SITE CHARACTERIZATION REPORT AND DRAFT FINAL REMOVAL ACTION WORKPLAN

PROVIDENCE QUARTZ MILL SITE
APN 05-100-87
Nevada City, California

Prepared for:

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Attention: Mr. Eric Byous

Project: Providence Quartz Mill Site
APN 05-100-87
Nevada City, California

Transmittal: Site Characterization Report and Draft Final Removal Action Workplan

Dear Mr. Byous:

Sierra Streams Institute prepared this Site Characterization Report and Draft Final Removal Action Workplan (RAW) to describe proposed mine waste cleanup activities at the Providence Quartz Mill Site located in Nevada City, California. The approximately 0.8-acre Site is located in the northwestern corner of the 38-acre property known as the Environs Property, which comprises Nevada County assessor's parcel number (APN) 05-100-87. The Site is located on Providence Mine Road in an undeveloped area approximately one mile west of downtown Nevada City. The Site is adjacent to the west of the Providence Mine Brownfields cleanup site where previous cleanup activities were performed in 2014 and 2015. This report summarizes the results of Sierra Streams Institute's recent assessment of the Site, evaluates remedial alternatives, presents recommended remedial actions and describes procedures for conducting the remediation.

If you have any questions regarding this Site Characterization Report and Draft Final RAW, please contact the undersigned.

Sincerely,

Sierra Streams Institute

Kyle Leach, P.G. 7108
Project Geologist

copies: 1 Nevada City/Attn: Dawn Zydonis

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LIST OF ACRONYMS

AOC	Area of concern
APN	Assessor's Parcel Number
ARAR	Applicable, relevant and appropriate requirements
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BMP	Best Management Practice
Cal/EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CFR	Code of Federal Regulations
COPC	Constituent of potential concern
cy	Cubic yards
DI	Deionized water
DMP	Dust Mitigation Plan
DTSC	California Department of Toxic Substances Control
DTSC SL	DTSC Screening Level
EE/CA	Engineering Evaluation/Cost Analysis
EPA	United States Environmental Protection Agency
HHRA	Human Health Risk Assessment
HSC	California Health and Safety Code
H&K	Holdrege & Kull
H:V	Horizontal to vertical
LUC	Land use covenant
mg/kg	Milligrams per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operation and maintenance
PEA	Preliminary Endangerment Assessment
ppm	Parts per million
RAO	Remedial action objective
RAW	Removal Action Workplan
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
RWQCB	California Regional Water Quality Control Board
sf	Square feet
SSI	Sierra Streams Institute

LIST OF ACRONYMS (continued)

SMP	Soil Management Plan
SSP	Site Safety Plan
STLC	Soluble Threshold Limit Concentration
VCA	Voluntary Cleanup Agreement
VSAP	Verification Sampling and Analysis Plan
WET	Waste Extraction Test
WRA	Waste Rock Area
XRF	X-ray fluorescence
µg/dL	Micrograms per deciliter
µg/L	Micrograms per liter

EXECUTIVE SUMMARY

The City of Nevada City and Sierra Streams Institute utilized funds from a Sierra Nevada Conservancy Assessment Grant and a US EPA Brownfields cleanup grant to characterize and mitigate recognized environmental conditions at the Providence Quartz Mill Site (Site). On behalf of the proponent, Sierra Streams Institute (SSI) prepared this Site Characterization Report and Removal Action Workplan (RAW) to describe remedial action to be performed at the Site.

SSI prepared the RAW pursuant to California Health and Safety Code (HSC) Chapter 6.8, Sections 25323.1 and 25356.1, California Senate Bill 1706, and the National Contingency Plan (NCP). The purpose of this RAW is to describe procedures for conducting remedial activities to address recognized environmental conditions associated with past site use. The RAW presents remedial action objectives, proposes remedial procedures for the recommended remedial alternatives, and provides a verification soil sampling plan to document that remedial action objectives are achieved.

SITE DESCRIPTION

The Providence Quartz Mill Site is located on an approximately 0.8 acre area in the northwestern portion of an approximately 38-acre property, which comprises APN 05-100-87, and is known as the Environs Property. The Site is located to the west and south of Providence Mine Road across Providence Mine Road from the Providence Mine site upslope of Deer Creek, approximately one mile downstream of downtown Nevada City, Nevada County, California.

For administration purposes related to the Brownfields Cleanup Grant funding, the term “Site” (denoted with capital “S”) refers to the area where the proposed cleanup will occur.

Surface topography in the eastern, central and northern portions of the Site generally slopes toward the north toward Providence Mine Road. Deer Creek is located approximately 150 feet to the north of the Site. The western portion of the Site slopes to the west toward Pecks Ravine, a small tributary which flows into Deer Creek approximately 300 feet to the northwest of the Site. The Site elevation ranges from approximately 2300 feet to approximately 2340 feet above mean sea level. The Site is generally vegetated by fir, oak, cedar and pine trees and various underbrush including honeysuckle, Himalayan blackberry and poison oak. Rock outcrop was observed on limited areas of the site.

The Site is currently undeveloped. Relic foundations of structures from the historic mining operations remain on the adjacent Providence Mine site but are not present on the Quartz Mill cleanup Site. However, scattered metal debris is exposed in mine waste in the central portion of the Site.

The Site is located in the historic Nevada City Mining District at the former location of the Providence Mine, which operated between the 1860s and 1920. A total of over $20 million in gold was produced by the mine in this period. Abandoned mine features identified at the Site include surface exposures of apparent mill waste and mine waste rock and disturbed metal and concrete relics. No foundations or structures remain at the Site.

SITE CHARACTERIZATION INVESTIGATION

Sierra Streams Institute (SSI) performed a site characterization of the previously uncharacterized portions of the 38-acre Environs Property including the Providence Quartz Mill Site as part of the Environs Mining Legacy Project funded by a Sierra Nevada Conservancy Grant. Results of the site characterization are presented in a *Soil Investigation Report for the Environs Mining Legacy Project, Nevada City Environs Property* (Soil Investigation Report) dated December 9, 2015. Additional data evaluation and remedial investigation were performed under the current Brownfields Cleanup Grant to provide information for use in completing site characterization and determining remedial alternatives. A summary of the Soil Investigation Report findings and additional data evaluation are presented in this Characterization Report/RAW.

An estimated minimum of 32 cubic yards of mill tailings and 350 cubic yards of mining impacted soil were identified at the site, all of which have elevated metals concentrations exceeding regulatory standards for unrestricted land use.

RISK TO GROUNDWATER AND SURFACE WATER

Solubility analysis was performed on a selected sample of quartz mill waste with high total metals concentrations. Results of soluble metals analysis by the Soluble Threshold Limit Concentration (STLC) and (TCLP) method indicate the mine waste analyzed exceeds soluble hazardous waste levels. Solubility analysis of selected soil samples considered representative of soil proposed to be left on site were analyzed for metals solubility by the Waste Extraction Test using deionized water (DI WET) method. Results indicates lead and mercury were detected at concentrations slightly exceeding Maximum Contaminant Levels (MCLs) for drinking water. However, based on site conditions including shallow bedrock, assumed depth to groundwater of approximately 50 feet and proposed cover

soil placement, attenuation between mine waste and groundwater will likely result in a low threat to groundwater. Proposed cover soil and erosion control measures will be protective of surface water.

HUMAN HEALTH RISK ASSESSMENT

A human health risk assessment (HHRA) was performed by Holdrege & Kull (H&K) as part of the remedial evaluation for the RAW. Exposure media for the site are soil and air. Exposure pathways are incidental ingestion and dermal contact with the affected soil, and inhalation of particulates. Risk assessment findings demonstrate that baseline conditions at the Providence Quartz Mill (PQM) assessment area are not suitable for residential land use and are not considered protective under other exposure scenarios (adult recreational trail use, routine child visitation, adult unauthorized camping, and construction worker). Metals concentrations (including arsenic, lead, cadmium, cobalt, mercury, thallium) contribute to risk and hazard. Additional assessment was performed for the PQM assessment area for two potential cleanup scenarios, as described in Section 2.7 and Appendix C.

