulatory criteria for comparison with data are further discussed in the Phase II Sampling and Analysis Plan, Plymouth Mine (Burleson, 2017a). Levels of concern in mine waste, surface water, soil and sediment are determined in part by regulations and in part through comparison with screening benchmarks. Regulations, such as California Code of Regulations (CCR) Title 27, include prescriptive requirements for mine waste management such as capping to minimize infiltration of water, and isolation from waterways. Classification of the mine wastes in accordance with Title 27 is in part dependent on the degree of hazard they represent based on risk assessment and threats to water quality and in part on site characteristics.

Evaluation of potential water quality threats and/or potential threats to human health relies on physical site attributes including slope, vegetation, soil characteristics, distance to receiving water, anticipated
land use, and receiving water beneficial uses. Evaluating potential threats also requires information regarding chemistry of soil and water, both site-affected, and not affected by the site (background or reference). The appropriate scale for decision-making will depend upon the intended use of the property. For this reason, screening benchmarks believed to be protective of human health and the environment under intended site use will be used to evaluate the analytical data.
2.0 PROJECT/TASK DESCRIPTION

The project tasks supported under this QAPP focus on addressing environmental impacts associated with mine drainage, and mine waste impacted soil and surface water. The ultimate goal of the project is to achieve a significant improvement in water quality through reducing metal loading to nearby creeks.

2.1 Work Statement and Produced Products

Quantitative and qualitative data will be collected during a Phase II Environmental Site Assessment (ESA) as described in the Sampling and Analysis Plan Phase II Environmental Site Assessment Plymouth Mine (Burleson, 2017a).

The tasks included in this QAPP include: mine waste, background soil, sediment characterization and sampling, and surface water and mine drainage sampling.

2.2 Constituents Monitored and Measurement Techniques

Table 3 lists the data quality objectives for the Phase II ESA for all sites, and includes the types of sampling, the rationale (decision statement, available information), volume and extent, frequency of sample collection, as applicable.

2.3 Project Schedule

Table 2 includes the schedule for activities performed under this QAPP.

Table 2: Project Schedule and Deliverables

<table>
<thead>
<tr>
<th>GRANT PROJECT TASK</th>
<th>SUB-TASKS</th>
<th>GRANT PRODUCT</th>
<th>ESTIMATED INITIATION DATE OR TIMEFRAME</th>
<th>ESTIMATED COMPLETION DATE OR TIMEFRAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase II</td>
<td>Prepare SAP/QAPP</td>
<td>Phase II ESA – Plymouth Mine</td>
<td>November 2017</td>
<td>December 2017</td>
</tr>
<tr>
<td></td>
<td>Site visit to collect samples and Map features</td>
<td>Phase II ESA – Plymouth Mine</td>
<td>January 2018</td>
<td>January 2018</td>
</tr>
<tr>
<td></td>
<td>Prepare final report</td>
<td>Phase II ESA – Plymouth Mine</td>
<td>February 2018</td>
<td>March 2018</td>
</tr>
</tbody>
</table>
Table 3: Data Quality Objectives

<table>
<thead>
<tr>
<th>Target Population</th>
<th>Decision Statement</th>
<th>Available Information</th>
<th>Volume and Extent</th>
<th>Metals Concentration</th>
<th>Chemical Properties</th>
<th>Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine Waste</td>
<td>• If the mine waste contains metals above levels of concern, and exposure pathways are complete through erosion/sedimentation to surface water and/or sediment, then we will document a release. • If the mine waste does not contain metals above levels of concern, and/or there is no exposure pathway through erosion/sedimentation, a remediation work plan may not be necessary.</td>
<td>• Parcel ID • Literature</td>
<td>• Site mapping • Shallow hand excavation</td>
<td>Minimum of one composite sample per mine waste location</td>
<td>Minimum of 1 composite sample per mine waste pile</td>
<td>Minimum of 1 composite sample per waste type</td>
</tr>
<tr>
<td>Mine Drainage</td>
<td>• If mine drainage is encountered and contains metals above levels of concern, we will determine if that mine drainage is interacting with surface water, and if so, we will document a release. • If the mine drainage does not contain metals above levels of concern, or does not encounter surface water, then a remediation work plan may not be necessary.</td>
<td>• Parcel ID • Literature</td>
<td>• Site mapping • Public Domain Information • On-Site Measurement</td>
<td>Number of samples and locations to be determined</td>
<td>Measure field parameters • Sample &amp; analyze total metals and general chemical parameters</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Surface Water</td>
<td>• If metal concentrations or loads are at or above levels of concern in surface water, then we document a release. • If metal concentrations or loads are below levels of concern in surface water, then a remediation work plan may not be necessary.</td>
<td>• Parcel ID • Literature</td>
<td>• Site mapping • Public Domain Information • On-Site Measurement</td>
<td>Number of samples and locations to be determined</td>
<td>Measure field parameters • Sample &amp; analyze total metals and general chemical parameters</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Sediment</td>
<td>• If metals are present in sediment at levels that pose an unacceptable risk to receptors, then we will document a release through erosion of mine waste or enriched rock. • If metals are present in sediment below levels posing an unacceptable risk, then a remediation work plan may not be necessary.</td>
<td>• Parcel ID • Literature</td>
<td>• Site Mapping</td>
<td>Number dependent on presence of sediment at each selected location</td>
<td>Minimum of 1 composite sediment sample per location (upstream and downstream)</td>
<td>Minimum of 1 composite sample</td>
</tr>
<tr>
<td>Soil</td>
<td>• If suitable reference areas for comparison of metal concentrations in soil, sediment, and surface water with affected media are available, then reference concentrations can be identified for use in evaluating risk. • If suitable reference areas for comparison of metal concentrations in soil, sediment, and surface water with affected media are not available, then reference concentrations cannot be identified, and alternative sources of reference concentrations (regional, local, etc.) need to be evaluated.</td>
<td>• Parcel ID • Literature</td>
<td>• Reference Soil: TBD • Reference Sediment: TBD • Reference Surface Water: TBD</td>
<td></td>
<td></td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Air</td>
<td>• If metals are migrating through air at levels that pose an unacceptable risk to receptors, then we will document a release from either dust or volatilization of mine waste. • If metals migrating through air do not pose unacceptable risks to receptors, then a remediation work plan may not be necessary.</td>
<td>• Parcel ID • Literature</td>
<td>• Visual Observation • Mercury Vapor measurement • Particulate Monitoring</td>
<td>• Total Hg: Vapor survey • Metals: calculation from particulate and soil data</td>
<td>Minimum of one vapor survey per feature • Minimum of one set of dust particulate values from each feature</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>
2.4 Geographical Setting

The project area is located in the Mayacmas Mercury District, a historical mercury mining area located south of Clear Lake East of Middletown, California. Saint Helena Creek is a sub-watershed tributary to Pope Creek, a major tributary to Lake Berryessa. This area represents the third largest mercury producing region in the nation when production was most active between 1850 and 1961 (US Department of Interior, Bureau of Mines [USBM], 1965). Half of all toxic mercury pollution that enters the Sacramento River watershed comes from the Putah and Cache Creek watersheds. This mining legacy contributes to the state’s listing as impaired of several creeks in the region. And has resulted in fish consumption advisories posted for lakes and streams in the region.

3.0 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

This section presents the QA objectives for the project data quality indicators: precision, accuracy, representativeness, completeness, detection limits, and comparability. Tables 4 through 8b summarize the analytical parameters and laboratory QA/QC objectives for each analysis.

3.1 Precision and Accuracy

Precision and accuracy goals depend on the types of samples, analyses, and ultimate use of the analytical data. Accuracy will be evaluated from matrix spike/matrix spike duplicate (MS/MSD) samples as percent recovery (%Recovery). In addition, laboratory control samples (LCS) prepared from a different stock solution than the calibration standards and traceable to established standards will be analyzed with each sample batch and the % Recovery calculated. Precision will be evaluated as the relative percent difference (RPD) between MS/MSD results. Precision also will be evaluated using laboratory duplicates. An RPD will be calculated for each analyte in the duplicate pair. The QA objectives for all analyses will be 25% RPD for precision and 75-125 % for accuracy.

3.2 Detection Limits

Expected detection limits listed in the tables below are based on historical method detection limit (MDL) studies by the laboratory and experience with the type of matrix being analyzed within the evaluation. Method blank results will be reported only at concentrations greater than the detection limit to decrease reporting of low-level blank contamination.

3.3 Completeness

Completeness is an assessment of the amount of valid data obtained from a measurement system compared to the amount of data expected. The percent completeness is calculated as follows: the number of samples yielding acceptable data is divided by the total number of samples collected multiplied by 100. The objective for the degree of completeness is 90 percent. If completeness is less than 90 percent, this will be documented during the data quality assessment why this objective was not met and the impact of any lower percentage on the project.
3.4 Representativeness

For this project, representativeness involves sample size, sample volume, and sampling locations. The QA goal is to obtain an adequate number of samples that represent the media and its properties at the time of collection. The volume of sample collected also depends on the analytical method chosen, allowing for QC sample analysis and re-analysis if needed. Method blanks are also an indicator of representativeness. If target compounds are not detected in method blank samples, then target compounds detected in analytical samples are representative of the sample rather than laboratory or cross-contamination.

3.5 Comparability

Data comparability will be maximized by using standard EPA analytical methods when possible. Procedures for all planned methods are specified, and any deviations from the methods will be documented. All results will be reported down to the detection limit in the standard units shown in the tables or in the units specified in the method. Comparability also will be maximized by use of consistent sample collection techniques and analytical methods.
Table 4: Screening Benchmarks and Analytical Detection Limits for Metals in Soil/Sediment/Mine Waste.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Screening Criteria (mg/kg)</th>
<th>Analytical Detection Limit (mg/kg)</th>
<th>Analytical Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td>35(^1)</td>
<td>0.5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Aluminum</td>
<td>NA</td>
<td>50</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Arsenic</td>
<td>1(^1)</td>
<td>1.0</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Barium</td>
<td>6,300(^2)</td>
<td>5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Beryllium</td>
<td>1,700(^2)</td>
<td>0.5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Boron</td>
<td>NA</td>
<td>5.0</td>
<td>EPA 200.7/3050B SW-846 6010B</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.3(^1)</td>
<td>0.25</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Cobalt</td>
<td>3,200(^2)</td>
<td>0.5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Chromium III</td>
<td>100,000(^2)</td>
<td>1.0</td>
<td>EPA 200.7/3050B SW-846 6010B</td>
</tr>
<tr>
<td>Copper</td>
<td>7(^1)</td>
<td>1.0</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Iron</td>
<td>NA</td>
<td>20</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Manganese</td>
<td>960(^1)</td>
<td>20</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Mercury</td>
<td>1(^1)</td>
<td>0.05</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>4,800(^2)</td>
<td>0.5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Nickel</td>
<td>135(^1)</td>
<td>0.5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Lead</td>
<td>6(^1)</td>
<td>0.5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Antimony</td>
<td>380(^2)</td>
<td>1.0</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Selenium</td>
<td>35(^1)</td>
<td>2.0</td>
<td>EPA 200.8/3050B-SW-846 6020A</td>
</tr>
<tr>
<td>Thallium</td>
<td>63(^2)</td>
<td>0.5</td>
<td>EPA 200.8/3050B SW-846 6020A</td>
</tr>
<tr>
<td>Vanadium</td>
<td>6,700(^2)</td>
<td>1.0</td>
<td>EPA 200.7/3050B SW-846 6010B</td>
</tr>
<tr>
<td>Zinc</td>
<td>43(^1)</td>
<td>5.0</td>
<td>EPA 200.7/3050B SW-846 6010B</td>
</tr>
</tbody>
</table>

Notes:
2. California Human Health Screening Level for Soil—Commercial/Industrial Land Use
NA – not applicable
### Table 5: Metal Detection Limits and Screening Criteria for Water/Drainage.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Screening Criteria (µg/L)</th>
<th>Analytical Detection Limit (µg/L)</th>
<th>Analytical Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td>0.84&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Aluminum</td>
<td>87&lt;sup&gt;3&lt;/sup&gt;</td>
<td>50</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Arsenic</td>
<td>10</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Barium</td>
<td>1,000</td>
<td>5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Beryllium</td>
<td>4</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Boron</td>
<td>700</td>
<td>5.0</td>
<td>EPA 200.7/3010 A SW-846 6010B</td>
</tr>
<tr>
<td>Cadmium</td>
<td>1.1&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0.25</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Cobalt</td>
<td>50</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Chromium</td>
<td>50</td>
<td>1.0</td>
<td>EPA 200.7/3010 A SW-846 6010B</td>
</tr>
<tr>
<td>Copper</td>
<td>4.1&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.0</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Iron</td>
<td>300</td>
<td>20</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Manganese</td>
<td>50</td>
<td>20</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.05</td>
<td>0.05</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>10</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Nickel</td>
<td>24&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Lead</td>
<td>0.92&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Antimony</td>
<td>6</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Selenium</td>
<td>5&lt;sup&gt;3&lt;/sup&gt;</td>
<td>2.0</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Thallium</td>
<td>1.7</td>
<td>0.5</td>
<td>EPA 200.8/3010 A SW-846 6020A</td>
</tr>
<tr>
<td>Vanadium</td>
<td>50</td>
<td>0.5</td>
<td>EPA 200.7/3010 A SW-846 6010B</td>
</tr>
<tr>
<td>Zinc</td>
<td>54&lt;sup&gt;4&lt;/sup&gt;</td>
<td>5.0</td>
<td>EPA 200.7/3010 A SW-846 6010B</td>
</tr>
</tbody>
</table>

**Notes:**
2. California Human Health Screening Level for Soil—Commercial/Industrial Land Use
3. A Compilation of Water Quality Goals, California Regional Water Quality Control Board—Central Valley Region (August 2003)
4. Varies with hardness for protection of fresh water aquatic life, value provided is for 40 mg/l hardness.
5. Method for most metals is ICP/MS, EPA Method 200.8; a few metals are analyzed using ICP, EPA Method 200.7.
NA – not applicable

### Table 6: Field Analytical Methods and Detection Limits

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>PHASE</th>
<th>METHOD</th>
<th>DETECTION LIMIT</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved Oxygen (DO)</td>
<td>Total</td>
<td>DO Polarographic Probe</td>
<td>0.0 to 19.9</td>
<td>mg/L or (% Saturation)</td>
</tr>
<tr>
<td>pH</td>
<td>Total</td>
<td>EPA 150.1</td>
<td>0.1 (0 to 14)</td>
<td>pH</td>
</tr>
<tr>
<td>Specific Conductance</td>
<td>Total</td>
<td>EPA 120.1</td>
<td>1</td>
<td>µmho</td>
</tr>
<tr>
<td>Oxidation Reduction Potential (ORP)</td>
<td>Total</td>
<td>SM 2580 AB</td>
<td>± 25mv</td>
<td>mv as Eh</td>
</tr>
</tbody>
</table>

mg/L = milligrams per liter, ng or mg/m³ = nanograms or milligrams per cubic meter, mv = millivolts, ORP = oxidation reduction potential
### Table 7: Laboratory Measurement Quality Objectives for Analytical Parameters for Water