The Environs Waste Rock (EWR) assessment area includes two waste rock piles (WR1 and WR2) located near Deer Creek to the northeast of the Providence Quartz Mill site. The waste rock piles are separated from the Environs recreational trail by a steep slope. Arsenic was detected in the EWR assessment area only at concentrations within the background range; therefore, arsenic is not considered a constituent of concern for the EWR assessment area. Risk assessment findings demonstrate that although the EWR assessment area may be acceptable for recreational trail use and periodic visitation, soil metals concentrations are not acceptable for unrestricted use. Removal action for Environs Waste Rock may not be justified from a human health standpoint based on the limited access.

ECOLOGICAL SCOPING ASSESSMENT

SSI prepared an Ecological Scoping Assessment for the Site. Field surveys conducted for the assessment did not identify the presence of any state or federally listed threatened or endangered species at the site. No riparian habitat was identified on the Site.

EVALUATION OF REMEDIAL ALTERNATIVES

SSI evaluated remedial alternatives separately for the Site. A summary of the evaluation is as follows:

SSI reviewed four potentially applicable alternative soil remediation methods for the Site. Alternative 1 - No Action was eliminated from consideration since it does not provide adequate protection of human health. Alternative 2 - Excavation and Off-Site Disposal of all waste exceeding remedial goals would be cost prohibitive. Alternative 3 - Excavation and On-Site Disposal was eliminated due to issues related to on-site disposal of hazardous waste. Alternative 4 - Combined Approach, including elements of Alternatives 2 and 3, was considered cost effective and protective of human health and was also considered protective of water quality.

SELECTED REMEDIAL ALTERNATIVES

Proposed remedial Alternative 4 - Combined Approach includes excavation and off-site disposal of lead and mercury impacted soil exceeding hazardous waste levels, excavation and on-site consolidation and placement of non-hazardous soil exceeding human health cleanup goals, placement of soil cover, re-vegetation and erosion control measures. These measures along with institutional controls will effectively reduce risk to human health and water quality while being feasible within the budgetary constraints of the EPA Brownfields funded project.

PROPOSED REMEDIAL MEASURES

Proposed remedial actions at the site will be implemented in a two-phase approach with Hazardous Waste excavation and disposal followed by excavation, consolidation and on-site placement of non-hazardous mine waste. The proposed remediation activities are summarized below.

Clearing and Grubbing, Water Quality BMPs and Temporary Access Construction

Remedial areas will be cleared and grubbed of surface vegetation prior to any excavation. Trees greater than 6-inch diameter will be left in place, except where removal is necessary for equipment access. Best Management Practices (BMPs) features including reinforced

silt fences and straw wattles etc. will be installed to protect water quality in down slope areas. Temporary access to remedial areas will be constructed with graded ramps extending from the staging area along Providence Mine Road to the Quartz Mill Site.

Excavate and Remove Hazardous Waste in Mine Features Area

Approximately 32 cubic yards of soil impacted by lead and mercury at concentrations exceeding hazardous waste levels (1000 mg/kg lead or 20 mg/kg mercury) will be excavated from three locations, and temporarily stockpiled on site. The excavation will be limited to 18-inches in depth or less in areas of shallow bedrock. Verification soil sampling will be performed around the perimeter of the excavation and additional excavation will occur as needed to achieve remedial goals. The excavated soil will be characterized and disposed of off-site at a hazardous waste disposal facility. The hazardous waste excavation will be backfilled with non-hazardous soil consolidated from surrounding areas before resuming other excavation activities.

Non-Hazardous Soil Excavation and On-Site Disposal

Areas of the Site where lead concentrations exceed the cleanup goal of 270 mg/kg will be excavated to a depth of up to 12-inches. Excavated material will be consolidated and placed as compacted fill in the hazardous waste excavation areas and immediately surrounding areas. Verification soil sampling will be performed and additional excavation or soil cover placement will be performed to achieve remedial goals.

Cover Soil and Fill Placement

Soil remediation excavations and areas where soil metals remain at concentrations above remedial goals will be backfilled with clean imported soil. Cover soil may also be placed in areas where excavation cannot be performed to meet cleanup goals due to poor access or tree root mass protection. Fill will be placed in maximum 6-inch loose lifts to achieve a soil cover with a minimum compacted thickness of 8-inches in the non-hazardous waste areas and 12-inches in the hazardous waste excavation locations. Cover soil placed in re-vegetation areas will be relatively loose at the surface to allow vegetation growth and stabilization.

Dust Mitigation Plan

The Dust Mitigation Plan (DMP) appended to this RAW outlines engineering controls to reduce the release of fugitive dust into the environment during mechanical soil

disturbance. Mechanical soil disturbance includes site clearing, excavation, grading, and soil placement activities.

Erosion Control and Re-vegetation

Erosion control and re-vegetation activities at the site will include installing straw wattle rolls on and along the base of slopes exceeding 1:5 vertical to horizontal. Hydroseed will be sprayed or wood chip mulch applied to all disturbed areas. Re-vegetation efforts will begin as soon as possible after excavation, grading and soil cover placement are complete and will include all areas where cover soil is placed. A restoration biologist will be consulted regarding plant selection.

Institutional Controls

Nevada City and SSI will consult with the California Department of Toxic Substances Control regarding institutional controls necessary to protect human health and the environment. Signs will be placed at two Site access points to inform the public that mine waste with elevated metals concentrations is present on the Site. DTSC will be consulted regarding sign language. To provide additional human health protection, land use controls will be established for areas of the Site where elevated concentrations of COPCs will remain in place. Future land use will be restricted to recreational use and open space. Disturbance of cover soil and vegetation will be prohibited. An Operation and Maintenance (O&M) agreement may be required by DTSC to include periodic monitoring and reporting of the integrity of the fill, vegetation and signs. We do not anticipate that permanent fence installation will be required.

PUBLIC PARTICIPATION

Section 25356.1 of the Health and Safety Code outlines public participation requirements for the remedial action. Requirements include the preparation of a community profile report to determine public interest in the remedial action, notice of the RAW in a newspaper of general circulation, provision of a minimum 30-day public comment period, and preparation of a responsiveness summary. A public meeting will be held if significant public interest is demonstrated or if required by a regulatory agency. A community profile was prepared as part of the RAW.

1 INTRODUCTION

Sierra Streams Institute (SSI) has prepared this Site Characterization Report and Draft Removal Action Workplan (RAW) on behalf of the City of Nevada City (the proponent) to describe procedures for conducting remedial activities associated with recognized environmental conditions at the Providence Quartz Mill Site (Site). The project is funded by an EPA Brownfields Cleanup Grant for the Providence Quartz Mill. The Brownfield cleanup Site is located in an approximately 0.8-acre area in the northwestern corner portion of the approximately 38-acre property known as the Environs Property, which comprises Nevada County assessor's parcel number (APN) 05-100-87. The Site is located on Providence Mine Road in an undeveloped forested area up slope of Deer Creek, approximately one mile downstream of downtown Nevada City. Figure 1 is a site location map.

The proponent has entered into a Voluntary Cleanup Agreement (VCA) with the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC), Docket No. HSA-VCA 11/12-036. Previous activities performed under the VCA included, SSI performed a Brownfield Cleanup of the Providence Mine Site located on the same property owned by the City of Nevada City across Providence Mine Road. SSI has prepared a Soil Investigation Report for the Nevada City Environs Property which includes the Providence Quartz Mill Site to evaluate site conditions and potential risks to human health and the environment resulting from historical site use. A summary of the Soil Investigation Report is presented in Section 2 of this RAW. A copy of the Soil Investigation Report is included in Appendix A.