<table>
<thead>
<tr>
<th>ANALYTE</th>
<th>ANALYTICAL METHOD OR EQUIVALENT</th>
<th>WATER DETECTION LIMIT A</th>
<th>PRECISION (RPD) B</th>
<th>ACCURACY (% R) C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total and Dissolved Metals</td>
<td>EPA 200.8</td>
<td>Various (see Table 8a)</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>EPA 415.3/SM5310B</td>
<td>0.02 mg/L</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Hardness (as CaCO₃)</td>
<td>SM2340/EPA 200.8/EPA 6010</td>
<td>1 mg/L</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Chloride</td>
<td>EPA 300.1</td>
<td>20 μg/L</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Nitrate-N</td>
<td>EPA 300.1</td>
<td>400 μg/L</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Turbidity</td>
<td>EPA 180.1</td>
<td>0.1 NTU</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Sulfate, Chloride, Nitrate</td>
<td>EPA 300.0</td>
<td>200 μg/L</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Alkalinity as CaCO₃</td>
<td>EPA 310.1/SM2320B</td>
<td>1.0 mg/L</td>
<td>25</td>
<td>75-125</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>EPA 360.1</td>
<td>1 mg/L</td>
<td>10</td>
<td>5% bias</td>
</tr>
<tr>
<td>pH</td>
<td>EPA 150.1</td>
<td>0.1 pH units</td>
<td>10</td>
<td>0.1 % bias</td>
</tr>
<tr>
<td>TDS/TSS</td>
<td>EPA 160.1/160.2</td>
<td>10 mg/L / 4 mg/L</td>
<td>10</td>
<td>5% bias</td>
</tr>
<tr>
<td>ORP</td>
<td>SM 2580 AB</td>
<td>± 25 mv as Eh</td>
<td>10</td>
<td>5% bias</td>
</tr>
<tr>
<td>SC</td>
<td>EPA 120.1</td>
<td>1 μmho</td>
<td>10</td>
<td>5% bias</td>
</tr>
<tr>
<td>Ethanol</td>
<td>EPA 8015B</td>
<td>2.0 mg/L (MDL 0.15 mg/L)</td>
<td>10</td>
<td>75-125</td>
</tr>
</tbody>
</table>

**Notes:**
- a = Detection limits may be higher for samples with elevated contaminant concentrations.
- b = Precision as relative percent difference (RPD)
- c = Accuracy as % R of matrix spikes
- ORP = Oxidation Reduction Potential
- mv = millivolts
- MDL = method detection limit
- SC = Specific Conductance
- %R = Percent recovery
- RPD = Relative percent difference
- mg/L = Milligrams per liter
- meq/L = Milliequivalents per liter
- mg/kg = Milligrams per kilogram
- μg/L = Micrograms per liter
- ng/L = Nanograms per liter
- ng/g = Nanograms per gram
- NTU = Nephelometric Turbidity Units
Table 8a: Measurement Quality Objectives for Metals in Water and Soil

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Analytical Method</th>
<th>Soil Detection Limit a mg/kg</th>
<th>Water/STLC – DI Detection Limit a μg/L</th>
<th>STLC-Citric Acid Detection Limit b μg/L</th>
<th>Precision (RPD) b</th>
<th>Accuracy (% R) c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>50</td>
<td>50</td>
<td>2500</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Antimony</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>1.0</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Arsenic</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>1.0</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Barium</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>5</td>
<td>5</td>
<td>250</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Beryllium</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>0.5</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Boron</td>
<td>EPA 200.7/SW-846 6010B</td>
<td>5</td>
<td>5</td>
<td>250</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Cadmium</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>0.25</td>
<td>0.25</td>
<td>12.5</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Calcium</td>
<td>EPA 200.7/SW-846 6010B</td>
<td>100</td>
<td>100</td>
<td>5000</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Chromium</td>
<td>EPA 200.7/SW-846-6010B</td>
<td>1.0</td>
<td>1.0</td>
<td>50</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Cobalt</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>0.5</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Copper</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>1.0</td>
<td>1.0</td>
<td>50</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Iron</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>20</td>
<td>20</td>
<td>1000</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Lead</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>0.5</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Magnesium</td>
<td>EPA 200.7/SW-846-6010B</td>
<td>20</td>
<td>20</td>
<td>1000</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Manganese</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>20</td>
<td>20</td>
<td>1000</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Mercury</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>0.05</td>
<td>0.2/0.05 d</td>
<td>10</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>0.5</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Nickel</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>0.5</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Potassium</td>
<td>EPA 200.7/SW-846-6010B</td>
<td>20</td>
<td>20</td>
<td>1000</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Selenium</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>2.0</td>
<td>2.0</td>
<td>100</td>
<td>25</td>
<td>75 to 125</td>
</tr>
<tr>
<td>Analyte</td>
<td>Analytical Method</td>
<td>Soil Detection Limit</td>
<td>Water Detection Limit a</td>
<td>Precision (RPD) b</td>
<td>Accuracy (% R) c</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>----------------------------------------</td>
<td>----------------------</td>
<td>-------------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>Total Mercury</td>
<td>EPA 245.1/7471</td>
<td>0.05 mg/kg</td>
<td>0.2 μg/L</td>
<td>25</td>
<td>75-125</td>
<td></td>
</tr>
<tr>
<td>Cation Exchange Capacity</td>
<td>EPA 9080</td>
<td>1 mg/L or 1 meq/L</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acid Base Accounting</td>
<td>EPA 600/2-78-054</td>
<td>100 mg/kg (AGP and ANP)</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC)</td>
<td>EPA 415.3/SM5310B/EPA 9060</td>
<td>200 mg/kg</td>
<td>0.3 mg/L</td>
<td>25</td>
<td>75-125</td>
<td></td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>SM 2540D</td>
<td></td>
<td>4 mg/L</td>
<td>25</td>
<td>5% bias</td>
<td></td>
</tr>
<tr>
<td>Hardness (as CaCO$_3$)</td>
<td>SM2340/EPA 200.8</td>
<td></td>
<td>1 mg/L</td>
<td>25</td>
<td>75-125</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>EPA 300.1</td>
<td></td>
<td>500 μg/L</td>
<td>25</td>
<td>75-125</td>
<td></td>
</tr>
<tr>
<td>Nitrate-N</td>
<td>EPA 300.1</td>
<td></td>
<td>400 μg/L</td>
<td>25</td>
<td>75-125</td>
<td></td>
</tr>
<tr>
<td>Sulfate</td>
<td>EPA 300.1</td>
<td></td>
<td>500 μg/L</td>
<td>25</td>
<td>75-125</td>
<td></td>
</tr>
<tr>
<td>Alkalinity as CaCO$_3$</td>
<td>EPA 310.1/SM2320B</td>
<td></td>
<td>1.0 mg/L</td>
<td>25</td>
<td>75-125</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>SM 4500H-B</td>
<td></td>
<td>0.1 pH units</td>
<td>10</td>
<td>0.1 % bias</td>
<td></td>
</tr>
<tr>
<td>ORP (Eh)</td>
<td>SM 2580 AB</td>
<td>± 25mv</td>
<td></td>
<td>10</td>
<td>5% bias</td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>EPA 120.1</td>
<td></td>
<td>1 μmho</td>
<td>10</td>
<td>5% bias</td>
<td></td>
</tr>
</tbody>
</table>
Notes:
a = Detection limits based on CLS laboratory and may be higher for samples with elevated contaminant concentrations. The above laboratory detection limits for the STLC leachate are lower than the CCR Title 22 STLC regulatory values for identification of hazardous substances.
b = Precision as relative percent difference (RPD)
c = Accuracy as % R of matrix spikes
d = subcontracted to FGL laboratory for lower detection limit.

CCR  California Code of Regulations
STLC Soluble Threshold Limit Concentration
ORP  Oxidation Reduction Potential
Mv   millivolt
SC   Specific Conductance
%R  Percent recovery
RPD  Relative percent difference
SM   Standard Methods for Chemical Analysis of Water and Wastes (EPA 1983)
mg/L  Milligram per liter
meq/L Milliequivalents per liter
μmho micromhos
mg/kg Milligram per kilogram
NTU nephelometric turbidity units
μg/L  Microgram per liter
4.0 SPECIAL TRAINING NEEDS/CERTIFICATION

4.1 Specialized Training or Certifications

Training requirements specified in the Health and Safety Plan (HSP) (Burleson, 2017b) will be completed as required for field sampling.

In addition, personnel responsible for operating mechanical equipment will receive the necessary operating instruction on that equipment. Sampling personnel will be trained to use industry-standard practices.

4.2 Training and Certification Documentation

All personnel involved in field activities will be familiar with the requirements of this project QAPP. Hard copies of the current approved version of the project-specific QAPP and its appendices will be maintained by QAPP Personnel for ready reference.

Each analytical laboratory maintains their training documentation and certification.

4.3 Training Personnel

Sampling oversight will be provided by Greg Reller and Chris Scudder.
5.0 DOCUMENTS AND RECORDS

5.1 Field Documentation

Sample collection activities will be documented in permanently bound, page-numbered, weather-resistant field logbooks assigned to each field sampling technician or coordinator. Each notebook will be identified by project monitoring activity and the individual assigned custody of the logbook. If logbook custody is transferred to another individual, such transfer will be noted in the logbook and signed and dated by both parties. All entries will be made in indelible ink; errors will be corrected by one single line through the text being revised, and all such corrections will be initialed and dated.

Bound field logbooks will be used to record the following information:

- Sample date, time, types, numbers, and quantities;
- Sample container preservation steps performed;
- Sample locations or station identification (ID) number or code;
- Sampling equipment used;
- Decontamination steps performed;
- Calibration and maintenance actions;
- Information identifying other field equipment by equipment identification number, model/manufacturer, serial number, or other unique identifier; and
- Confirmation that Chain-of-Custody (COC) forms or notebook pages were properly completed and sample custody transferred as required by this QAPP.

In addition, other ancillary information should be recorded on a field form, including:

- Summary of daily activities;
- Any deviations from the associated work plan, sampling plan, QAPP, or standard operating procedure (SOP);
- Time of arrivals/departures of field technician and/or other visitors to the sampling station;
- Weather conditions;
- Time and subject of any incoming or outgoing telephone/radio contacts; and
- Any unusual events.

5.2 Chain-of-Custody Records

During sampling activities, a “paper trail” of sample custody must be maintained from the time the samples are collected until laboratory data are issued. Initial information concerning sample collection will be recorded in the field logbook. Information on the custody, transfer, handling, and shipping of samples will be recorded by the field technician on a COC form provided by the destination laboratory.
A COC form or equivalent notebook page will be completed for each set of samples collected daily and will contain the following information:

- Field Technician’s signature;
- Project name;
- Date and time of collection;
- Sample identification number and matrix;
- Analyses requested;
- Number of containers;
- Signature of persons relinquishing custody, dates, and times;
- Signature of persons accepting custody, dates, and times;
- Method of shipment; and
- Shipping papers/waybill identification number (as appropriate).

A copy of each as-transmitted COC form or equivalent log-book or forms will be retained in the monitoring program records.

5.3 Analytical Laboratory Records

The laboratories will be responsible for preparing analytical laboratory reports and electronic data deliverables (EDD) that are reviewed and approved by the laboratory’s QA Officer.

Laboratory analytical reports will include the following: field sample identification, laboratory sample identification, QA batch number, analyte name, units, dilution factor, results, results qualification code, method detection limit (if requested) and reporting limit, and laboratory QA codes as needed with explanation.

A written report will be prepared by the analytical laboratory documenting all the activities associated with each sample analysis. At a minimum, the following will be included in this report:

- Results of the laboratory analysis and laboratory QA/QC results;
- All protocols used during analyses;
- COC procedures; and
- Discussion of any deviations from the approved methods.

5.4 Project Record Files

Project records are defined as completed, legible documents, which furnish objective evidence of the quality and completeness of the data acquired pursuant to the requirements of the project activities. These records will be organized, filed and maintained under the direction the QA Officer, and will include, at a minimum:

- Copies of all bound field logbooks;
- Field copies and original (laboratory) copies of all COC forms;
- Personnel training records;
- Incoming and outgoing correspondence related to the project activity (e.g., letters, telephone conversation records, faxes, and hard copies of e-mail messages);
- Copies of all laboratory agreements and amendments thereto;
- As-received laboratory reports and data packages;
- All approved field changes;
- Draft and final versions of all reports and any associated laboratory data packages;
- Corrective and preventive action documentation or forms;
- Assessment and/or technical review reports;
- Data validation reports; and
- Draft and final versions of this QAPP and its appendices.

5.5 Field Change Request Forms

Field sampling activities can experience unexpected situations that will require deviations or modifications to the requirements of the QAPP (and/or sampling plan). Other changes may be required by other external stakeholders during the course of the project and monitoring program. The QA Officer or Project Manager may authorize the field coordinator to undertake modifications to the QAPP or its appendices provided that the scope of such modifications is discussed with and approved by the QA Officer.
6.0 SAMPLING METHOD

6.1 Field Sampling and Field Measurements Process

Activities to support site characterization were identified in the SAP (Burleson, 2017a). Based on the DQOs and data requirements, the activities described below were identified (Table 9).

6.1.1 Air Particulate Measurements

Air Particulate mass will be measured using a handheld air particulate measuring device. Visual observations will also be performed to evaluate sources of dust at the site. These measurements and observations would be collected during mapping of mine features.

6.1.2 Mercury Vapor Measurements

A mercury vapor survey will be completed using a Lumex RA-915 mercury vapor detector. Vapor measurements on mine waste piles will be made at ground level and about four feet above the ground, vapor measurements at adits will be made at accessible openings. The air temperature will be recorded at each measurement location. Mercury vapor measurements will be recorded on a field form. The mercury vapor locations measured will be recorded using GPS and included in the GIS for the site.

6.1.3 Surface Water Field Measurements

Field parameter measurements will be made in-situ in the streams or drainage, whenever possible. If an in-situ measurement is not possible, then the measurement will be made streamside by collecting the water using a decontaminated plastic container. Field equipment and meters will be calibrated prior to each sampling event, and when an instrument sampling probe is changed, in accordance with manufacturer’s instructions. The sampling probe will be decontaminated after each measurement, and before each sample is measured to avoid cross contamination. Measurements will be recorded on field sampling forms and in field logbooks.

6.1.4 Mine Drainage and Surface Water Sampling

Mine drainage and surface water samples will be collected by immersion of sample containers. Pre-cleaned sample containers provided by the laboratory will be used to collect surface water samples. Surface water will be collected by immersing sample containers directly into the water to be sampled when and where sufficient water is present. The mouth of the sample container will face upstream, and the sample will be collected at the approximate middle of the water column at the sampling location. Care will be taken to avoid collecting water with disturbed sediment by collecting samples upstream of sampling personnel positions and progressing from downstream to upstream sample locations. Samples for dissolved constituents will be collected by pumping water directly from the surface water and through a 0.45 micron disposable filter prior to filling the sample container. Preserved sample containers will be filled without over-flowing to avoid diluting preservatives. Unpreserved containers will be rinsed two times with water from the sample location prior to collecting the sample when sufficient water is present. At locations where sufficient water is not present to immerse the sample container, each container will be filled at a location where the natural flow of water allows, such as flow over the lip of a pool. Sample container rinsing will not be performed at low-flow locations.
6.1.5 Mine Waste Sampling

Loose material such as leaves, twigs, and rock will be cleared from the surface. An appropriate decontaminated or disposable tool will be used to remove the sample volume from the desired depth. The material sampled will be described based on visual characteristics. Large rock fragments (> than 0.25 inches in diameter) will be removed from the sample. The sample will be processed by completing visual description, classification of the soil, and logging soil descriptions on the sampling form; and sieving using a Number 10 (2 mm) sieve. The samples will then be placed into appropriate sample containers, labeled, recorded on a chain of custody form, and placed on and under ice in an ice chest pending transport to the analytical laboratory. Compositing will be performed in the field by mixing splits from each sieved sample in a plastic bag. Mixing will be performed by agitating the sample until no visible segregated sample volumes are observed.

6.1.6 Sediment and Reference Sampling

Loose material such as leaves, twigs, and rock will be cleared from the sediment surface prior to sample collection. An appropriate decontaminated or disposable tool will be used to remove the sample volume from the desired depth. The sample will be collected from the entire thickness of the sediment column up to 12 inches thick. If thicker sediment deposits are encountered, a core or exposed section of the sediment will be visually examined for presence of differing horizons or sediment layers, and representative samples from each layer will be collected. If an extensive sediment deposit (for example a sand bar) is present, a composite sample comprising a mixture of subsamples from across the deposit will be collected. Samples will be removed from the water, visually inspected, and sealed into the sample container with no/minimal head space to minimize the chance for oxidation. The sample will then be labeled, recorded on a chain of custody form, and placed on and under ice in an ice chest pending transport to the analytical laboratory. Sediment adjacent to the sample location will be visually described.
### Table 9: Field Sampling Locations and Analytical Methods

<table>
<thead>
<tr>
<th>Water</th>
<th>Sample Frequency Based on Available Flow and Grant Years</th>
<th>Approximate Number of Field Samples</th>
<th>Notes</th>
<th>Field parameters (Temperature, pH, DO, ORP, SC, Turbidity)</th>
<th>Acid Base Accounting (mine waste only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Metals (Full List) ¹</td>
<td>Sulfate, Chloride, Nitrate,</td>
<td>Hardness (Background aqueous samples only)</td>
<td>Grains Size</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aqueous Only</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surface Water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream of adit</td>
<td>1 X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Downstream of adit</td>
<td>1 X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Mine Waste</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirt Road west of Adit across Hoffman Creek</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Cuts uphill of adit</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sediment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream of adit in Hoffman Creek</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downstream of adit in Hoffman Creek</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saint Helena Creek upstream of Hoffman Creek</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saint Helena Creek downstream of Hoffman Creek</td>
<td>1 X</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reference Soil</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East and uphill of adit and open cuts</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southwest of adit across tributary of Hoffman Creek</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mercury Vapor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adit entrance</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirt road across Hoffman Creek from adit</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East and uphill of adit in open cuts</td>
<td>1 X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: NA = not applicable

¹ The full metals list includes: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, cobalt, chromium, copper, iron, magnesium, manganese, mercury, molybdenum, nickel, lead, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.
6.2 Decontamination

For routine field sampling, reusable equipment will be triple rinsed prior to taking each sample. All rinsate may be disposed of on-site. Field personnel will handle field equipment and containers carefully to minimize the potential for cross-contamination. Equipment rinsate blanks will be collected by directing rinsate water from the decontaminated tool into a sample container during the final rinse. If filtered aqueous samples are collected, a filter blank will be collected in the field by running distilled water through a filter and directing the filtered water into a sample container. One rinsate sample will be collected each day during field sampling.

In the event that EPA Method 1669, *Sampling Ambient Water for Determination of Trace Metals at EPA Water Quality Criteria Levels* (EPA, 1998) is necessary to preclude contamination during the sampling process, all sampling equipment and sample containers will be cleaned in a laboratory or cleaning facility using detergent, mineral acids, and reagent water, and filled with weak acid and double bagged for shipment. The laboratory is responsible for generating an acceptable equipment blank to demonstrate that the sampling equipment and containers are free from trace metals contamination before they are shipped to the field sampling team. Field blanks are also required to be collected. Upon arrival at the site, a two-person team (clean and dirty hands) collects the samples. Clean hands are used for contact with the sample bottles. Dirty hands for operating equipment. All personnel must wear gloves, and sampling equipment used must be non-metallic. Field duplicate samples are also required.

6.3 Sample Containerization, Preservation, and Holding Times

Table 10 presents containerization, preservation, and holding time requirements for each parameter to be analyzed by the laboratory. Container sizes have been selected to allow for adequate sample volume for the required analysis. All containers will be obtained from the laboratory, and the laboratory will place the appropriate amount of preservatives in each container before shipment. Holding times presented are identified from the analytical methods. The holding time is the duration a sample can be held—from the time it is collected to the time it is analyzed—and still produce acceptable results.

<table>
<thead>
<tr>
<th>ANALYSIS</th>
<th>METHOD</th>
<th>MATRIX</th>
<th>SAMPLE VOLUME REQUIRED</th>
<th>HOLDING TIME</th>
<th>PRESERVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CAM 17 Metals a plus Al, Fe, and Mn</td>
<td>EPA 200.8/6020A (ICP/MS)</td>
<td>Soil</td>
<td>8-ounce glass jar</td>
<td>6 months (28 days for Hg)</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>CAM 17 WET STLC b</td>
<td>CA Title 22, Ch. 11 App II</td>
<td>Soil</td>
<td>8-ounce glass jar (100 g minimum)</td>
<td>6 months (28 days for Hg)</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>EPA 7470/7471</td>
<td>Soil</td>
<td>8-ounce glass jar</td>
<td>28 days</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Parameter</td>
<td>Method Reference</td>
<td>Sample Type</td>
<td>Container</td>
<td>Storage Duration</td>
<td>Storage Method</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------------</td>
<td>-------------</td>
<td>-----------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Total Organic Carbon (TOC)</td>
<td>EPA9060</td>
<td>Soil</td>
<td>8-ounce glass jar</td>
<td>28 days</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Cation Exchange Capacity (CEC)</td>
<td>EPA9080</td>
<td>Soil</td>
<td>8-ounce glass jar</td>
<td>6 months</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Acid Base Accounting</td>
<td>EPA 600/2-78-054</td>
<td>Soil</td>
<td>8-ounce glass jar</td>
<td>NS</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Grain Size</td>
<td>ASTM D422</td>
<td>Soil</td>
<td>8-ounce glass jar</td>
<td>NA</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Total and Dissolved Metals a</td>
<td>EPA 200.8/SW-846 6020A(ICP/MS)</td>
<td>Water</td>
<td>500 Milliliter poly bottle</td>
<td>180 days</td>
<td>Nitric Acid pH&lt;2 Cool to 4 °C</td>
</tr>
<tr>
<td>Total Mercury</td>
<td>EPA 1631E/1669</td>
<td>Water</td>
<td>500 ml glass</td>
<td>If unpreserved, 48 hr</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Total Methyl Mercury</td>
<td>EPA 1630/1669</td>
<td>Water</td>
<td>500 ml glass (lab bottle blank &amp; field equipment blank)</td>
<td>If unpreserved, 48 hr</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Turbidity</td>
<td>180.1</td>
<td>Water</td>
<td>100 ml poly</td>
<td>48 hours</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>TDS, TSS</td>
<td>160.1, 160.2</td>
<td>Water</td>
<td>1 Liter poly</td>
<td>7 days</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Ethanol</td>
<td>EPA 8015B</td>
<td>Water</td>
<td>3-VOA</td>
<td>14 days</td>
<td>pH &lt;2, HCl Cool to 4 °C</td>
</tr>
<tr>
<td>Cations (Ca, Mg, Na, K)</td>
<td>EPA 6010</td>
<td>Water</td>
<td>500 Milliliter poly bottle</td>
<td>180 days</td>
<td>Nitric Acid pH&lt;2 Cool to 4 °C</td>
</tr>
<tr>
<td>Major Ions – Chloride, Nitrate-N, Sulfate</td>
<td>EPA 300.1</td>
<td>Water</td>
<td>500 Milliliter poly bottle</td>
<td>28 days/48 hours</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>SM5310B</td>
<td>Water</td>
<td>2 VOA glass vials</td>
<td>28 days</td>
<td>HCl pH&lt;2 Cool to 4 °C</td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>EPA 310.1/SM 2320B</td>
<td>Water</td>
<td>200 Milliliter poly bottle</td>
<td>14 days</td>
<td>Cool to 4 °C</td>
</tr>
<tr>
<td>Hardness</td>
<td>SM2340B/EP A 200.8</td>
<td>Water</td>
<td>100 milliliter Poly/Glass</td>
<td>6 months</td>
<td>pH &lt;2, HNO₃</td>
</tr>
</tbody>
</table>

Notes:
- a = Metals include aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc.
- b = WET will be performed using de-ionized water.
- < Less than
- °C Degrees Celsius
- ASTM American Society for Testing and Materials
- EPA U.S. Environmental Protection Agency
- NA Not applicable
- Poly Polyethylene
- SM Standard Methods for Examination of Water and Wastewater (1983)
7.0 SAMPLE HANDLING AND CUSTODY

General sample identification, labeling, handling and COC requirements are discussed in this section. COC procedures will be strictly adhered to during sample collection, transportation and laboratory handling to assure the identity of the samples. Improper sample and data handling and inadequate COC procedures affect the credibility and acceptability of analytical results, regardless of their accuracy or precision. COC documentation will document the processing of the sample from the time of collection to the time of analysis.

7.1 Sample Labeling and Handling

Sample containers with the necessary preservatives will be provided by the contract laboratories. After collection, samples will be labeled with all necessary information filled out using waterproof ink. At a minimum, each sample label will contain the following information:

- Project name;
- Site location;
- Sample identification code;
- Date and time of sample collection, with sampler’s initials;
- Analyses required;
- Method of preservation, if used; and
- Sample matrix.

Each sample will be assigned a unique ID according to sample location and date. This ID will consist of the location code, followed by the date (4-digit year, 2-digit month, and the number for the day). For example, a sample collected from an Adit on January 15, 2018 would be labeled A20180115.

Sample containers will be sealed in Ziploc® plastic bags and immediately placed on ice in an insulated cooler chilled to 4 degrees centigrade (°C). Insulated coolers will be provided by the contract laboratories. Samples will be placed right-side up in a cooler with ice for delivery to the laboratory.

7.2 Chain-of-Custody Procedures

The field team responsible for the collection of samples will sign and retain a copy of the COC form, document the method of shipment, and send the original with the samples. The original signed COC form will be sealed in a watertight plastic envelope and attached to the inside lid of the cooler. Coolers will be secured with strapping tape and a container custody seal applied that is over-strapped with clear strapping tape. All sample shipment coolers will be transferred from the field directly to the analytical laboratory. In cases where direct delivery to the analytical laboratory is not possible, samples will be stored in a refrigerator at no more than 4°C, but above freezing. Access to the refrigerator will be restricted to the field technician or coordinators and technicians.
A COC form will be shipped or accompany the cooler to confirm transfer; the carrier waybill number will be recorded on the original COC. Commercial carriers are not required to sign the COCs. Copies of the COCs, notebook pages, and waybills will be forwarded to the monitoring program records by the field technician or coordinator.

Sample shipment will be scheduled to prevent exceeding any required holding times. Failure to conduct analyses within the required holding times may potentially require the qualification of associated analytical results and will prompt appropriate corrective and preventive action measures.

7.3 Laboratory Operations

Laboratory analyses will be managed in accordance with the laboratories’ approved QA plans or manuals and the minimum requirements described in this section of the QAPP (Appendix A). In the event conflicts may exist between the QAPP and any of the laboratory QA plans, the more stringent requirement will apply.

7.3.1 Sample Receipt

When samples arrive at each laboratory, the designated laboratory custodian receiving the sample cooler will inspect the cooler custody seal. The custodian will sign the shipping COC (when utilized) and attach the carrier billing. The shipping COC and waybill will be archived in the laboratory’s project file and a copy of the shipping COC and waybill will be forwarded for filing in the project records. The laboratory custodian will then open the cooler to inspect the samples for integrity and compare the number of containers and label information with the COC form attached to the inside of the cooler lid. Cooler temperatures will be checked and documented on the COC form. Broken custody seals, damaged sample containers, sample labeling discrepancies between container labels and the COC form, and analytical request discrepancies will be noted on the COC form. The QA Officer or field technician or coordinator will be notified of any such problems for their appropriate action.

Once any discrepancies are resolved, the laboratory custodian will enter the samples into an analytical custody log and will assign each sample a unique identification number that is cross referenced to the sample number assigned in the field. The identification number will be used by the laboratory in its internal tracking system and the status of any given sample can be checked at any time by referring to the laboratory numbers on the COC form and in the laboratory logbooks. The laboratory custodian will then sign the COC form. The original COC will be routed to the laboratory’s data management group. Copies of the COC forms documenting custody changes and documentation will be received and kept in the laboratory’s project files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. Samples, extracts, or digestates will not be sent to another laboratory without the written authorization of the QA Officer. After sample disposal, a copy of the original COC will be sent to the QA Officer to be filed in the monitoring program records.

The following identifying information will be entered into the laboratory’s database or logged into the laboratory’s bound sample receiving logbook:

- Date and time of receipt
- Laboratory project number or work order number
- Project name and number
- Sample numbers, matrices
• Analyses required

7.3.2 Sample Storage and Security

Samples will be stored in secure, designated refrigerated areas as required for the analysis to be performed. A logbook or form will be maintained for each refrigerated area, and the temperature will be recorded each working day. At a minimum, the following procedures will be applied:

- Samples and extracts will be stored in a secure area controlled by the laboratory’s designated sample custodian;
- Samples will be removed from the shipping container and stored in their original containers unless damaged; damaged samples will be disposed in an appropriate manner after notifying the lab manager and authorization to dispose is received and documented;
- Whenever samples are removed from storage, removal will be documented;
- Sample transfers will be documented on internal COC records;
- Samples and extracts will be stored after completion of analyses in accordance with contractual requirements, or until instructed otherwise by the lab manager; and
- Samples will not be stored with standards or sample extracts.

7.3.3 Sample Tracking

Laboratory personnel will use COC records, notebook pages, and databases to generate backlist reports of analyses for each sample. The reports will include the collection times along with the laboratory sample number, and will include a reference to the project title, field sample identifications, and sample matrix. Sample analyses will be scheduled on the basis of holding time considerations. Analytical assignments will be reviewed on a daily basis to ensure that holding times are not exceeded. If holding times are exceeded during laboratory custody, the QA Officer or field technician or coordinator will be immediately notified for their appropriate action.