The requirement for preparation of a RAW was created by Senate Bill 1706 in 1994. The RAW is one of two remedy selection documents that may be prepared for a hazardous substance release site pursuant to Section 25356.1 of the California Health and Safety Code (HSC). A RAW was chosen over a Remedial Action Plan because the proposed remediation is not an emergency action, and the estimated cost of the recommended remedial action is projected to be less than the threshold cost of $1,000,000.

The remedial action outlined in this RAW is to be conducted in a manner consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 Code of Federal Regulations (CFR) 300.400 et seq). The NCP requires the use of an Engineering Evaluation/Cost Analysis (EE/CA) or equivalent. This RAW is to serve as the equivalent of an EE/CA.

Section 25356.1 of the HSC outlines public participation requirements for the RAW. Requirements include the preparation of a community profile report to determine public interest in the remedial action, notice of the RAW in a newspaper of general circulation, provision of a minimum 30-day public comment period, and preparation of a responsiveness summary.

1.1 BASIS FOR REMEDIAL ACTION

Pursuant to Section 25356.1.5 of the California HSC, the proposed remedial action shall be based upon, and be no less stringent than:

- Requirements established under federal regulation pursuant to Subpart E of the NCP (40 CFR 300.400 et seq), as amended, which pertains to remedial action and selection of remedial alternatives;

- Regulations established pursuant to Division 7 (commencing with Section 13000) of the California Water Code, which pertains to state and regional water quality control;

- Applicable water quality control plans adopted pursuant to Section 13170 of the California Water Code;

- Article 3 (commencing with Section 13240) of Chapter 4 of Division 7 of the California Water Code, which pertains to water quality control plans and waste discharge requirements;

- Applicable state policies for water quality control adopted pursuant to Article 3 (commencing with Section 13140) of Chapter 3 of Division 7 of the California Water Code, to the extent that those policies are consistent with the federal regulations;

Applicable provisions of the California HSC, to the extent those provisions are consistent with the federal regulations.

1.2 PURPOSE

The purpose of the RAW is to evaluate remedial alternatives and to select a remedial alternative that effectively reduces, to the extent feasible, the human health risks associated with mine waste and impacted soil at the site. The evaluation considers the

effectiveness, implementability and cost associated with each alternative. This RAW presents the recommended remedial action.

1.3 ORGANIZATION

Per Section 25323.1 of the HSC, a RAW must include a plan for conducting the remedial action, a description of the on-site contamination, the goals to be achieved by the remedial action, and the rationale for consideration of alternative removal options.

This RAW contains components required by DTSC's *Removal Action Workplans* memorandum dated September 23, 1998, and is organized in the following sections:

1. *Introduction*. This section includes an overview of the proposed remedial action and associated regulations, purpose of the RAW, and organization of the RAW.

2. *Site Characterization*. This section includes site description, ownership and operational history, site conditions, brief description of site characterization activities conducted, nature and extent of contamination, and description of response actions taken, if any.

3. *Remedial Action Objectives*. This section includes a discussion of regulations, identification and review of applicable or relevant and appropriate requirements (ARARs), identification of media and constituents of concern, estimate of volumes, and remedial action goals.

4. *Evaluation of Remedial Action Alternatives*. This section includes a listing of alternative remedial measures and basis for selection of the recommended measure.

5. *Remedial Procedures and Implementation*. This section includes a description of techniques and methods to be employed in the remedial action, including excavation, storing, handling, transportation, treating and disposing of material on or off the site, as applicable.
6. *Site Safety Plan*. This section includes a brief overall description of the methods that will be employed during the removal action to ensure the health and safety of workers and the public during the removal action.

7. *Public Participation*. This section includes a discussion of public participation in the remedial action.

8. *Remedial Action Reporting*. This section includes a brief description of the post-remediation report which is to be prepared to summarize remedial activities and to document compliance with the RAW.

2. SITE CHARACTERIZATION

2.1 SITE LOCATION

The Providence Quartz Mill Site is located in the northwest portion of a 38-acre property owned by the City of Nevada City (APN 05-100-87), known as the "Environs Property". The site is located approximately 150 feet to the south of Deer Creek, a tributary of the Yuba River, approximately one half to one (1) mile downstream of downtown Nevada City, California. The Environs property is generally steeply sloped toward Deer Creek which flows along the northern edge of the property and is wooded with a mature fir, oak and cedar forest. The Environs Property (including the Site) is zoned Open Space by the Nevada City Planning Department.

An approximately 2-acre area in the northwest corner of the Environs Property was occupied by the historic Providence Mine. This portion of the property was recently remediated under a voluntary cleanup agreement between Nevada City and DTSC. The cleanup was funded by two EPA Brownfields cleanup grants and a Sierra Nevada Conservancy Cleanup grant. Providence Mine Road runs generally along the western edge of the Environs property and makes a looping curve to the east, north and west before it drops to its northern end on the bank of Deer Creek. The approximately 1-acre subject Providence Quartz Mill Site is located on the west side or inside of the curve and is bounded by Providence Mine Road to the east and north and by the western Environs property boundary to the west. The Providence Mine site is located immediately across Providence Mine Road from the Quartz Mill Site.

For administration purposes related to the draft RAW included in this report and the Brownfields Cleanup Grant funding, the term "Site" (denoted with capital "S") refers to the approximately 0.8-acre Providence Quartz Mill Site where the proposed cleanup will occur.

The Environs property is traversed by several segments of the Deer Creek Tribute Trail, a portion of which crosses Deer Creek on a suspension bridge and generally crosses from east to west through the property to Providence Mine Road. An upper "ditch trail" follows a historic mining era water conveyance ditch and also extends to Providence Mine Road uphill of the Site. A spur trail extends from the Tribute Trail through the Providence Mine site ending directly across Providence Mine Road from the Quartz Mill site.

According to the Nevada City Quadrangle map (United States Geological Survey, provisional edition 1995), the Site is located in the southwest quarter of the southwest

quarter of Section 12, Township 16 North, Range 8 East. The center of the Site is located at latitude 39.258603 degrees, longitude -121.037951 degrees. Figure 1 is a Site Location Map. Figure 2 is Site Map, showing historic site features, boundaries of the Brownfields grant Site, and property boundaries. Figure 3 is a Sample Location Map showing locations of soil samples obtained during the Soil Investigation Report. A detailed description of the Brownfield Site is provided below.

2.2 SITE DESCRIPTION AND CURRENT USES

Surface topography in the eastern, central and northern portions of the Site generally slopes toward the north toward Providence Mine Road. Deer Creek is located approximately 150 feet to the north of the Site. The western portion of the Site slopes to the west toward Pecks Ravine, a small tributary which flows into Deer Creek approximately 300 feet to the northwest of the Site. The Site elevation ranges from approximately 2300 feet to approximately 2340 feet above mean sea level. The Site is generally vegetated by fir, oak, cedar and pine trees and various underbrush including honeysuckle, Himalayan blackberry and poison oak. Rock outcrop was observed on limited areas of the site.

The Site is currently undeveloped. Relic foundations of structures from the historic mining operations remain on the adjacent Providence Mine site but are not present on the Quartz Mill cleanup Site. However, scattered metal debris is exposed in mine waste in the central portion of the Site.