7.3.4 Sample Custody Records

Minimum requirements for laboratory sample COC controls are as follows:

- Samples will be stored in a secured area;
- Access to the laboratory will be through a monitored area; other outside access doors to the laboratory will be kept locked in accordance with local fire requirements;
- A visitor’s log will be maintained, and visitors will be escorted while in the laboratory;
- Refrigerators, freezers, and other sample storage areas will be securely locked or maintained in a secured area;
- Only authorized personnel will have keys to locked sample storage area(s);
- Samples will remain in secure sample storage until removed for preparation or analysis;
- Sample transfers into and out of storage will be documented; and
- Custody records will be maintained by the laboratory’s sample management group.
Samples, extracts, and digestates will be retained at the laboratory for at least 60 days after the laboratory's final analytical data report has been submitted, so that any potential analytical problems can be properly addressed. The samples, extracts, and digestates may then be discarded in an approved and environmentally safe manner unless otherwise directed by the lab manager.
8.0 ANALYTICAL METHODS

This project will focus on the metals aluminum, antimony, arsenic, barium, beryllium, cadmium, total chromium, cobalt, copper, iron, lead, manganese, total mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. In addition, field parameters (oxidation reduction potential (ORP), pH, temperature, specific conductance), total dissolved solids (TDS), major ions (such as sulfate, chloride, nitrate), and hardness will be monitored. Table 11 provides a list and description of the analytical methods used for this project for water, soil, and waste samples.

Table 11: Summary of Analytical Parameters and Methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Matrix</th>
<th>Method Reference</th>
<th>Method Type</th>
<th>Method Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total and Dissolved Metals a</td>
<td>Water</td>
<td>EPA 200.8 or 3010A / SW-846 6020A(ICP/MS)</td>
<td>Laboratory</td>
<td>Inductively coupled plasma mass spectrometry (ICP/MS)</td>
</tr>
<tr>
<td>Total and Dissolved Hg</td>
<td>Water</td>
<td>EPA Method 245.1</td>
<td>Laboratory/FIELD Sampling</td>
<td>Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)</td>
</tr>
<tr>
<td>Major Anions – Chloride, Sulfate, Nitrate-N</td>
<td>Water</td>
<td>EPA 300.1</td>
<td>Laboratory</td>
<td>Determination of Inorganic Anions in Drinking Water by Ion Chromatography</td>
</tr>
<tr>
<td>Hardness</td>
<td>Water</td>
<td>SM2340B/EPA 200.8</td>
<td>Laboratory</td>
<td>Hardness by calculation, and inductively coupled plasma mass spectrometry (ICP/MS)</td>
</tr>
<tr>
<td>pH</td>
<td>Water</td>
<td>SM 4500H-B</td>
<td>Lab/Field</td>
<td>pH</td>
</tr>
<tr>
<td>Eh (ORP)</td>
<td>Water</td>
<td>SM2580 AB</td>
<td>Field</td>
<td>Oxidation-Reduction Potential (ORP)</td>
</tr>
<tr>
<td>Specific Conductance (SC)</td>
<td>Water</td>
<td>EPA 120.1</td>
<td>Field</td>
<td>Specific Conductance (SC)</td>
</tr>
<tr>
<td>Total Metals (CAM 17 list plus Aluminum, Iron and Manganese b)</td>
<td>Soil</td>
<td>200.8/EPA Method 3050B 6020A(ICP/MS)</td>
<td>Laboratory</td>
<td>Inductively coupled plasma mass spectrometry (ICP/MS)</td>
</tr>
<tr>
<td>CAM 17 b Metals plus Aluminum, Iron and Manganese/STLC c</td>
<td>Soil/Waste/DI-STLC c</td>
<td>CA Title 22, Ch 11, App II/EPA 3010A or 200.8/6020A(ICP/MS)</td>
<td>Laboratory</td>
<td>CA Hazardous Waste Soluble Threshold Limit Concentration waste extraction test method using deionized water/ Inductively coupled plasma mass spectrometry (ICP/MS)</td>
</tr>
<tr>
<td>Total Mercury</td>
<td>Soil/Waste</td>
<td>EPA 7471</td>
<td>Laboratory</td>
<td>Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)</td>
</tr>
</tbody>
</table>
### Table 11: Summary of Analytical Parameters and Methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Matrix</th>
<th>Method Reference</th>
<th>Method Type</th>
<th>Method Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cation Exchange Capacity (CEC)</td>
<td>Soil</td>
<td>EPA 9081/9080</td>
<td>Laboratory</td>
<td>Cation –Exchange Capacity of Soils (Sodium Acetate or Ammonium Acetate)</td>
</tr>
<tr>
<td>Acid Base Accounting</td>
<td>Soil</td>
<td>EPA 600/2-78-054</td>
<td>Laboratory</td>
<td>Acid Generating Potential/Acid Neutralizing Potential</td>
</tr>
<tr>
<td>Grain Size Analysis by Sieve</td>
<td>Soil</td>
<td>ASTM D422</td>
<td>Laboratory</td>
<td>Particle Size Analysis Test</td>
</tr>
<tr>
<td>Temperature</td>
<td>Soil</td>
<td>SM2550</td>
<td>Field</td>
<td>Temperature</td>
</tr>
</tbody>
</table>

**Notes:**

- a = Metals include aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc.
- b = CAM 17 metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc. Iron, and manganese will be added.
- c = STLC WET will be performed using de-ionized water. California Assessment Manual, CCR Title 22, Soluble Threshold Limit Concentration (STLC) Waste Extraction Test (WET).

**Abbreviations:**

- EPA U.S. Environmental Protection Agency
- SM Standard Methods for the Examination of Water and Wastewater (1983)
- ASTM American Society for Testing and Materials
- TCLP Toxicity Characteristic Leaching Procedure
9.0 QUALITY CONTROL

Quality assurance checks include laboratory and field methods. Laboratory quality assurance checks may include the use of blank, spiked, split and duplicate samples, calibration checks and internal standards. These samples will be handled and analyzed using the same procedures as the primary samples.

9.1 Field Quality Control Samples

Field QC samples should be collected in the field and used to evaluate the quality of the field sampling activities. Each project-specific work plan will address the specific field QC sampling requirements listed in this QAPP. Field QC samples may consist of field duplicate samples, field method blanks and/or field equipment rinsate blanks.

9.1.1 Field Duplicate Samples

Field duplicate samples may be collected to assess the accuracy, precision and overall quality of the sampling and analytical procedures. Field duplicates will be collected at a rate of 1 per 10 samples (at least one field duplicate collected per day). Field duplicate samples are collected at the same time and from the same source as the original sample. Duplicate samples will be collected, numbered, packaged, and sealed in the same manner as other samples, and submitted blind to the laboratory for identical analyses as the original sample.

9.1.2 Field Method Blank Samples

Field method blanks consist of source water (often commercially distilled water or laboratory-prepared deionized water, depending on the specific QC requirements) that is placed into the sampling containers at the same time and location of a field sample. Field method blank samples will be collected at a rate of 1 per 20 samples, or at least one per day. The field blank sample is handled in the same manner as other samples, and submitted blind to the laboratory for identical analyses as the other samples. Field blanks are used to evaluate any contamination present during sampling and/or laboratory contamination.

9.1.3 Field Equipment Rinsate Blank Samples

The equipment rinsate blank sample is collected in the same manner as other samples, utilizing any non-dedicated, decontaminated sampling equipment (sample tubing, filters, shovels, etc.). Field equipment rinsate blanks consist of the final rinsate after equipment decontamination directed into a sample container after it is poured over the decontaminated piece of equipment. Field method blank samples will be collected at a rate of 1 per 20 samples per day, or at least one per day. These samples are submitted blind to the laboratory for identical analyses as the other samples. Field equipment rinsate blanks are used to evaluate decontamination procedures of sampling equipment.

9.2 Laboratory Quality Control Samples

Laboratory QC checks are designed to determine analytical precision and accuracy, demonstrate the absence of interferences and contamination from glassware and reagents, and ensure comparability of data. Laboratory QC checks consist of LCS, method blank samples, MS/MSD samples, laboratory
duplicate samples, and other checks specified in the methods. The laboratory also will complete initial
calibrations and continuing calibration checks according to specified analytical methods.

9.2.1 Method Blanks

Method blanks will be used for the laboratory processes, as defined by the governing method. A
method blank is a volume of deionized water that is carried through the entire sample preparation and
analysis procedure. The method blank volume or weight will be approximately equal to the sample
volumes or sample weights being processed. Method blanks are used to monitor interference caused by
constituents in solvents and reagents and on glassware and other sampling equipment. A method blank
is prepared and analyzed with each analytical batch of 20 or fewer samples prepared.

9.2.2 Matrix Spikes

A spike is a sample to which is added a known amount of analyte(s) before analysis. From the
concentrations of the analyte in the spiked and unspiked samples, a percent recovery is calculated.
Many samples show matrix effects in which other sample components interfere with the determination
of the analyte. The value of the percent recovery indicates the extent of the interference. A matrix
spike is prepared by adding an analyte to a subsample of a field sample before sample preparation and
analysis. For multi-analyte methods, a representative suite containing all of the analytes is used in the
matrix spike. If matrix spikes are spiked at too low of a concentration (i.e., less than 3-5 times the native
concentration), they may be repeated at a higher spike concentration. An analytical spike is prepared by
adding analyte to an aliquot of a processed sample prior to analysis, and is used to determine whether
the analysis system provides results that are representative of the sample when a matrix spike is outside
its limits.

9.2.3 Laboratory Control Samples (Verification Solutions)

A LCS, or a blank spike, is an aqueous or solid control sample of known composition that is analyzed
using the same sample preparation, reagents, and analytical methods employed for the monitoring
program samples. An LCS is obtained from an outside source or is prepared in the laboratory by spiking
reagent water or a clean solid matrix for a stock solution that is different than that used for the
calibration standards. The LCS is the primary indicator of process control used to demonstrate whether
the sample preparation and analytical steps are in control, apart from sample matrix effects. LCSs
contain the target analytes identified in the method.

9.2.4 Laboratory Duplicate Samples

Duplicate samples are samples that have been divided into two portions at some step in the
measurement process. Each portion is then carried through the remaining steps of the process.
Duplicate samples provide information on the precision of the operations involved. Analytical duplicates
are a pair of subsamples from a field sample that are taken through the entire preparation and analysis
procedure; difference between the results indicates the precision of the entire method in the given
matrix. Under the laboratory protocols, the matrix spike is duplicated to provide a matrix spike
duplicate. Matrix spike duplicates will be prepared for every analytical batch of at least 20 samples.
Analytical duplicates are prepared by taking two aliquots of a process sample and analyzing them in the
same manner. Both matrix and analytical spike duplicates are used to monitor the precision of the
analytical process.
The laboratory will analyze one laboratory duplicate sample per sample delivery group. A sample delivery group is defined as a group of up to 20 samples received within a 14-day period. Laboratory internal QC checks are summarized in Table 12. Table 12 also indicates the required frequency, acceptance criteria, and corrective action for each QC check. Each of these checks and their frequencies are discussed below.
<table>
<thead>
<tr>
<th>QC CHECK SAMPLE</th>
<th>FREQUENCY</th>
<th>ACCEPTANCE CRITERIA</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory control samples</td>
<td>5 percent or 1 per batch, whichever is more</td>
<td>Accuracy 85 to 115% (varies based on method) RPD 15% to 25% (varies with media and method)</td>
<td>1. Evaluate other QC samples in batch. 2. Correct the problem. 3. Repeat the analysis. 4. Flag data in report.</td>
</tr>
<tr>
<td>Method blank</td>
<td>5 percent or 1 per batch, whichever is more</td>
<td>Less than the PQL</td>
<td>1. Terminate the analysis. 2. Correct the problem. 3. Reanalyze affected samples. 4. Flag data in report.</td>
</tr>
<tr>
<td>Instrument blank</td>
<td>At the beginning, end, and after every 10</td>
<td>Less than the PQL</td>
<td>1. Terminate the analysis. 2. Correct the problem. 3. Recalibrate and reanalyze samples. 4. Flag data in report.</td>
</tr>
<tr>
<td></td>
<td>samples during analysis sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory duplicate sample</td>
<td>5 percent or 1 per batch, whichever is more</td>
<td>RPD of 20 (varies based on method)</td>
<td>1. Evaluate other QC samples in the batch. 2. Flag the data in report.</td>
</tr>
<tr>
<td>(analyze duplicate aliquots from an</td>
<td>frequent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>actual field sample submitted for this</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>project)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matrix Spikes and Duplicate</td>
<td>5 percent or 1 per batch, whichever is more</td>
<td>Accuracy 75 to 125%</td>
<td>1. Evaluate other QC samples in the batch. 2. Flag the data in report.</td>
</tr>
<tr>
<td>Matrix Spikes</td>
<td>frequent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matrix Duplicate</td>
<td>5 percent or 1 per batch, whichever is more</td>
<td>RPD of 25</td>
<td>1. Evaluate other QC samples in the batch. 2. Flag the data in report.</td>
</tr>
<tr>
<td></td>
<td>frequent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

- %R: Percent recovery
- RPD: Relative percent difference
- PQL: Practical quantitation limit
- QC: Quality control
10.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

10.1 Calibration of Sampling Equipment

For water sampling, instrumentation and equipment used will generally be limited to filtration apparatus and field meters. The filtration apparatus will be used and maintained in accordance with the manufacturer’s instructions. Field meters, including the air monitoring analyzer, will be calibrated following the manufacturer’s instructions for each analyte of interest and at least once per sampling event.

10.2 Calibration of Laboratory Equipment

All analytical measurement instruments and equipment used by the laboratories will be controlled by a formal calibration and preventive maintenance program. At a minimum, each laboratory will require that equipment be of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and equipment that measure a quantity, or whose performance is expected at a stated level, are subject to calibration. In addition, each laboratory’s preventive maintenance program will include the following, as a minimum:

- A listing of the instruments and equipment that will be used;
- The frequency of maintenance considering manufacturer’s recommendations and previous experience with the equipment; and
- A file for each instrument containing a list of spare parts maintained, external contracts, and a listing of the items to be checked or serviced during maintenance.
11.0 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

11.1 Calibration Methods

Physical and chemical calibrations will be performed within each laboratory as described in this subsection. Physical calibration refers to physical measurements that are made on equipment to verify or provide corrections to the observed data. Physical calibrations will be documented on data sheets that are designed for each specific application. At a minimum, the information recorded will include the date, analyst, instrument identification, identification of reference standard, expected values, measured values, and correction factors, if applicable.

Chemical calibration or standardization refers to operations in which instrument response is related to analyzed concentration. The minimum requirements for chemical calibration will be as specified in the applicable method. Chemical calibrations consist of initial and continuing calibrations, which are documented in several ways depending on the type of instrument. For non-computerized data systems such as strip chart recorders and meter readouts, the instrument responses will be transcribed, along with other pertinent information, onto data sheets for each specific analysis. When computerized data systems are used, the data will be collected and stored in computer files, as well as hard-copy printouts, which may either be included with the data package or kept in a central record. With computerized data systems, the run logs provide a cross-reference to the calibration runs. At a minimum, the information recorded for the calibrations will include the data, analyst, instrument identification, standard identification and concentrations, raw instrument responses, file descriptor, and calibration parameters such as regression coefficients, correlation coefficients, or response and calibration factors.

Initial calibration consists of the establishment of a calibration or standard curve, which associates instrument response and analyzed concentration. The curve is constructed by measuring the responses of a series of standard solutions containing the analytes of interest at known concentrations. This initial calibration will be verified each working day by measurement of one or more calibration standards.

11.2 Calibration Apparatus

The use of calibration apparatus, including field instruments and data loggers, will be according to the manufacturer’s instructions or the laboratory’s SOPs.

11.3 Calibration Standards

Primary standards will be obtained as either neat materials, which will be used to prepare stock standard solutions, or as prepared solutions to be used as stock standards. Records will be maintained on primary standards that include date of receipt, source, purity, composition, storage conditions, and expiration dates. Primary standards will be traceable to National Institute of Standards and Technology standards, or will be vendor-certified. The preparation of stock, intermediate, and working standard solutions will be documented in standards preparation logbooks. Each stock, intermediate, and working standard will be assigned a number to permit traceability of preparation from stock to working standards and to reference the analysis of the standards. Logbooks will be completed by the appropriate analysts as they prepare standards and will be subject to supervisory review. At a minimum, working standards will be labeled with preparation data, and the number or designation of
the logbook where information on the standard is recorded. Measurements made during standards preparation will also be recorded.

11.3 Calibration Frequency

The frequency of instrument calibration will be according to the manufacturer’s instructions or the laboratories’ SOPs. Table 13 includes a summary of calibration requirements.
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>METHOD REFERENCE</th>
<th>CALIBRATION STANDARD AND FREQUENCY</th>
<th>ACCEPTANCE CRITERIA</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Metals</td>
<td>EPA 200.8/SW-846 6020A</td>
<td>Mass spectrometer tuning solution representing all of the mass regions of interest analyzed to verify that the resolution and mass calibration of the instrument are within required specifications.</td>
<td>Mass calibration must be no more than 0.1 atomic mass units (amu) from the true value. Peak resolution must also be verified to be less than 0.9 amu full width at 10 percent peak height. Four integrations (measurements) of tuning solution values must be within a relative standard deviation of 5 percent for the analytes contained in the tuning solution.</td>
<td>Mass calibration must be adjusted to the correct value.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low-level initial calibration (LLICV) standard analyzed daily and at the end of each analysis batch.</td>
<td>All analytes measured values are within ±30 percent of the expected value.</td>
<td>Terminate the sequence, correct the problem, recalibrate the instrument, and reanalyze.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial calibration verification (ICV) immediately following daily calibration (using a second source standard).</td>
<td>Measured value within ±10 percent of the expected value.</td>
<td>Terminate the analysis, correct the problem, and recalibrate the instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial and Continuing Calibration blank (ICB and CCB) immediately following the daily calibration, after every 10th sample, and at the end of the analytical run.</td>
<td>Below the detection limit.</td>
<td>Terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze the previous 10 samples</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuing calibration verification (CCV) immediately following the daily calibration, after every tenth sample, and at the end of the analytical run</td>
<td>Measured value within 10 percent of the expected value.</td>
<td>Terminate the analysis, correct the problem, recalibrate the instrument and reanalyze the previous samples following the last acceptable CCV and CCB.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interference check sample (ICS) at the beginning of each analytical run or weekly after five consecutive daily analyses are within 20% of the expected value</td>
<td>Measured value within 20 percent of the expected value.</td>
<td>Terminate the analysis; determine and correct the cause of the change, update the interelement correction factor, and recalibrate the instrument</td>
</tr>
<tr>
<td>Total Mercury</td>
<td>EPA Method 1631 E</td>
<td>Initial Blanks (3 System blanks or 3 Bubbler blanks)</td>
<td>Bubbler blanks must contain &lt;50 pg Hg.</td>
<td>Terminate the analysis, correct the problem, reanalyze samples.</td>
</tr>
<tr>
<td>PARAMETER</td>
<td>METHOD REFERENCE</td>
<td>CALIBRATION STANDARD AND FREQUENCY</td>
<td>ACCEPTANCE CRITERIA</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Total Mercury</td>
<td>EPA Method 1631 E</td>
<td>System blanks must contain &lt;0.50 ng/L Hg.</td>
<td></td>
<td>If RSD ≤ 15%, calculate the recovery for the lowest standard using mean calibration factor (CFm). If the RSD ≤ 15% and the recovery of the lowest standard is in the range of 75-125%, the calibration is acceptable and CFm may be used to calculate the concentration of Hg in samples. If RSD &gt; 15% or if the recovery of the lowest standard is not in the range of 75-125%, recalibrate the analytical system and repeat the test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Five non-zero calibration standards. Lowest calibration point must be at the Minimum Level (ML) of 0.5 ng/L</td>
<td>Relative Standard Deviation (RSD) of calibration factors (CF) for all points must be ≤ 15 %</td>
<td></td>
</tr>
<tr>
<td>Initial Precision and Recovery (IPR)</td>
<td></td>
<td>Recovery must be within 79 -121 %</td>
<td>RSD must be within 21%</td>
<td>Analyze four replicates of IPR solution. If outside of the acceptance range, correct problem, and repeat the test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bubbler blanks must contain &lt;50 pg Hg.</td>
<td>System blanks must contain &lt;0.50 ng/L Hg.</td>
<td>Terminate the analysis, correct the problem, reanalyze samples.</td>
</tr>
<tr>
<td>Method blanks analyzed after every three or four samples.</td>
<td></td>
<td>Recovery must be within 77 to 123 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-going precision and recovery (OPR) at beginning and end of each batch.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If system is not in control, correct the problem, repeat ongoing precision and recovery test. If system performance is verified at the end of the sequence using the OPR, analysis of samples and blanks may proceed without recalibration, unless more than 12 hours has elapsed since verification of system performance.
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>METHOD REFERENCE</th>
<th>CALIBRATION STANDARD AND FREQUENCY</th>
<th>ACCEPTANCE CRITERIA</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl Mercury</td>
<td>EPA Method 1630</td>
<td>Three method blanks (distillation blanks) with each analytical batch.</td>
<td>Mean blank value &lt; 0.045 ng/L methyl mercury. Variability should be &lt;0.015 ng/L methyl mercury.</td>
<td>Indicates problem with system and unacceptable for low level ambient analysis. Investigate and repeat analysis.</td>
</tr>
<tr>
<td>Methyl Mercury</td>
<td>EPA Method 1630</td>
<td>One Ethylation Blank after OPR and prior to samples. Used to blank correct standards.</td>
<td>Value must be &lt;2 pg methyl mercury.</td>
<td>Indicates problem with reagent water or solutions. Investigate, make new batch of ethylation blank solution, repeat analysis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Five non-zero calibration standards. Lowest calibration point must be at the ML of 0.06 ng/L methyl mercury.</td>
<td>RSD of CF for all points must be ≤ 15 %</td>
<td>If RSD ≤ 15%, calculate the recovery for the lowest standard using CFm. If the RSD ≤ 15% and the recovery of the lowest standard is in the range of 75-125%, the calibration is acceptable and CFm may be used to calculate the concentration of Hg in samples. If RSD &gt; 15% or if the recovery of the lowest standard is not in the range of 75-125%, recalibrate the analytical system and repeat the test.</td>
</tr>
<tr>
<td>IPR</td>
<td></td>
<td>Recovery must be within 69 -131 %</td>
<td>RSD must be within 31 %</td>
<td>Analyze four replicates of IPR solution. If outside of the acceptance range, correct problem, and repeat the test.</td>
</tr>
<tr>
<td>Method blanks analyzed after every three or four samples.</td>
<td></td>
<td>Bubbler blanks must contain &lt;50 pg Hg. System blanks must contain &lt;0.50 ng/L Hg.</td>
<td></td>
<td>Terminate the analysis, correct the problem, reanalyze samples.</td>
</tr>
<tr>
<td>OPR at beginning and end of each batch (within 12-hours).</td>
<td></td>
<td>Recovery must be within 67 to 133 %</td>
<td></td>
<td>If system is not in control, correct the problem, repeat ongoing precision and recovery test.</td>
</tr>
</tbody>
</table>
Table 13: Summary of Laboratory and Field Calibration Requirements for Major Parameters

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>METHOD REFERENCE</th>
<th>CALIBRATION STANDARD AND FREQUENCY</th>
<th>ACCEPTANCE CRITERIA</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl Mercury</td>
<td>EPA Method 1630</td>
<td>Spectrophotometer Performance Check standard is analyzed to demonstrate performance of spectrophotometer.</td>
<td>Reading must be within 10 percent of the expected absorbance value.</td>
<td>If system performance is verified at the end of the sequence using the OPR, analysis of samples and blanks may proceed without recalibration, unless more than 12 hours has elapsed since verification of system performance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial five point calibration verification with low standard defining the minimum reporting limit (RL).</td>
<td>Measured value within ± 10 percent of the expected value.</td>
<td>Terminate the analysis, correct the problem, and recalibrate the instrument.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CCV after every tenth sample, and at the end of the analytical run.</td>
<td>Measured value within 15 percent of the expected value.</td>
<td>Terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze the previous 10 samples.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ICB and CCB immediately following the daily calibration, after every 10th sample, and at the end of the analytical run.</td>
<td>Below the detection limit.</td>
<td>Terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze the previous 10 samples.</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>EPA Method 415.3</td>
<td>Initial Calibration Standards, 5 calibration standards for each analyte (one at lower and one at upper range of each analyte).</td>
<td>Within 85 to 115 percent accuracy.</td>
<td>Terminate the analysis, correct the problem, and recalibrate the instrument.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial Calibration Check Standard, daily</td>
<td>Within 85 to 115 percent.</td>
<td>Terminate the analysis, correct the problem, and recalibrate the instrument.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuing Calibration Check Standard, after every 10 samples.</td>
<td>Within 85 to 115 percent.</td>
<td>Terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze the previous 10 samples.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End Calibration Check Standard, after last field sample.</td>
<td>Within 85 to 115 percent.</td>
<td>Terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze the previous samples after last calibration standard within acceptance criteria.</td>
</tr>
<tr>
<td>Major Anions – Chloride, Sulfate, Nitrate-N</td>
<td>EPA 300.1</td>
<td>Initial Calibration Standards, 5 calibration standards for each analyte (one at lower and one at upper range of each analyte).</td>
<td>Within 85 to 115 percent accuracy.</td>
<td>Terminate the analysis, correct the problem, and recalibrate the instrument.</td>
</tr>
<tr>
<td>PARAMETER</td>
<td>METHOD REFERENCE</td>
<td>CALIBRATION STANDARD AND FREQUENCY</td>
<td>ACCEPTANCE CRITERIA</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Laboratory Reagent blank, with each batch of samples.</td>
<td>Below the detection limit.</td>
<td><strong>Laboratory Reagent blank, with each batch of samples.</strong></td>
<td><strong>Below the detection limit.</strong></td>
<td><strong>Terminate the analysis, correct the problem, and reanalyze the samples.</strong></td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>EPA 310.1/SM 2320B</td>
<td>Standardize pH meter using standard buffer solutions, or electrically operated titrator according to manufacturer’s instructions, daily. Calculate normality of standard acids (0.1N or 0.02N) by potentiometric titration with Na₂CO₃.</td>
<td>Expected amount of Na₂CO₃ for normality of standard acid. pH readings within 0.05 pH units.</td>
<td>Repeat titration. Make fresh reagents.</td>
</tr>
<tr>
<td>Turbidity</td>
<td>EPA 180.1</td>
<td>Measure standards on the turbidimeter covering range of interest.</td>
<td>At least one standard should be run in each instrument range to be used. Turbidities exceeding 40 units, dilute with turbidity-free water.</td>
<td>Recalibrate the instrument.</td>
</tr>
<tr>
<td>TSS, TDS</td>
<td>EPA 160.1, 160.2</td>
<td>Gravimetric. Drying oven, 180° C.</td>
<td>Oven temperature should be verified to within ± 2° C. Analytical balance calibrated and capable of weighing to 0.1 mg</td>
<td>Recalibrate the instrument.</td>
</tr>
<tr>
<td>Hardness</td>
<td>SM2340/EPA 200.8</td>
<td>Calculation method, sum of calcium and magnesium concentrations, expressed as calcium carbonate.</td>
<td>See metals</td>
<td>See metals</td>
</tr>
<tr>
<td>pH (field)</td>
<td>EPA 150.1</td>
<td>Calibrate using 3 pH buffer standard solutions, daily.</td>
<td>Within 0.05 pH unit</td>
<td>Rinse electrode, repeat. Replace with fresh buffer solutions.</td>
</tr>
<tr>
<td>ORP (field)</td>
<td>SM2580 AB</td>
<td>Follow manufacturer’s instructions for calibration.</td>
<td>Follow manufacturer’s instructions.</td>
<td>Follow manufacturer’s instructions.</td>
</tr>
<tr>
<td>Dissolved Oxygen (field)</td>
<td>EPA 360.1</td>
<td>Follow manufacturer’s instructions.</td>
<td>Follow manufacturer’s instructions.</td>
<td>Follow manufacturer’s instructions.</td>
</tr>
<tr>
<td>Conductivity (SC) (field)</td>
<td>EPA 120.1</td>
<td>Measure 0.01 M KCl solution, daily. Reading at 25 C is 1413 µmho/cm, adjusted for temperature.</td>
<td>Within 10 µmho</td>
<td>Correct for temperature. Repeat. Replace KCl solution.</td>
</tr>
</tbody>
</table>
12.0 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All purchased supplies and consumables that support field monitoring and sampling activities or that have a direct relationship to sample quality (e.g. sample containers, decontamination supplies, distilled/de-ionized water) will be inspected upon receipt. At a minimum this inspection will check:

- Part number/physical description matches requisition;
- Supplies are intact and undamaged;
- All required components/documentation is included; and,
- Any non-conforming items will be documented and returned to the supplier for replacement, rework or other action as necessary.
13.0 NON-DIRECT MEASUREMENTS (EXISTING DATA)

All existing data has been summarized in the Phase I Environmental Site Assessment Plymouth Mine Middletown, California (Burleson, 2017c).

14.0 DATA MANAGEMENT

14.1 Field Data Verification and Reporting

Field data will be recorded in field logbooks as the measurements are taken. Integrity of daily field instrument calibrations will be performed by the field staff and/or the Field Manager according to the instrument calibration procedures provided by the equipment manufacturer. The field instrument QC measurements will be reviewed to assure the accuracy and precision of the field screening measurements. As a standard QC procedure, the field staff and/or field coordinator will conduct verification of field data calculations and documentation entries. Prior to entry into the database, field data will be screened to ensure that no transcription errors occurred.