2.2.1 Providence Quartz Mill Site

Prior to completing a detailed reconnaissance of the Quartz Mill Site, SSI reviewed historic maps including a 1912 Sanborn Fire Insurance Map. The Sanborn Map was superimposed on a current map of the Site to identify the former locations of historic mine processing facilities including from east to west; a 40 Stamp Quartz Mill (inactive in 1912), Sulphurete Room, and Roasting Furnace. Current conditions at the abandoned Quartz Mill site consist of hummocky sloped terrain of apparently disturbed native soil in the eastern portion of the mill site and a graded area along Providence Mine Road in the northern portion of the mill site. To the west of the stamp mill in the Sulphurete Room location is a relatively level benched area cut into bedrock which was strewn with apparent mine waste including broken and crushed quartz rock and fine grained purple stained soil (apparent sulphurete waste). An exposed slope of apparent mine waste and additional piles of mine waste rock and mill tailings are located to the north and west of the Sulphurete Room area. The Roasting Furnace was located in an elongated level area

which was apparently cut into native soil and rock. The western property boundary crosses through the roasting furnace area with approximately the western third of the area on the adjacent property. Other than scattered quartz rock fragments, little or no apparent mine waste was observed in the roasting furnace area.

2.2.2 Adjacent Property

The project Site is bordered to the south and east by the remainder of the city owned Environs Property. The Environs Property is generally bounded by Deer Creek to the north, Providence Mine Road to the west, the Nevada City Waste Water Treatment Plant to the east and commercial/industrial property to the south which is occupied by Nevada City Tech Center. Undeveloped property lies to the west of Providence Mine Road in areas south of the Site and to the west of the subject Site. Undeveloped property formerly occupied by the historic Champion Mine is located across Deer Creek to the north and northwest of the Site.

2.2.3 Geologic Setting

The Site is located within a region underlain by a complex assemblage of igneous and metamorphic rocks in the western foothills of the Sierra Nevada. The regional structure of the foothills is characterized by the north-northwest trending Foothills Fault System, a feature formed during the Mesozoic era (between 65 million and 248 million years before present) in a compressional tectonic environment. A change to an extensional tectonic environment during the late Cenozoic (last nine million years) resulted in normal faulting, which has occurred coincident with some segments of the older faults in the region.

2.2.4 Geologic Conditions

According to the Geologic Map of the Grass Valley - Colfax Area (A. Tuminas, 1983), the Site and surrounding areas are underlain by the massive diabase unit of the Jurassic aged Lake Combie Complex. A north-northwest trending contact is depicted approximately 150 feet to the east of the Site near the main shaft of the Providence Mine. Areas to the east of this contact are mapped as early Cretaceous aged Yuba River Granodiorite.

According to the Mineral Land Classification of Nevada County (Special Report 164, California Department of Conservation Division of Mines and Geology, 1990), the Site geology is mapped as Jurassic aged Plutonic Rocks, predominantly gabbro but locally including diorite and quartz diorite. Areas to the east of the Site are mapped as Jurassic

aged Plutonic Rocks consisting of quartz diorite to granodiorite. The Mesozoic era occurred from approximately 245 to 65 million years ago. The Jurassic period occurred from approximately 206 to 144 million years ago.

The Nevada City Special Folio, California (United States Geologic Survey; 1896) depicts a north northeast trending quartz vein passing approximately 150 feet to the east of the Site through the western portion of the adjacent Providence Mine site and crossing the approximate Providence Mine inclined shaft location. The vein depicted dips to the east at approximately 35 degrees.

Field observations of current geological conditions indicate much of the Site surface is covered in native or disturbed soil. Limited areas of massive diabase bedrock was observed in the central portion of the Site and in the cut slope to the east of the roasting furnace area in the western portion of the Site. Mine waste rock of varying consistency was observed in the central and northwestern areas of the Site. The waste rock includes moderately weathered to unweathered rock fragments of granodiorite and diabase with fragments of unweathered milky quartz. An outcrop of massive diabase is also exposed in a road cut approximately 200 feet southeast of the Site. Outcrops of granodiorite were observed in steep stream bank exposures along Deer Creek to the northeast of the Site.

2.2.5 Soil Conditions

The *Soil Survey of Nevada County, California, Western Part* (United States Department of Agriculture, Soil Conservation Service, August 1993) indicates that soil conditions across the central, eastern and southern portions of the Site are mapped as Musick sandy loam, 5 to 50% slopes. This soil type is found on gently sloping to strongly sloping terrain with 1% to 10% rock outcroppings. Runoff is medium and the hazard of erosion is moderate. The western edge of the Site and areas to the west are mapped as Sites very stony loam 15 to 50 % slopes. This soil type has moderate to slow permeability with medium to high runoff and the hazard of erosion is moderate. The Musick and Sites soil types are used primarily for timber production. The northern edge of the Site and areas between Providence Mine Road are mapped as Tailings which include hard rock mine waste rock and processed tailings as well as placer and hydraulic mine waste.

2.2.6 Groundwater Conditions

A groundwater investigation was not performed at the Site. The subject site and properties within 0.5 miles to the east and south of the site are located within the city limits of Nevada City where water supply wells are not permitted. No residences are located

within at least 0.25 miles to the west, south or east of the Site. Areas to the north are rural and across Deer Creek from the site and likely not hydraulically connected. The Nevada City, City Engineer is not aware of any wells in the Site vicinity. Thus, no specific information is available regarding site groundwater. Groundwater in the site vicinity is typically encountered within bedrock fractures, and depth to groundwater is, therefore, difficult to predict. Based on site topography and the location within 150 to 300 feet of Deer Creek, we anticipate groundwater may be present beneath the Site within approximately 50 feet of the ground surface with a hydraulic gradient and flow direction generally toward Deer Creek. Environmental attenuation factors including the estimated depth to groundwater (approximately 50 feet) and the presence of underlying weathered soil and indurated or fractured rock, as well as the relatively small surface area of the mine waste impacted areas of the Quartz Mill site (approximately 5000 square feet) will significantly reduce potential impacts of soluble metals to groundwater beneath the site.

Since the Site is zoned open space, potential Site reuse likely will not include construction of water supply wells. No construction of infrastructure is anticipated and the Site is within the city limits where domestic water is available from a treated municipal source.

2.2.7 Surface Water Conditions

According to the 7.5-minute Nevada City Quadrangle Map (U.S. Geological Survey, provisional edition 1995), Deer Creek is located to the north of the Site. An unnamed surface drainage (identified on other maps as Pecks Ravine) is located to the west of the site. Surface water (Deer Creek) is present within approximately 150 feet of the north side of the subject Site and within approximately 150 feet to the west of the Site (Pecks Ravine). No ephemeral drainages or storm drain structures are apparent on the Site.

Pecks Ravine flows to the north and has a confluence with Deer Creek approximately 300 feet to the northwest of the Site. Deer Creek generally flows toward the west, to its confluence with the Yuba River approximately 17 miles downstream of the Site. One impoundment, Lake Wildwood, is located approximately 11 miles downstream of the Site. The Yuba River flows into the Feather River at Marysville, approximately 40 miles west of the Site.