14.2 Laboratory Data Verification/Validation

Any anomalies or limitations for the use of the data will be documented as part of the laboratory’s analytical data packages. The laboratories will establish calibration curves and calculation of sample concentrations from instrument responses. Raw laboratory data will be converted to sample concentrations using formulas defined by applicable laboratory SOPs. The calculations will be performed by computerized data systems interfaced to the instruments by personnel calculators, or through programs installed on stand-alone personnel computers. Each laboratory analyst will be responsible for the reduction of the raw data that they generate. At a minimum, such activities will include:

- Reduction of raw data generated to reportable values;
- An initial review of analytical and QC data;
- Performance of manual calculations and transfer of data onto forms, laboratory reports, and laboratory databases;
- Preparation of computer files for instrumental calculations;
- Generation of data forms for the analytical reports;
- Copying of relevant forms and logs for inclusion in the laboratory reports;
- Submittal of the laboratory report to a supervisor for a QA/QC review; and
- Resolution of discrepancies noted during the QA/QC review.

For non-instrument methods and for methods using instruments without computerized data systems that require manual calculations, the responsible analyst will enter bench-generated data into bound laboratory workbooks with form-specific instrument responses, standard and spike concentrations, sample numbers, and other pertinent information. For instruments that are directly coupled to computerized data systems, raw data consist of instrument responses in the form of printer output or computer-generated data files. Printer output will be filed by sample batch, and the data files archived on disk or magnetic tape. Computer data files will be identified by unique, sequential descriptors cross-
referenced in the run logs to the analysis sequence. At a minimum, strip chart recordings will be labeled with the following information:

- Sample identification number;
- Date and time of analysis;
- Instrument identification;
- Name of analyst(s);
- Applicable operational parameters;
- Date file identification; and
- Positively identified elements or compounds.

Completed analytical packages (hard copies and EDDs) for each sampling round will be routed to the QA Officer for evaluation and preparation of reports. All data will be screened to ensure that data packages are complete and do not contain any obvious entry errors; any observed problems will be referred to the affected laboratory for resolution. At a minimum, the screening process will verify:

- COC forms were properly maintained from the field, to the laboratory, and through all analytical procedures;
- Laboratory reports are complete and contain no transcription errors or omissions;
- Holding time requirements were met;
- Method blanks met method requirements; and
- Quantitation limits did not exceed established values.

14.3 Data Storage and Retrieval

Data collected at the site must be in accordance with the QAPP, from sample collection in the field to data quality evaluation and data entry. Each entity collecting and analyzing data is responsible for its own data quality.
15.0 DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

15.1 Data Review and Verification Requirements

Data review is the laboratory in-house examination to ensure that the data have been processed correctly. Data verification refers to the routine checks that the field sampling coordinator or project QA officer, or laboratory staff, conduct in ensuring that the sampling plan and QAPP was followed, as applicable.

At a minimum, data verification will include evaluation of sampling documentation/ representativeness, technical holding time, instrument calibration and tuning, field and lab blank sample analyses, method QC sample results, field duplicates and the presence of any elevated detection limits. The output of data verification includes the verified data package from the laboratory with any applicable laboratory qualifiers. In addition, the lab will provide hard copies of the data with supporting laboratory quality assurance documentation.

15.2 Validation Methods

Data validation refers to the confirmation by independent examination of the data and provides objective evidence that the analytical method-specific and sample-specific procedures were followed by the laboratory and met the particular requirements for the intended use of data. Data validation methodology will differ according to the project’s DQOs. At a minimum, the following items are addressed as part of a cursory data validation process:

- Chain-of-custody forms and laboratory data sheets will be checked to verify that appropriate analyses were run and that the samples were analyzed within specified holding times;
- Review of duplicate, matrix spikes, and blank samples will be used to evaluate method precision and accuracy by the laboratory;
- An overall review of the sample delivery group will be conducted to evaluate the overall quality of the data. Included will be a review for potential transcription errors, detection limit discrepancies, data omissions and suspect or anomalous values; and
- Field data will be reviewed. Anomalous or suspect values will be noted and an explanation provided.

The analytical laboratory that generates the data will be responsible for in-house validation of the results. Laboratory validation checklists for inorganic analyses have been developed for implementation by the laboratory, as indicated in Table 14. The minimum output of data validation activities is a set of validated data with any additional qualifiers and a data validation report summarizing the findings of the data validation. An example of laboratory data flags and qualifiers for inorganic data is included in Table 14. Each laboratory uses their unique set of data qualifiers and QA flags or codes to indicate non-conformance issues.
Table 14: Definitions of Data Flags and Qualifiers for Inorganic Data

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Flag(^a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Laboratory spike sample results outside control limits</td>
<td>--</td>
</tr>
<tr>
<td>*</td>
<td>Laboratory duplicate results outside control limits</td>
<td>--</td>
</tr>
<tr>
<td>E</td>
<td>Sample results qualified because of interference (graphite furnace atomic absorption)</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>[GFAA] analytical spike or inductively coupled plasma [ICP] serial dilution</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Duplicate injection precision for GFAA analysis outside control limits</td>
<td>--</td>
</tr>
<tr>
<td>W</td>
<td>Post-digestion spike for GFAA outside control limits</td>
<td>--</td>
</tr>
<tr>
<td>+</td>
<td>Correlation coefficient for Method of Standard Additions (MSA) for GFAA less than 0.995</td>
<td>--</td>
</tr>
<tr>
<td>S</td>
<td>The reported value was determined by MSA</td>
<td>--</td>
</tr>
</tbody>
</table>

1.1.1.1.1.1 Qualifier

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R(^b)</td>
<td>Rejected</td>
<td>--</td>
</tr>
<tr>
<td>U(^b)</td>
<td>Undetected</td>
<td>--</td>
</tr>
<tr>
<td>J(^b)</td>
<td>Estimated</td>
<td>--</td>
</tr>
</tbody>
</table>


16.0 VERIFICATION AND VALIDATION METHODS

16.1 Data Validation Reports

After completing data validation review for a specific analysis type or group of analyses, the review will be summarized in a narrative report that addresses data quality, usability and acceptability in terms of the QAPP requirements. The validation report will be provided to the QA Officer for review in the format of a technical memorandum addressing the following items:

**Introduction:** This section of the memorandum will provide a short introduction to the project and outlines investigation objectives, DQOs, data quality assessment results, investigation site description, and sampling and analysis summary.

**Task and Project Location Name:** This section will identify the specific work plan under which the data have been collected and describe the specific project task. Sampling methods will be outlined and the appropriate QAPP referenced. Analytical results will be summarized and data summary tables included.

**Calculations:** This section of the memorandum will include the procedures used for calculations (if any) and a table indicating the results will be included.

**Deviations and Anomalies:** Any deviations from the approved QAPP or sampling plan will be listed and include a discussion of the usability of the data.

16.2 Corrective and Preventative Action

Corrective action and preventive action is required in response to a nonconformance. A nonconformance is defined as a potential or existing condition that may have an adverse impact on data quality. A nonconformance may be observed during routine project work or during any assessment process. Corrective and preventive action is applicable to both the field and laboratory procedures. In general, any member of the project team who identifies a nonconformance can initiate a corrective and preventive action.

The corrective and preventive action process is designed to identify, correct, and prevent or reduce the likelihood of recurrence of any nonconformance. The process consists of the following steps:

- Identify the problem constituting the potential nonconformance;
- Communicate the problem to the QA Officer, identifying the source of the quality requirement that has not been followed, applicable SOP, laboratory QA/QC procedure, applicable section of QAPP, as well as a description of the nonconformance;
- Project personnel assist in identifying the root cause of the nonconformance and identifying appropriate corrective actions as well as preventive actions;
- QA Officer and Project Manager approve proposed corrective and preventive actions and ensure that they are assigned to appropriate personnel with achievable deadlines;
- Assigned personnel (or external laboratory staff) implement actions and confirm completion;
- The QA Officer verifies completion and verifies that the actions taken were effective; and
• Any impact on data quality that was unable to be corrected must be noted in the data or relevant report.

The resolution of all quality issues will be documented in an internal memo or e-mail under the direction of the QA Officer and retained in the monitoring program records.

16.3 Reconciliation with User Requirements

All data quality issues concerning field sampling efforts, laboratory analysis, data validation, and data reporting will be reviewed by the QA Officer. A data quality assessment will be performed by each entity responsible for using the data to determine whether data generated are consistent with the investigation DQOs for each task. Specific issues to be reviewed include conformance with data quality requirements and overall data completeness, and SWAMP compatibility. Also, if data are found to deviate significantly (several orders of magnitude) from previous analyses or surrounding conditions upon which the sampling program was based, the data may be qualified based on the validator’s assessment of the usability of the data for the intended end uses.
17.0 REFERENCES


Appendix B
Health and Safety Plan
## SiteSpecificHSPChecklistForSiteSurveysAndSamplingActivities

**Project Name:** Westside Brownfields Coalition Assessment  
**Project Manager:** Greg Reller, Burleson Inc.  
**Telephone:** (916) 709-8487 ext. 111  
**Location:** Lake County, Napa County, Solano County, Yolo County, California  
**Client Contact:** Stephen McCord, McCord Environmental, Inc.  
**Telephone:** (530) 220-3165  
**EPA I.D. No.** Not applicable  
**Prepared By:** Greg Reller, Burleson Inc.  
**Date:** January 20, 2017  
**Project No.:** 99T30301  
**Date of Activities:** February 2017 – December 2018  

### Objectives:
Conduct six Phase I and two Phase II Environmental Site Assessments, prepare two Site Cleanup Plans.

### Site Type:
- **Active**  
- Landfill  
- Residential  
- **Inactive**  
- Railroad  
- Industrial  
- **Secured**  
- Uncontrolled  
- Urban  
- **Unsecured**  
- Controlled  
- Other (*specify*)  
- Abandoned mine, Rural  

### Initial Site Information
The focus of project field efforts will include:

**Phase I:** Non-intrusive site visit to allow visual inspections at six separate locations that are to be determined.

**Phase II:** Site visit to complete soil and water sampling at two of the six Phase I sites.

1. Mine feature mapping  
2. Manual sampling of soil, mine waste, and water  
3. Possible use of mechanical equipment such as a backhoe or geoprobe to access samples

### Wind Speed and Direction
(Approach from upwind): Provide on arrival at site (NA)  
**Temperature (°F):** Wet, cool winters, and warm, dry summers  
**Precipitation:** Average annual precipitation of 36 inches. January is the wettest month.  
**Forecast:** NA
### Contaminants of Concern
The contaminants of concern include mercury and nickel in water and soil.

There may also be acid drainage.

### Isolation and Protection Action Zones Based on Air Monitoring Results:
Avoid dust. Stay away from mine related apparatus, such as furnaces, where concentrations of mercury would be highest in soil. Do not enter adits or old structures; Confined space entry is not required, and will not be performed.

<table>
<thead>
<tr>
<th>Waste Type:</th>
<th>Liquid</th>
<th>Solid</th>
<th>Sludge</th>
<th>Gas</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Characteristics:</td>
<td>Corrosive</td>
<td>Toxic</td>
<td>Volatile</td>
<td>Flammable</td>
<td>Unknown</td>
</tr>
<tr>
<td>Hazard(s) of Concern:</td>
<td>Heat stress</td>
<td>Cold stress</td>
<td>Explosion or fire hazard</td>
<td>Oxygen deficiency</td>
<td>Radiological hazard</td>
</tr>
<tr>
<td>Explosion or Fire Potential:</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
<td>Unknown</td>
<td></td>
</tr>
</tbody>
</table>
### Chemical Products Project Team Will Use or Store On Site:
(Attach a Material Safety Data Sheet [MSDS] for each item.)

<table>
<thead>
<tr>
<th>Item Description</th>
<th>□</th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alconox or Liquinox</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid (HCl)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitric acid (HNO₃)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH Calibration Standards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SulphoRhodamine B dye</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration gas (Pentane)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household bleach (NaOCl)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration gas (Methane)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazcat Kit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfuric acid (H₂SO₄)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark I Kits (number?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetic acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Site Hazards/Activities:
Check as many as applicable

- General Safe Work Practices
- Control of Hazardous Energy Sources (Lockout/Tagout)
- Safe Drilling Practices
- Excavation Practices
- Working Over or Near Water
- Hot Work Practices
- Special Site Hazards
- Safe Electrical Work Practices
- Fall Protection Practices
- Portable Ladder Safety
- Drum and Container Handling Practices
- Shipping Dangerous Goods
- Flammable Hazards and Ignition Sources
- Spill and Discharge Control Practices
- Heat Stress
- Cold Stress
- Biohazards
- Underground Storage Tank Removal Practices
- Work Around Heavy Equipment
- Respirator Cleaning Procedures
- Safe Work Practices for Use of Air Purifying Respirators
- Respirator Qualitative Fit Testing Procedures

### Burleson Employee Training and Medical Requirements:

#### Basic Training and Medical

- Initial 40 Hour Training
- 8-Hour Supervisor Training (one-time)
- Current 8-Hour Refresher Training
- Current Medical Clearance (including respirator use)
- Current First Aid Training (minimum 1 Burleson employee on site)
- Current CPR Training (minimum 1 Burleson employee on site)

#### Other Specific Training

- Confined Space Training
- Level A Training
- Radiation Training
- Atropine (Nerve Agent Antidote) Injector Training
- Other ________________________________
### SITE SPECIFIC HSP CHECKLIST FOR SITE SURVEYS AND SAMPLING ACTIVITIES

#### Westside Brownfields Sites

<table>
<thead>
<tr>
<th>Materials Present or Suspected at Site</th>
<th>Highest Observed Concentration (specify units and media)</th>
<th>PEL/TLV Exposure Limit (specify ppm or mg/m³)</th>
<th>IDLH Level (specify ppm or mg/m³)</th>
<th>Primary Hazards of the Material (explosive, flammable, corrosive, toxic, volatile, radioactive, biohazard, oxidizer, etc.)</th>
<th>Symptoms and Effects of Acute Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>Not available</td>
<td>0.1 mg/m³-air/0.025 mg/m³-air</td>
<td>10 mg/m³ (as Hg)</td>
<td>Toxic</td>
<td>Acute exposure to high concentrations of mercury vapor causes severe respiratory damage, while chronic exposure to lower levels is primarily associated with central nervous system damage</td>
</tr>
<tr>
<td>Nickel</td>
<td>Not available</td>
<td>0.1 mg/m³ (inhalable fraction)</td>
<td>Ca [10 mg/m³ (as Ni)]</td>
<td>Toxic</td>
<td>Sensitization dermatitis, allergic asthma, pneumonitis; lung damage; nasal cancer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>

### Information Source(s):

- Site information based on professional experience.

Note: Use the following short forms to complete the table above.

- IDLH = Immediately dangerous to life or health
- PEL = Permissible exposure limit
- ppm = Part per million
- TLVL = Threshold limit value
- mg/m³ = Milligram per cubic meter
- Ca = carcinogen,
# Field Activities Covered Under This Plan:

<table>
<thead>
<tr>
<th>Task Description:</th>
<th>Level of Protection¹</th>
<th>Date of Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Phase I Site Visit</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
<tr>
<td>2. Phase II Sampling of soil, mine waste, and water</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
<tr>
<td>3.</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
<tr>
<td>4.</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
<tr>
<td>5.</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
<tr>
<td>6.</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
<tr>
<td>7.</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
<tr>
<td>8.</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
</tbody>
</table>

## Site Personnel and Responsibilities (include subcontractors):

<table>
<thead>
<tr>
<th>Employee Name</th>
<th>Task(s)</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greg Reller, Burleson Consulting, Inc.</td>
<td>All</td>
<td>• Project Manager or Field Team Leader: Directs project site activities, makes site safety coordinator (SSC) aware of pertinent project developments and plans, and maintains communications with client as necessary.</td>
</tr>
<tr>
<td>Chris Scudder, Burleson Consulting, Inc.</td>
<td>All</td>
<td>• Field Personnel: Completes tasks as directed by the project manager, field team leader, and SSC, and follows all procedures and guidelines established in activity specific Health and Safety Manual.</td>
</tr>
<tr>
<td>Chris Scudder, Burleson Consulting, Inc.</td>
<td>All</td>
<td>• Site Safety Coordinator: Completes tasks as directed by the project manager, field team leader, and SSC, and follows all procedures and guidelines established in the activity specific Health and Safety Manual.</td>
</tr>
</tbody>
</table>

Note: ¹ See next page for details regarding levels of protection
<table>
<thead>
<tr>
<th>Task</th>
<th>Primary Level of Protection (A,B,C,D)</th>
<th>PPE Component Description (Primary)</th>
<th>Contingency Level of Protection (A, B, C, D)</th>
<th>PPE Component Description (Contingency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D</td>
<td>CPC material:</td>
<td>D</td>
<td>If on-site observation indicates potentially unsafe work conditions, work will stop and appropriate engineering controls will be implemented to remove the unsafe condition(s). If engineering controls are not effective, work will stop until increased levels of protection are identified and properly implemented.</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>Glove material(s): Leather, Nitrile or Latex when in contact with contaminated materials (water and soil)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boot material: Leather with reinforced toe and steel shank</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard hat: When working around heavy equipment or if there is an overhead hazard</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other: Long sleeves and long pants. Protective eye-wear and hearing protection during drilling and as necessary. Weather gear as necessary</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

All levels of protection must include eye, head, and foot protection.
CPC = Chemical protective clothing
PPE = Personal Protective Equipment
A = Highest level of respiratory, skin, eye, and mucous membrane protection.
B = Highest level of respiratory protection, lesser level of skin and eye protection.
C = Airborne substance known and meets criteria for air-purifying respirators. Skin and eye exposure unlikely.
D = Work uniform for nuisance contamination. Requires coveralls or dedicated work clothing, and safety shoes/boots. Other PPE based on situation.

Level C may be acceptable for certain tasks in some situations. If you are uncertain whether Level C is appropriate, consult the Corporate Safety Officer. Additionally, when working with unknown respiratory hazards, Level C cartridge must provide protection for organic vapors, acid gases, ammonia, amines, formaldehyde, hydrogen fluoride, and particulate aerosols.
## SITE SPECIFIC HSP CHECKLIST FOR SITE SURVEYS AND SAMPLING ACTIVITIES

### Westside Brownfields Sites

### Monitoring Equipment: (Specify instruments needed for each task; attach additional sheets as necessary)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Task</th>
<th>Instrument Reading</th>
<th>Action Guideline</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustible gas indicator model:</td>
<td>1</td>
<td>0 to 10% LEL</td>
<td>Monitor; evacuate if confined space</td>
<td>Not needed</td>
</tr>
<tr>
<td>GasTech or similar Needs to detect H2S and %oxygen</td>
<td>2</td>
<td>10 to 25% LEL</td>
<td>Potential explosion hazard; notify SSC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;25% LEL</td>
<td>Explosion hazard; interrupt task; evacuate site; notify SSC</td>
<td></td>
</tr>
<tr>
<td>Oxygen meter model:</td>
<td>1</td>
<td>&gt;23.5% Oxygen</td>
<td>Potential fire hazard; evacuate site</td>
<td>Not needed</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>23.5 to 19.5% Oxygen</td>
<td>Oxygen level normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;19.5% Oxygen</td>
<td>Oxygen deficiency; interrupt task; evacuate site; notify SSC</td>
<td></td>
</tr>
<tr>
<td>Radiation survey meter model:</td>
<td>1</td>
<td>Normal background</td>
<td>Proceed</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Two to three times background</td>
<td>Notify SSC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;Three times background</td>
<td>Radiological hazard; interrupt task; evacuate site; notify Health Physicist</td>
<td>X</td>
</tr>
<tr>
<td>Photoionization detector model:</td>
<td>1</td>
<td>Any response above background to 5 ppm above background</td>
<td>Level C is acceptable Level B is recommended</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>&gt;5 to 500 ppm above background</td>
<td>Proceed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;500 ppm above background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury Vapor Detector</td>
<td>1</td>
<td>Any response up to the PEL (0.1 mg/m³)</td>
<td>Proceed</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>&gt;PEL</td>
<td>Implement engineering controls and reevaluate, if reading remains above the PEL respiratory protection is necessary. Stop work in this area and contact the project manager</td>
<td>Not needed</td>
</tr>
<tr>
<td>Particulate Meter: (needed for air monitoring during sampling with mechanized equipment)</td>
<td>2</td>
<td>Any response up to the PEL (0.1 mg/m³ based on dust with maximum reported Hg concentration)</td>
<td>Proceed</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; background + 0.1 mg/m³</td>
<td>Implement engineering controls and reevaluate, if reading remains above the PEL respiratory protection is necessary. Level C is adequate.</td>
<td>Not needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>X Background readings to be taken in area not affected by site activity.</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- eV = electron volt
- LEL = Lower explosive limit
- mrem = Millirem
- PEL = Permissible exposure limit
- ppm = Part per million
**SITE SPECIFIC HSP CHECKLIST FOR SITE SURVEYS AND SAMPLING ACTIVITIES**

**Westside Brownfields Sites**

<table>
<thead>
<tr>
<th>Site Map: to be provided for each site before leaving the office</th>
</tr>
</thead>
</table>

**Attach Maps**

As appropriate for each specific activity, label the following items on your maps:

1. Orientation
2. Wind direction
3. Muster Point and Evacuation route
4. Area of safe refuge
5. Exclusion zone
6. Contamination reduction zone (CRZ)
7. Support zone
8. Location(s) of hazardous materials
9. Monitoring Location(s)
10. Sampling location(s)
11. Command post

---

**Burleson Consulting, Inc**

Page 8 of 21
## Emergency Contacts:

<table>
<thead>
<tr>
<th>Emergency Contact</th>
<th>Telephone No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Napa, Lake, Solano, Yolo County Emergency Response</td>
<td>911</td>
</tr>
<tr>
<td>U.S. Coast Guard National Response Center</td>
<td>(800) 424-8802</td>
</tr>
<tr>
<td>National Poison Control</td>
<td>(800) 222-1222</td>
</tr>
<tr>
<td>Fire department</td>
<td>911</td>
</tr>
<tr>
<td>Napa County Sheriff</td>
<td>911 or (707) 253-4509</td>
</tr>
<tr>
<td>Lake County Sheriff</td>
<td>(707) 262-4200</td>
</tr>
<tr>
<td>Yolo County Sheriff</td>
<td>(530) 668-5280</td>
</tr>
<tr>
<td>Solano County Sheriff</td>
<td>(707) 421-7090</td>
</tr>
<tr>
<td>Burleson Consulting Inc. Personnel:</td>
<td></td>
</tr>
<tr>
<td>Project Manager: Greg Reller</td>
<td>(916) 984-4651 ext 111</td>
</tr>
<tr>
<td>SSC: Chris Scudder</td>
<td>(916) 984-4651 ext 113</td>
</tr>
</tbody>
</table>

## Medical and Site Emergencies:

Signal a site and/or medical emergency with three blasts of a loud horn (car horn, fog horn, etc.). Site personnel should evacuate to the area of safe refuge designated on the site map.

To be provided for each site

Step-by-step Route to Hospital: (see route map)

To be provided for each site


Note: This page must be posted on site.
EMERGENCY INFORMATION
POST ON SITE
Hospital Route To Be Provided Before Leaving Office

To be provided for each site
From Highway 29:
1. Head south on Hwy 29
2. Turn left onto Silverado Trail N
3. Turn left onto Glass Mountain Road
4. Turn left onto Sanitarium Rd
5. Turn right onto Woodland Rd
6. Arrive at 10 Woodland Rd., St. Helena, CA-Destination will be on right

20.6 mi – about 32 mins
**APPROVAL AND SIGN-OFF FORM**

**Project No.: ________________**

I have read, understood, and agree with the information set forth in this Health and Safety Plan and will follow the direction of the Site Safety Coordinator as well as recommended procedures and guidelines provided in this plan. I understand the training and medical requirements for conducting field work and have met these requirements.

<table>
<thead>
<tr>
<th>Name</th>
<th>__________________________</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

APPROVALS (Two Signatures Required):

<table>
<thead>
<tr>
<th>Site Safety Coordinator</th>
<th>__________________________</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Health and Safety Plan Reviewer/Approver</th>
<th>__________________________</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DEFINITIONS AND NOTES

Emergency Contacts

U.S. Coast Guard National Response Center - For issues related to spill containment, cleanup, and damage assessment; this hotline will direct spill information to the appropriate state or region

Limitations:

The Project HSP is not appropriate for projects involving unexploded ordnance, radiation sources as the primary hazard, or known chemical/biological weapons site must employ the Long Form HSP

Decontamination:

Decontamination Solutions for Chemical and Biological Warfare Agents: PPE and equipment can be decontaminated using 0.5% bleach (1 gallon laundry bleach to 9 gallons water) for biological agents (15 minutes of contact time for anthrax spores; 3 minutes for others) followed by water rinse for chemical and biological agents. In the absence of bleach, dry powders such as soap detergents, earth, and flour can be used. The powders should be applied and then wiped off using wet tissue paper. Finally, water and water/soap solutions can be used to physically remove or dilute chemical and biological agents. Do not use bleach solution on bare skin; use soap and water. Protect decon workers from exposure to bleach.

Decontamination for Radiological and Other Chemicals: For primary decontamination, staff should use Alconox and water unless otherwise specified in chemical-specific information resources. The effectiveness of radiation decontamination should be checked using a radiation survey instrument. Decontamination procedures should be repeated until the radiation meter reads less than 100 counts per minute over a 100 square centimeter area when the probe is held 1 centimeter from the surface and moving slower than 2.5 centimeters per second.

Decontamination Corridor: The decontamination set-up can be adjusted to meet the needs of the situation. The Level A decontamination set-up is included on Page 10 because it is the most complicated and critical. When compound- and site-specific information is available, the decontamination procedures can be altered to meet the needs of the specific situation.

Decontamination Waste: All disposable equipment, clothing, and decontamination solutions will be double-bagged or containerized in an acceptable manner and disposed of with investigation-derived waste.

Decontamination Personnel: Decontamination personnel should dress in the same level of PPE or one level below the entry team PPE level.

Most investigation-derived waste should be contained in trash bags and placed in regular trash. All investigation-derived waste considered to be grossly contaminated should be left on-site with the permission of the property owner. DO NOT dispose of contaminated waste until proper procedures are established.

Notes:

Attachments

Site Hazard/Activity Descriptions

MSDS for Alconox for cleaning sampling equipment
MSDS for Nitric Acid used to preserve Sample Containers
MSDC for Hydrochloric Acid used to preserve Sample Containers

Detailed Site Maps (To be provided for each site)
SITE SPECIFIC HSP CHECKLIST FOR SITE SURVEYS AND SAMPLING ACTIVITIES

Westside Brownfields Sites

SITE HAZARDS/ACTIVITY DESCRIPTIONS

GENERAL

This section provides information on potential hazards from performing site surveys and soil and water sampling activities and at various sites located in Napa County, Yolo County, Solano County, and Lake County, California. Field activities and physical features of the site may expose field personnel to a variety of physical and biological hazards. The sites are remote; therefore, all staff will employ the buddy system while working at the site. Two or more personnel will perform the field work, or alternatively an employee could be accompanied by another consultant or the ranch supervisor to perform the work so long as two people remain on site during field work.

Injuries resulting from physical and biological hazards can be avoided by following appropriate guidelines and employing caution. To ensure a safe workplace, each person working on site will coordinate with the Site Safety Coordinator (SSC) and document regular safety inspections and will make sure that all workers and visitors are informed of any potential physical and biological hazards related to the site.

The following guidelines are provided to ensure worker safety at the site.

GENERAL SAFE WORK PRACTICES

Site workers will follow these general safe work practices:

- Hazard assessment is a continual process; personnel must be aware of their surroundings and the chemical, physical, biological, and radiological hazards.

- Individuals will be familiar with the physical characteristics of a site including: wind direction; accessibility to associates, equipment, vehicles, and communication; areas of known or suspected contamination; site access; and water sources.

- The number of people should be limited to only those necessary to complete the work tasks in a safe and efficient manner.

- Eating, drinking, chewing tobacco, smoking, and carrying matches or lighters are prohibited in a contaminated or potentially contaminated area or where the possibility for contamination transfer exists.

- If flammable materials are to be ignited, equipment will be bonded and grounded, spark-proof, and explosion-resistant, as appropriate. Smoking and any other sources of ignition are prohibited within 50 feet of any work area and sources of flammable/combustible chemicals.

- Avoid contact with potentially contaminated substances or materials. Do not walk through stained soils, puddles, pools, or mud, or handle soils without protective clothing. Avoid, whenever possible, kneeling on the ground, leaning, or sitting on equipment or the ground. Do not place monitoring equipment on the ground or other potentially contaminated surfaces.

- Under no circumstances will personnel enter any mine openings. Any evidence for a mine opening will be immediately communicated to all site personnel.

- Personnel are required to work using the buddy system unless specifically stated.

- All field-crew members should be alert to potentially dangerous situations, such as the presence of strong, irritating, unusual, or nauseating odors.
Use protective equipment as specified.

Use of heavy equipment on-site, such as backhoes, trucks, and bobcats, may be hazardous to site workers. For example, the vision of a backhoe operator is limited; therefore, all field crew members should stay clear when heavy equipment is operating.

Wearing PPE can impair the ability to operate site equipment. Field crew members should pay specific attention to decreased performance capabilities resulting from the use of PPE, such as poor tactile skills when wearing gloves. Prior knowledge of limitations associated with such equipment will allow the worker to assess his or her own decrease in capability to perform field operations in a safe manner.

Wearing of jewelry, such as rings and loose bracelets and necklaces, is prohibited. Jewelry can become entangled in site machinery.