2.2.8 Site History

SSI reviewed available topographic maps, historical mining maps, fire insurance maps and documents relating to Site mining history, as well as a Phase 2 Environmental Site Assessment of the Providence Mine Site prepared by FoDC in 2006. Figures 2 and 3

depict the locations of the identified mine or mine processing facility features. The following documents were reviewed:

- Lindgren, Waldemar (1896). Nevada City Special Folio, California: U.S. Geological Survey Folio
- Nevada County Mining Review, The Union Newspaper, 1895
- Mines and Mineral Resources of Nevada County Chapters of State Mineralogists Report, Biennial Period 1917 1918 (California State Mining Bureau, 1918)
- Map of the Vicinity of Grass Valley/Nevada City, California (Uren, 1897)
- Thompson and West, History of Nevada County 1880
- Sanborn Fire Insurance Maps, Nevada City CA (1885, 1891, 1898, 1912)
- State Mineralogists Report, 23 (California State Mining Bureau, 1930)

Providence Quartz Mill

The Providence Quartz Mill was located up slope of Deer Creek to the west of the Providence Mine. The Quartz Mill operated from the mid-1860s until 1902 when the Providence property was purchased by the Champion Mine and all gold processing was moved to the Champion site across Deer Creek to the north. The Providence Quartz Mill consisted of a 40 stamp mill which crushed the gold quartz ore, amalgam tables where mercury was used to recover a portion of the gold, a sulphuretes room and chlorination works where chemicals were added to release additional gold and other metals from sulphide minerals in the crushed ore, and a roasting furnace used to further break down the ore and improve gold recovery. Fine grained sulphurete waste produced by this process and recently found at the site has a distinct purplish color (due to added potassium permanganate) and consistently has some of the highest heavy metal contaminant concentrations of any mine waste in the region.

An 1898 Sanborn Fire Insurance Map shows the layout of the buildings at the Providence Mine site and Providence Quartz Mill Site. A large building labeled Quartz Mill was located in the eastern and central portion of the Site. This area has been extensively re-graded since the end of mining times with apparent covering by imported fill and construction of Providence Mine Road. A “Sulphurets Room” was located adjacent to the Quartz Mill in the west central portion of the Site and a Roasting

Furnace were located to the southwest of the Sulphurets Room location in the southwestern portion of the Site.

After the Providence Mine closed in 1921, the mine and Quartz Mill sites were abandoned. All above ground structures were later removed and likely used as scrap for the war effort in the 1940s. The site has sat idle since that time except for the construction of Providence Mine Road in the late 1960s and subsequent off-hauling of a portion of the mine waste for use in the construction of the Gold Center Freeway between Nevada City and Grass Valley. The road passes between the Providence Mine site and the Providence Quartz Mill Site. Grading for this paved road disturbed or covered much of the eastern and northern portions of the 40 Stamp Mill building footprint.

According to Bill Falconi, the City Engineer for Nevada City and life-long local resident, the buildings at the Providence Mine and Quartz Mill Site were removed prior to the early 1950s. Providence Mine Road was constructed during the 1960s to access mine waste piles down slope to the north of the Site which was used as fill during construction of the Golden Center Freeway between Nevada City and Grass Valley. Mr. Falconi recalls a large pile of waste in the current location of the sharp curve in Providence Mine Road in the eastern portion of the Site. This waste was excavated and a portion used as fill beneath the road. Providence Mine road extended to the bank of Deer Creek and provided access to the mine waste piles from the west. Mr. Falconi estimated that up to two-thirds of the mine waste in the area was excavated and removed from the area and placed as off-site fill in 1965 and 1966.

No records of mining or processing activities at the site after the early 1940s were encountered. Most hard rock gold mines in the area closed during World War II and did not reopen.

2.3 SOIL INVESTIGATION REPORT

SSI performed a site characterization of the previously uncharacterized portions of the 38-acre Environs Property including the Providence Quartz Mill Site as part of the Environs Mining Legacy Project funded by a Sierra Nevada Conservancy Grant. Results of the site characterization are presented in a *Soil Investigation Report for the Environs Mining Legacy Project, Nevada City Environs Property* (Soil Investigation Report) dated December 9, 2015. Preparation of a Preliminary Endangerment Assessment (PEA) was not within the scope of the Environs Project assessment. As part of the Brownfields

Cleanup planning process for the Site, SSI reviewed the Soil Investigation report and other existing site data, and performed additional activities to evaluate current site conditions. Details of the Soil Investigation report and additional evaluation are summarized below. USEPA has provided technical assistance including limited soil sample analysis and expert consultation to support a preliminary evaluation of potential risks to human health and the environment resulting from historical site use. The site characterization presented in this report generally fulfills the requirements of a PEA equivalent to the extent possible within the scope of the Brownfields Cleanup budget and EPA assistance. A copy of the Soil Investigation Report is presented in Appendix A.

Two general areas of the Environs Property site were identified and investigated during the 2014-2017 SNC funded project and identified in the Soil Investigation report. These areas include the Waste Rock Stockpiles in the east central portions of the Environs Property and the Providence Quartz Mill Site in the west portion of the property. For the purposes of this Site characterization, only the Providence Quartz Mill Site is addressed.

2.4 SITE CHARACTERIZATION SAMPLING AND ANALYSIS

SSI reviewed data from the Soil Investigation Report for the Environs Property regarding the Providence Quartz Mill Site as well as additional data from the remedial evaluation, including results of additional samples that were analyzed.

Soil sampling was performed at the Providence Quartz Mill site in two events on July 7, 2015 and October 27, 2015. A total of 34 soil samples were obtained from the Quartz Mill site and upslope locations. Figure 3 is a Sample Location Map for the Quartz Mill area. Twenty near surface samples were obtained from near surface (0-0.5 feet) soil or mine waste during the initial sampling event. Based on a review of initial results, 14 follow up samples were obtained from the near surface (0-0.5 feet) and from hand dug sample pits to further define the extent of metal impacts to site soil. A total of seven near surface samples were obtained from the approximate Quartz Mill building site (“QM” samples). Fourteen samples were obtained from the Waste Rock area (“WR” samples), Six from the Sulphurete Room location (“SR” samples) and three from the Roasting Furnace location (“RF” samples). Fifteen of these samples were obtained from the near surface (0 to 0.5 feet depth) and 5 from depths of 0.5 feet to 1.5 feet. Hand sampling excavation depths in this area were limited due to shallow depths to hard bedrock or dense weathered rock. Four near surface samples were also obtained from areas upslope of the quartz mill site (‘US” samples).

Soil samples from the site were analyzed for Title 22 priority pollutant metals by EPA Methods 6010A and 7471B. Based on a review of initial laboratory results, selected

samples from the Quartz Mill site were also analyzed for soluble metals of concern (lead and mercury) by the Waste Extraction Test (WET) method with standard citrate soaking solution and the Toxic Characteristic Leaching Potential (TCLP) method, typically used to characterize waste for landfill disposal. Two selected samples were also analyzed by the WET method with a deionized water (DI) soaking solution which may better approximate in-situ soil solubility. Copies of the analytical laboratory reports are included in Appendix C of the Soil Investigation report.

2.5 CONSTIUENTS OF CONCERN AND ANALYTICAL RESULTS

Based on a review of soil sample results and comparison with Regional Screening Levels (RSLs) for commercial or industrial soil; lead, mercury, arsenic and to a lesser extent cadmium and other metals were determined to be constituents of concern at the Site.

A summary of soil sampling and analytical results of these constituents of concern including samples from the Soil Investigation and subsequent sampling conducted by SSI is provided below.

2.5.1 ANALYTICAL LABORATORY RESULTS- TOTAL METALS

Analytical results of soil samples from the site were compared with three threshold concentrations typically used to characterize soil at abandoned mine sites to establish constituents of concern (COCs): Total Threshold Limit Concentrations (TTLCs or Hazardous Waste levels), California Regional Screening Levels (CA RSLs or cleanup goals for unrestricted land use) and typical background arsenic concentrations for the project area (21 mg/kg). Results were also compared with the site specific cleanup goals established at the adjacent Providence Mine site (Site Specific Goals for recreational site use and potential cleanup goals for a potential Quartz Mill site cleanup).
Results from the Quartz Mill site samples indicated significantly elevated levels of lead, mercury, arsenic, and to a lesser extent cadmium. Other Title 22 metals were generally below typical levels of concern. Thus lead, mercury, arsenic and cadmium are considered COCs for the site. Results from the Quartz Mill Site sampling areas for each COC are summarized below:

Total lead: Lead concentrations in the 30 samples from the Quartz Mill site ranged from 74 milligrams per kilogram (mg/kg) to 20,000 mg/kg. Eight samples exceeded TTLC levels (1,000 mg/kg). 29 of 30 samples exceeded the CA RSL for lead (80 mg/kg) and 11 of 30 samples exceeded the Providence Mine cleanup goal (270 mg/kg).