Site personnel will perform only those tasks that they are qualified to perform.

Site visitors are to be escorted by qualified personnel at all times.

Running and horseplay are prohibited in all areas of the site.

PHYSICAL HAZARDS

Physical hazards that have been identified at these sites include the following:

- Driving to/from and at the site
- Slip-Trip-Fall and working and hiking in steep terrain
- Work around heavy equipment

Driving To/From the Site

The safety hazards associated with the operation of motorized equipment, including trucks and other vehicles, can be effectively controlled by the driver if a constant awareness of these hazards is maintained. All traffic regulations and rules of the road will be followed by personnel. Drivers will be alert and well rested. Use of a cell phone during driving is prohibited, drivers needing to make a phone call will park in a safe area and make the call while parked and resume driving only after the phone call is ended.

- Headlights will be turned on at all times.
- A 15-mile-per-hour (mph) speed limit on dirt roads at each site will be observed.

Personnel will not enter a site until Livermore Ranch personnel confirm access.

Slip-Trip-Fall Hazards

While it is difficult to prevent slip-trip-fall hazards, injuries can be prevented by proper site control measures and by keeping the work area free of obstructions. Each contractor or the SSC is responsible for monitoring the work site daily and ensuring that good housekeeping is maintained. The work surfaces and steps on equipment shall be kept clean. Materials and equipment not in use will be properly stored in a manner that does not interfere with ongoing work. Personnel will use established entry/exit points during the field activities, which will be kept clear of obstructions. Personnel will use established trails and access corridors to minimize the chance for trips and falls. Sturdy hiking boots are recommended and hiking poles are helpful.
Work Around Heavy Equipment

The hazards associated with the operation of heavy equipment can be effectively managed through adequate training and constant awareness. Consistent visual or verbal contact with the equipment operator will facilitate such awareness. All personnel working around heavy equipment will wear hard hats, safety glasses, steel-toed boots, hearing protection, and orange vests or shirts. Personnel will not approach the work area in which heavy equipment is being used without first making eye contact with the operator and verifying that the operator has seen the personnel via hand signals. In addition, personnel should keep an air-horn on site to allow instantaneous communication with the equipment operator. A system of air-horn signals will be agreed upon with the equipment operator to allow rapid communication.

Working near heavy equipment can subject workers to noise exposures in excess of allowable limits. The use of ear plugs or ear muffs is mandatory when noise prevents conversation in a normal voice at a distance of 3 feet. This “rule of thumb” is an indication that noise levels may exceed the OSHA action level of 85 decibels. All personnel required to wear hearing protection, as provided by this section, shall be in a hearing conservation program in compliance with 29 CFR Section 1910.95 and 8 CCR Section 5096. When the work area is noisy or workers are wearing hearing protection, workers must be more alert to account for the decrease in communication ability.

HEAT/COLD STRESS HAZARDS

Severe heat/cold stress hazards are not anticipated for this project. Work will be scheduled around severe weather events. Work activities do not include strenuous work tasks; however, avoid over-exertion when hiking on steep grades. Employees will use appropriate weather equipment. Bring adequate water.

BIOLOGICAL HAZARDS

Biological hazards associated with site activities present a potential threat to on-site personnel. Dangers are posed by poison oak, stinging insects (bees and wasps), black widow spiders, ticks, rattlesnakes, large animals (bears and mountain lions), dehydration, and giardia.

The chance for injuries from biological hazards may be minimized by following these guidelines, and avoiding areas of reported wildlife activity. To ensure a safe workplace, the SSC may conduct and document regular safety inspections and will make sure that all workers and visitors are informed of any potential biological hazards related to the site.

Giardia

Workers should assume that all fresh water streams are infected with the giardia organism and not drink any untreated water. Workers collecting sediment and water samples from streams should wash their hands thoroughly with soap and water after collecting the samples.

Poison Oak \((R.\ diversiloba)\)

Poison oak is a shrub, climbing plant that grows up to 8 feet height, with three leaflet leaves. It is usually not found above 4,000 feet elevation. The tissues of this plant (leaves, branches, roots) contain a poisonous oil called urushiol, which is extremely irritating to the skin and causes a rash. It may be brushed onto the clothing or skin of people coming in contact with the plants, or onto pets. Contact with the plants should be avoided. After the oil has touched the skin, it usually takes some time for it to penetrate. Wash the skin thoroughly several times with plenty of soap (such as Technu) and water.
Venomous Arthropods and Snakes

Snakes and venomous arthropods, including insects, spiders, ticks, scorpions, centipedes, millipedes, and others, create a hazard when their habitats are disturbed. Wasp and bee stings account for a number of fatalities each year. In the United States, snake bites rarely cause fatalities because effective treatments have been developed. The best defense is to understand where these creatures may be found and avoid them before they can cause harm. Should a bite or sting occur, first aid should be applied immediately and medical treatment sought.

The likelihood for bites or stings can be reduced by refraining from placing hands and feet in areas that are not readily visible, by carefully inspecting the area before entering, by carefully inspecting the ground before sitting down, and by carefully inspecting objects before picking them up for examination.

Encounters with Large Animals

Large animals that could be present at the sites include bears and mountain lions. Mountain lions may be found in the vicinity, particularly if deer are present. Bears may also be found in the region.

Large animals should be avoided to prevent worker injuries. If large animal activity is noticed or reported in an area, then the area should be avoided until such activity has stopped. The following text summarizes what to do if a bear or mountain lion is encountered.

Black Bear

- While hiking, make noise to avoid a surprise.
- Never approach a bear. Give it plenty of room to pass by. Most black bears try to avoid confrontation when given a chance.
- Do not run from a bear. Running away from a black bear may stimulate its instinct to chase. You cannot outrun a bear. Instead, stand and face the animal.
- Make eye contact without staring.
- Give the bear room so that it can avoid you.
- If you encounter a bear cub, do not approach it! You run the risk of being attacked by a protective mother bear.

If a Black Bear approaches: Try to demonstrate to the bear that you may be a danger to it. Make yourself appear larger, stand up, raise your arms and open your jacket. Yell at the bear, bang pots and pans or whatever objects you may have with you, and create a general commotion.

If a Black Bear attacks: Research indicates that bear attacks have been avoided or injuries reduced when the victims fought back using any means available. Throwing rocks and striking the bear with branches or camping equipment have been shown to be effective.

Mountain Lion

Mountain lions are quiet, solitary and elusive, and typically avoid people. Mountain lion attacks on humans are extremely rare. However, conflicts are increasing as California’s human population expands into mountain lion habitat.

- Avoid hiking when mountain lions are most active—dawn, dusk, and at night.
- Do not approach a mountain lion.
- If you encounter a mountain lion, do not run; instead, face the animal, make noise and try to look bigger by waving your arms; throw rocks or other objects.
- If attacked, fight back.

EXCAVATIONS

Hazards associated with excavations include: potential collapse of the sides; employees or equipment falling into excavations; damaging utilities; and exposures to site contaminants.

A “competent person” (someone knowledgeable about the hazards and authorized to implement controls) will oversee excavation activities. Protective measures such as sloping, benching, or shoring will be implemented depending on the nature of the entry and soil classification. All trenching and excavation activities will conform to the requirements of T8 CCR Sections 1539 - 1543.

Excavation to depths greater than 5 feet requiring personnel entry are not anticipated. A permit will be obtained from Cal/OSHA (T8 CCR Section 341) before starting work on an excavation 5 feet deep or greater that personnel are required to enter.

Particulate Monitoring

Dust and airborne particulates are frequently generated during excavation and remediation activities, so inhalation of contaminants in fugitive dust or entrained soil particles represent an occupation exposure concern. A direct-reading dust monitor, such as the MiniRam or equivalent, may be used to measure particulates in the air. If elevated (visible) particulate matter conditions persist for 15 minutes or longer, the FM/SSHO is responsible for sampling the breathing zone with a particulate monitor. If dust control does not reduce dust generation, work will be temporarily stopped in affected area until monitoring equipment is obtained or until the visible dust has subsided to below the above limit.

DRILLING HAZARDS

Potential hazards associated with drilling operations include exposure to site contaminants; electrical hazards such as overhead power lines and underground utilities; rolling, spreading, or sliding tools and supplies; and rotating machinery. No drilling will be allowed within 5 feet of marked underground utilities or within 20 feet of overhead high-voltage electrical hazards. Whenever equipment operations must be performed closer than 20 feet from overhead power lines, the site safety manager must be notified.

Before the start of work, the drilling subcontractor will inspect all drilling equipment in the presence of the site safety officer. In addition to verifying that all drilling equipment is in good condition, the lead driller shall demonstrate that all safety interlock switches on the drilling equipment operate correctly. Drilling equipment inspections will be conducted at least weekly.

SPILLS OR LEAKS

If a hazardous waste spill or material release to the air, soil, or water at the site is observed, the site safety officer will notify the PM. An assessment will be made of the magnitude and potential impact of the release.

The PM will be notified immediately in the event of an emergency. The PM will immediately evaluate the incident and, if necessary, notify the appropriate emergency support services and the client. The authority to order personnel to evacuate the area rests with the PM or a qualified representative.
Transportation routes and maps will be posted in the project office and in each site vehicle prior to the initiation of on-site activities. The Emergency Notification Sheet will be posted next to the directions to the hospital. Emergency contacts, phone numbers and maps are shown at the front of this SSHSP.

Pre-planning measures to avoid personal injury or exposure include employee training, fire and explosion prevention and protection, chemical spill and discharge prevention and protection, and safe work practices. Before the start of the project, all personnel will review the project emergency response procedures including:

- Escape routes;
- Critical operations;
- Rescue/medical duties;
- Emergency reporting; and
- Emergency contacts.

During any on-site emergency, work activities in the affected area will cease until the emergency is bought under control.

Qualified first aid and CPR providers will treat minor injuries on site. If additional treatment beyond first aid is required, the injured personnel will be transported to the identified emergency medical care.

**SPILLS**

**Drummed Soil Cuttings and Decontamination Water:** 1) Drums of soil cuttings generated during direct push drilling and monitoring well installation will be stored upright on a pallet in an area of low vehicle traffic to minimize the potential for an accidental release. Drums will be clearly labeled as IDW and the contents will be specified. Before handling a drum, bung lids will be checked to be sure they are tight to prevent leaks should the drum inadvertently fall or be knocked over. 2) Full drums shall be moved only by heavy equipment to minimize the risk of worker injury or of tipping the drum over.

**Vehicle and Equipment Fluids:** 1) Materials that may cause contamination will be present in radiators, fuel tanks, hydraulic reservoirs, fuel cans, and oil cans. Vehicles and equipment will be inspected daily and immediately taken out of service in the event of leaks. Cans containing fuels or oils will be labeled and stored appropriately. 2) Non-emergency maintenance of heavy equipment or vehicles will not be performed on site. In the event on-site equipment maintenance is required, precautions such as buckets and plastic sheeting will be used to ensure contaminants are not released to the environment.

**Stock Piles:** Excavated soil will be stockpiled on-site pending backfill of the excavation. Transport of these materials by wind or rain erosion poses a potential hazard to operations and nearby surface water. Erosion will be mitigated by placing the stock piles on plastic sheeting and covering with plastic sheeting. Regular inspections and maintenance of the sheeting will be conducted to ensure it is maintained in good working order. It is recommended that a temporary earthen containment berm be constructed or silt fence be installed around the perimeter of the pile.
Material Safety Data Sheets

MSDS for Alconox for cleaning sampling equipment
MSDS for Nitric Acid used to preserve Sample Containers
MSDS for pH Meter Calibration Standards
Detailed Site Figures

To be Provided Before Leaving Office
Appendix C
Photographic Log
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Appendix C
Plymouth Mine Photographic Log
(4 Pages)
<table>
<thead>
<tr>
<th>Photo Description</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> View to the east of the two adits (circled). The partially collapsed lower adit is visible in the lower left of the photo, and the fully collapsed upper adit is behind the bush above and to the right of the lower adit.</td>
<td>![Image of partially collapsed lower adit and fully collapsed upper adit behind bush]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photo Description</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> View to the northwest of the waste rock pile north of Hoffman Creek associated with the Adit.</td>
<td>![Image of waste rock pile north of Hoffman Creek]</td>
</tr>
</tbody>
</table>
## Appendix C
**Plymouth Mine Photographic Log**

<table>
<thead>
<tr>
<th>Photo Description</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> View to the southeast of the waste rock pile north of Hoffman Creek associated with the adit.</td>
<td><img src="image1.jpg" alt="Photo" /></td>
</tr>
<tr>
<td><strong>Description:</strong> View to the northeast of the waste rock pile associated with the shaft, uphill of the adit.</td>
<td><img src="image2.jpg" alt="Photo" /></td>
</tr>
</tbody>
</table>
## Appendix C

### Plymouth Mine Photographic Log

<table>
<thead>
<tr>
<th>Photo Description</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong>: View of the shaft. The waste rock pile associated with the shaft is to the right of the photo.</td>
<td>![Shaft Photo]</td>
</tr>
<tr>
<td><strong>Description</strong>: View to the east of a retaining wall along a tributary to Hoffman Creek retaining waste rock. The adit is visible in the background.</td>
<td>![Retaining Wall Photo]</td>
</tr>
<tr>
<td>Photo Description</td>
<td>Photo</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Description:</strong>  View of the mercury vapor meter in use on the fire break road uphill of the adit.</td>
<td><img src="image1.jpg" alt="Photo Description" /></td>
</tr>
<tr>
<td><strong>Description:</strong>  View to the north of Saint Helena Creek near a sediment sample location.</td>
<td><img src="image2.jpg" alt="Photo Description" /></td>
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</table>
Appendix D
Field Forms
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### Mercury Vapor Exposure

<table>
<thead>
<tr>
<th>Feature</th>
<th>Vapor</th>
<th>Measured Range of Hg (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Breathing Zone</td>
<td>15</td>
<td>10-100</td>
</tr>
<tr>
<td>Ground Vapor</td>
<td>10</td>
<td>2-50</td>
</tr>
<tr>
<td>Analyte in Outdoor Air</td>
<td>5</td>
<td>0.1-1</td>
</tr>
<tr>
<td>Mercury (A2)</td>
<td>4</td>
<td>0.01-0.1</td>
</tr>
<tr>
<td>Permissible</td>
<td>1</td>
<td>0.005</td>
</tr>
<tr>
<td>OSHA Permissible</td>
<td>0.5</td>
<td>0.05</td>
</tr>
<tr>
<td>8 Hour Time Weighted Average</td>
<td>1.5</td>
<td>0.15</td>
</tr>
<tr>
<td>8 Hour Personal Exposure Limit</td>
<td>12</td>
<td>1</td>
</tr>
</tbody>
</table>

### Comparison Criteria

- Hg Vapor: 12 μg/m³
- Time Weighted Average Exposure Limit: 1.5 μg/m³
- Personal Exposure Limit: 12 μg/m³

### Notes

- Weather: None
- Equipment: Gas/Laser 955
- Date: 21 June 19