Total mercury: Mercury concentrations ranged from 0.74 mg/kg to 100 mg/kg. 5 of 30 samples exceeded the TTLC for mercury (20 mg/kg), 8 of 30 samples equaled or

exceeded the RSL for mercury (18 mg/kg). No site specific goal was established for mercury.

Total arsenic: Arsenic concentrations ranged from 11 mg/kg to 250 mg/kg. None of the samples exceeded the TTLC (500 mg/kg), all 30 samples exceeded the CA RSL for arsenic (0.07 mg/kg) and 15 of 30 samples exceeded typical regional background levels of arsenic (21 mg/kg).

Total cadmium: Cadmium concentrations ranged from less than 1.0 mg/kg to 19 mg/kg. None of the samples exceeded the TTLC (100 mg/kg), 22 of 30 samples exceeded the RSL for cadmium (1.7 mg/kg). No site specific cleanup goal was established for cadmium.

Total hexavalent chromium: One duplicate sample WR-11b was analyzed for total hexavalent chromium by EPA Method 7196. Analytical results indicated 2.10 mg/kg. No site specific cleanup goal was established for hexavalent chromium.

Soil sample locations are shown on Figure 3. Soil sample results for total metals are presented in Table 1. Analytical laboratory reports are included in Appendix C of the Soil Investigation Report and in Appendix B of this report.

2.5.2 XRF SAMPLING AND ANALYSIS

SSI and EPA conducted additional soil sampling and X-Ray Florescent (XRF) analysis of surface soil samples at the Quartz Mill Site. The purpose of the investigation was to provide a more detail delineation of the extent of soil exceeding TTLC levels for lead and mercury and soil exceeding the secondary cleanup goal for lead of 270 mg/kg (equivalent to parts per million (ppm) reported for the XRF results. Twenty four soil samples were obtained by SSI from stepped out locations in areas documented as exceeding cleanup goals in previous soil samples. Soil was screened with a #10 screen, dried to less than 5% moisture and transported to the EPA laboratory in Richmond California. XRF analysis was performed by EPA personnel. 6 duplicate samples were also analyzed at the EPA laboratory by EPA method 6010A and 7471B. XRF sample locations are shown on Figure 3 and results are presented in Table 3. Copies of the XRF results and analytical laboratory reports are included in Appendix B.

2.6 SOLUBLE METALS SAMPLING AND ANALYTICAL RESULTS

Soluble metals sampling and analysis was performed for the 2015 Soil Investigation Report for the Nevada City Environs Property in order to further characterize Site soil for the purposed of possible disposal characterization and to characterizes soil which may remain in place at the site after remediation. Metals solubility analyses were performed

by three separate extraction methods: the California Waste Extraction Test (Cal WET), the Toxicity Characteristic Leaching Procedure (TCLP) and the de-ionized water Waste Extraction Test (DI-WET), and quantified using EPA Methods 6010B and 7471A.

In order to determine the appropriate method for soluble metals analysis, DTSC conducted a search for sites in the project vicinity where acid base accounting analysis (ABA) has been conducted. A search of DTSCs Envirostor database was reviewed and four sites in the Nevada City/Grass Valley area were found to have ABA analysis completed. All four were net neutralizing. Thus, the DI Wet Method was deemed appropriate for use in determining soluble metal concentrations in soil proposed to be left in place after Site remediation. The Standard WET method and toxicity characterization leaching procedure (TCLP) were used to characterize soil likely to require off-site disposal (soil exceeding TTLC and or STLC levels).

Soluble Metals Analysis of Soil Requiring Off-site Disposal

Sample WR21 (20,000 mg/kg lead, 250 mg/kg arsenic) was analyzed for soluble lead, arsenic and copper by the WET Method. Results indicated soluble lead at 560 milligrams per liter (mg/L) which exceeds the Soluble Threshold Limit Concentration (STLC) for lead of 5 mg/L. Soluble arsenic was detected at 1.0 mg/L and soluble copper at 2.4 mg/L both of which are less than the STLC for arsenic and copper of 5 mg/L and 25 mg/L respectively.

Sample WR21 was also analyzed for soluble lead by the TCLP method. Results indicated soluble lead at 230 mg/L which exceeds the STLC for lead of 5 mg/L.

Sample WR8-B (100 mg/kg total mercury) was analyzed for soluble mercury by the WET Method. Results indicated soluble mercury at 5.5 micrograms per liter (ug/L).
WR8-B was also analyzed for soluble mercury by the TCLP method. Results indicated soluble mercury was not detected above the practical quantitation limit (PQL) of 0.20 ug/L.

Soluble Metals Analysis of Soil Proposed to be Left On-site

Sample WR10 (340 mg/kg total lead) and WR12 (580 mg/kg lead) were analyzed for soluble lead by the Deionized (DI) WET Method (used to approximate in-situ solubility at the Providence Mine site). Results indicated soluble lead was not detected in either sample above the PQL of 0.50 mg/L. These reported PQLs were significantly higher than the corresponding Maximum Contamination Levels (MCLs) for these metals, thus additional DI WET solubility analysis was warranted.

On September 22, 2016 and February 15, 2017 SSI obtained duplicate soil samples from selected locations and coordinated additional total and soluble metals analysis.

Duplicate samples QM-1B and WR-12B were analyzed for soluble lead and mercury by the DI WET method. Results for sample QM-1B (corresponding to sample WR-12 with 430 mg/kg lead and 14 mg/kg mercury) indicated soluble lead at 14.8ug/L and mercury at 0.487ug/L. Results for sample WR-12B (corresponding to sample QM-12 with 580 mg/kg lead and 9.7 mg/kg mercury) indicated soluble lead was not detected above the PQL of 10 ug/L and soluble mercury was detected at 2.79 ug/L.

Duplicate samples RF-18b, WR-12b and WR-11b were analyzed for total and soluble arsenic, cadmium, lead and mercury by EPA Methods 6010A and 7471B and DI WET. These three sampled were selected as representative of metals concentrations likely to be left in place with a soil cover after site cleanup based on the cleanup goals established for the adjacent Providence Mine site and proposed for the Providence Quartz Mill (as documented below).

Results indicated no soluble arsenic or cadmium were detected above the laboratory reported PQL of 10 ug/L which is equal to the MCL for arsenic of 10 ug/L and twice the MCL for cadmium of 5 ug/L. Soluble lead was detected in sample WR-12b at 16.4 ug/L, slightly above the MCL for lead of 15 ug/L. Soluble mercury was detected in sample WR-12b at 0.251 ug/L which is below the MCL for mercury of 2 ug/L. Soluble metals analytical results are presented in Table 2. Analytical laboratory reports are included in Appendix C of the Soil Investigation Report and Appendix B of this report.

DISCUSSION OF RESULTS

SSI reviewed the results and locations of soil samples analyzed for total and soluble metals and compared results with cleanup goals previously established for the nearby Providence Mine site (which has similar COC's and land use) to estimate the surface area and volumes of soil which may require cleanup.

Results from the Quartz Mill Site samples indicate near surface soil and mine waste exceeds TTLC levels (Hazardous Waste) in three locations with a total surface are of approximately 850 square feet. These areas corresponds to the approximate former location of the Sulphurete room and adjacent areas as well as a small area near the former Roasting Furnace. The depth to dense rock appears to range from less than 6-inches to over 1.5 feet in these areas.

Three larger irregular shaped areas also has soil metals exceeding the assumed secondary cleanup goals for lead (270 mg/kg), RSLs for mercury or cadmium or typical local background levels of arsenic. These areas have a total surface area of approximately 3,500 sf. The depth of this impacted soil has not been determined, but based on site observations and our experience with similar sites, likely ranges from one foot to four feet or greater.

Based on these results an estimated 32 cubic yards of soil at the site exceeds hazardous waste levels and approximately 350 cubic yards of soil and mine waste exceed the assumed secondary cleanup goals.

Soluble metal analysis has determined that a portion of the Hazardous Waste level soil with the highest detected total metals concentrations also exceeds the STLC and TCLP threshold levels for soluble lead and thus would likely be considered RCRA Hazardous Waste. Waste classification will be performed during cleanup by analyzing composite samples of the excavated soil per landfill disposal characterization requirements.

DI WET analysis of five duplicate samples considered representative of soil proposed to be left in place with a soil cover after Site cleanup, indicate soluble lead was detected above the MCL for lead of 5 ug/L in one sample (WR-12b with total lead at 557 ug/L and soluble lead at 16.4 ug/L). Soluble mercury was detected at a concentration exceeding the MCL for mercury of 2 ug/L in one sample (WR-12B with total mercury at 9.7 mg/kg and soluble mercury at 2.79 ug/L). However, based on site conditions including shallow depths to bedrock and an assumed depth to groundwater within fractured rock of approximately 50 feet, attenuation of at least 10 fold can be assumed between metal impacted soil left in place and groundwater. The proposed soil cover would add an additional level of protection for both surface water and groundwater. Thus, based on the results of soil sampling and analysis performed to date, the proposed site cleanup described below would be protective of groundwater and surface water.

Assuming similar remedial goals are established for the site to those at the adjacent Providence Mine site, soil exceeding Hazardous Waste levels would be required to be excavated and disposed of off-site. Soil exceeding secondary cleanup goals may be allowed to be excavated or consolidated and placed as fill on site with a clean soil cover.

XRF sample results were used to define the extent of soil exceeding cleanup goals and surface areas where remediation is proposed. XRF results were also used to estimate cleanup volumes and for remediation cost estimates. XRF results were not included in the human health risk assessment for the site since the initial HHRA was performed prior to XRF sampling and since XRF sample results may not have the same level of accuracy as results from analysis using EPA Methodology.

2.7 HUMAN HEALTH RISK ASSESSMENT

Holdrege & Kull (H&K) performed a human health risk assessment (HHRA) for areas of the Nevada City Environs Property not previously evaluated. Areas evaluated in the HHRA included the Providence Quartz Mill assessment area and the Environs Waste Rock Piles assessment area. This Site Characterization report and RAW only addresses the Providence Quartz Mill assessment area. The purpose of the HHRA was to evaluate potential risks to human health from constituents of potential concern (COPCs) identified at the site. A Site conceptual model is presented as Figure 4.

SUMMARY OF RISK ASSESSMENT FINDINGS

Human health risk assessment findings are summarized below. Detailed findings are presented in Appendix C, "Human Health Risk Assessment for Providence Quartz Mill Site, Nevada City, California" (Holdrege & Kull; January 9, 2018).

Providence Quartz Mill (PQM) Assessment Area

In general, arsenic concentrations in mine waste and soil govern the calculated chronic human health hazard and excess lifetime cancer risk. Lead, cadmium, cobalt, mercury, thallium and other metals contribute to the chronic human health hazard. The assessment did not differentiate health hazards by critical health effect, but instead conservatively considered the aggregate hazard index irrespective of critical health effect.

Baseline conditions at the PQM assessment area are not suitable for residential land use, and are not considered protective under the other exposure scenarios considered in the assessment (adult recreational trail use, routine child visitation, adult unauthorized camping, and construction worker). The results of lead hazard assessment demonstrate that soil lead concentrations at the Providence Quartz Mill are not suitable for unrestricted land use.

In addition to the baseline risk assessment summarized above, Appendix C presents additional assessment associated with two potential cleanup scenarios. Both cleanup scenarios consider lead as the driver for site cleanup. Risk and hazard is calculated for all COCs based on two possible remedial actions:

1. Removal of soil with metals (lead and mercury) concentrations exceeding the corresponding Total Threshold Limit Concentrations (TTLCs; 1,000 mg/kg and 20 mg/kg, respectively).
2. Removal of soil with lead concentrations exceeding a cleanup goal (270 mg/kg) previously used for the adjacent Providence Mine Site.

<u>Removal of Soil Exceeding TTLCs</u>

Only lead and mercury were detected at concentrations exceeding the corresponding TTLCs:

- Lead concentrations in samples WR-8, WR-8B, WR-9, WR9-.75, WR9-1.5, SR-13, WR21 and WR21-1 exceed the TTLC for lead (1,000 mg/kg).

- Mercury concentrations in samples WR-8, WR-8B and SR-13 exceed the TTLC for mercury (20 mg/kg). Lead also exceeds the TTLC in these samples.

These samples were obtained from the vicinity of the historical location of the sulphuret room, on the southwest side of the historical location of the quartz mill. The PQM data set was culled by removing all metals data for the eight soil samples listed above, and 95% UCL values were calculated for the culled data set. Using the UCL values as exposure point concentrations (EPCs), the PQM assessment area would not be acceptable for unrestricted land use after removal of soil with metals exceeding the TTLC, nor would it be acceptable under the other exposure scenarios considered (adult recreational trail use, routine child visitation, adult unauthorized camping, and construction worker).

Soil cover would be required to limit recreational exposure, and engineering controls would be required for dust mitigation during construction or other soil disturbing activities.

Removal of Soil with Lead Exceeding 270 mg/kg

As described in Section 6.7, lead hazards were assessed using LeadSpread 8 (DTSC, 2011) for child exposure and the Modified ALM (DTSC, 2011) for adult exposure. A modified exposure frequency (two days per week) was previously used by H&K (2013) for child lead exposure in consultation with USEPA for the adjacent Providence Mine Site. Considering this modified exposure frequency for child lead exposure, the benchmark 90th percentile blood lead level (1.0 µg/dL) for non-pica child corresponds to a soil lead concentration 270 mg/kg.

Removal of soil from the PQM assessment area with lead concentrations exceeding 270 mg/kg would result in soil removal from most of the assessment area. Only 12 of the 30 samples obtained from the assessment area have lead concentrations less than or equal to 270 mg/kg.

To evaluate possible post-removal conditions, the PQM data set was culled by removing all metals data except for the 12 samples where lead is less than or equal to 270 mg/kg, and 95% UCL values were calculated for the culled data set. Using the UCL values as EPCs, the PQM assessment area would not be acceptable for unrestricted land use or routine child visitation after removal of soil with lead exceeding 270 mg/kg, but it may be acceptable for some forms of trail use. Soil cover would likely be required.

Considering adult recreational trail use, the chronic health hazard index is 1.1 and risk is 1.4E-05. Arsenic (95% UCL = 17.1 mg/kg) drives hazard and risk (HQ = 0.7, risk = 7.0E-06). Excluding arsenic (BTV = 17 mg/kg), the hazard index is 0.7 and risk is 8.0E-06.

For the adult unauthorized camping scenario, hazard (1.3) and risk (6.0E-06) are driven by arsenic. Excluding arsenic (BTV = 17), hazard is less than one and risk is less than one-per-million.

For the construction worker exposure scenario, hazard (27) and risk (1.0E-05) are driven by arsenic, with cadmium, cobalt, nickel and thallium also resulting in hazard quotients greater than one. As mentioned above, the EPCs for cobalt and nickel do not exceed the corresponding screening levels for residential soil.

2.8 ECOLOGICAL SCOPING ASSESSMENT

SSI prepared an Ecological Scoping Assessment of the Providence Quartz Mill Site with the assistance of other consulting biologists. The Ecological Scoping Assessment did not identify the presence of any state or federally listed threatened or endangered species at the site. No riparian habitat was identified on the Providence Quartz Mill Site. A copy of the Ecological Scoping Assessment is presented in Appendix D.

3. REMEDIAL ACTION OBJECTIVES

3.1 OVERVIEW

Pursuant to 40 CFR 300.430, remedial action objectives (RAOs) must be established. The RAOs must specify contaminants and media of concern, potential exposure pathways, and remediation goals. Remediation goals shall establish acceptable exposure levels that are protective of human health and the environment, and shall be developed by considering applicable, relevant and appropriate requirements (ARARs) under federal or state environmental laws, if available.

For known or suspected carcinogens, acceptable exposure levels are generally concentrations that represent an excess upper bound lifetime cancer risk to an individual of between one in ten thousand and one in one million, using information on the relationship between dose and response. For systemic toxicants, remediation goals shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety.

Remediation goals must also consider factors related to technical limitations such as metals concentrations in ambient soil; detection/quantification limits for contaminants; factors related to uncertainty; and other pertinent information.

3.2 ARARS

The NCP requires compliance with ARARs during remedial actions to the extent practicable. ARARs include federal, state, and local environmental laws, regulations, and standards that can be chemical-specific, location-specific, or action-specific. Chemical-specific ARARs are health-based or environmentally-based numerical limits pertaining to the amount of a contaminant released to the environment or allowed to remain in the environment as a result of the proposed remedial activity. Location-specific ARARs may restrict remedial action if the proposed action is located in an environmentally sensitive or historically significant area. Action-specific ARARs may restrict remedial action based on the specific remedial action and/or byproducts of the remedial action.

3.2.1 Chemical Specific ARARs

Resource Conservation and Recovery Act (RCRA)

RCRA Subtitle C, contained in 40 CFR, pertains to the characterization of hazardous waste. Based on the results of soil samples obtained at the site to date, soil from three relatively small areas of the Site meets federal criteria for classification as hazardous waste. Soil which is proposed for excavation and off- site disposal, will be sampled and analyzed per landfill disposal requirements. Results will be evaluated to determine appropriate waste disposal requirements. Disposal of impacted soil is to comply with RCRA Subtitle C. Some mine waste may be exempt from classification as a hazardous waste per Section 261.4(b)(7) of CFR Title 40.

California Code of Regulations (CCR) Title 22

Section 66261 of CCR Title 22 pertains to the characterization of hazardous waste. Lead and mercury concentrations detected in three areas of the site exceed the state benchmark values for hazardous waste. Disposal of impacted soil is to comply with Title 22 and RCRA Subtitle C. Some mine waste may be exempt from classification as hazardous waste per CCR Title 22 Section 66261.4(b)(5)(A).

Regional Screening Levels (RSLs)

RSLs established by Cal/EPA for residential soil may be used as a screening tool for individual constituents of concern. The RSLs were developed using methodology and toxicological parameters set forth by Cal/EPA, which were also generally used in the site-specific HHRA performed as part of the RAW. The RSLs are applicable to the proposed remedial action as a screening tool.

California Water Code

Division 7 of the California Water Code establishes priorities for the California Regional Water Quality Control Board (RWQCB). RWQCB guidance and numerical limits are presented in various documents. The RWQCB Basin Plan, Designated Level Methodology, Antidegradation Policy and Water Quality Goals establish policies, procedures and numerical limits for protection of surface water and groundwater quality. The proposed remedial action focuses on protection of human health and does not propose remedial action that will significantly affect water quality.

3.2.2 Location-Specific ARARs

National Historic Preservation Act

The National Historic Preservation Act, as set forth in Sections 65 and 800 of CFR Title 36, pertains to cultural resources and historic sites. The type of historical mining activity documented at the site is common in the site vicinity. A cultural resources study and archeological report has been completed for the Providence Mine site with a coverage area which included the subject site. No sensitive cultural resources were identified on the site. The cultural resource study was reviewed and accepted by the California State Historic Preservation Office (SHPO). The proposed site remediation will comply with the National Historic Preservation Act and will be performed in a manner that will not disturb significant cultural resources or historic sites, if such are identified in the study.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act, as set forth in Section 6.302 of CFR Title 40, pertains in part to wetlands protection and flood management. No flood-prone areas have been identified in the proposed remedial action areas. Appropriate best management practices (BMPs) will be utilized to prevent off-site migration of soil contaminants.

Clean Water Act

The Clean Water Act, as set forth in Section 230 of CFR Title 40, pertains to flood-prone areas and wetlands. Flood-prone areas have not been identified the proposed remedial action areas. Appropriate BMPs will be implemented and remedial activities will comply with Section 230 of CFR Title 40.

RCRA

Section 264.18 of CFR Title 40 pertains to the treatment, storage and disposal of hazardous waste. Post excavation soil samples will be obtained to characterize soil excavated from the Site prior to off-site disposal. Analysis will include total and soluble metals analysis to determine if total or soluble threshold limits are exceeded. If characterization sample results indicate the excavated soil is RCRA waste, all appropriate RCRA regulations will be implemented during disposal.

3.2.3 Action-Specific ARARs

California Water Code

The California Water Code governs the characterization of waste for disposal to land. Waste disposal must comply with the provisions of the California Water Code.

Northern Sierra Air Quality Management District Rule 226

Northern Sierra Air Quality Management District Rule 226 requires that a dust control plan be prepared for construction activity disturbing more than one acre of land. The proposed remediation area, including staging and access areas, is not anticipated to exceed one acre in total area. Rule 226 is thus not applicable. However, to minimize fugitive emissions during remediation activities, SSI prepared a Dust Mitigation Plan (DMP), which is presented in Appendix I.

Air Resources Board Regulation 93105

Under California law, disturbance of soil and rock that contains ultramafic rock, serpentinite or naturally occurring asbestos minerals must be handled as described in Cal/EPA Air Resources Board Regulation 93105, *Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations*. No ultramafic rock, serpentinite or naturally occurring asbestos minerals have been observed on the subject site nor are they mapped within approximately 1.25 miles of the site. Thus, Air Resources Board Regulation 93105 does not apply.

Public Resources Code 4581 and 4621

The proposed remedial activities are not expected to include significant timber operations that involve the removal of large trees. A “significant” timber operation is generally considered to involve the disturbance of more than 2.99 acres of timberland. A Timber Harvesting Plan (Public Resources Code 4581) and a Timberland Conversion Permit (Public Resources Code 4621) are not expected to be required for the proposed remedial activities.

3.3 MEDIA AND CONSTITUENTS OF CONCERN

The primary medium of concern at the site is mine processing waste and soil impacted by mining or mine processing activities. Potential exposure pathways are associated with soil and include dermal absorption through direct contact, incidental ingestion, and inhalation of soil dust. Elevated metals concentrations are present in mine waste and affected soil in the assessment areas identified at the site. In general, soil lead, mercury

and arsenic concentrations govern the calculated chronic human health hazard and excess lifetime cancer risk. Cadmium and other metals are also considered COPCs.

3.4 QUANTITY ESTIMATE

An estimated 350 cubic yards (cy) of mine waste rock, processed mine waste or impacted soil were identified at the site. Figure 3 is a sample location map. Figure 5 5 depicts proposed work areas where mine waste and impacted soil has been identified at the site.

Only limited subsurface investigation was performed at the site. SSI generally estimated quantities of mine waste at the Site based on surface extent of apparent mine waste and roughly estimated volumes based on observations of surface topography and stratigraphic relationships including shallow depths to bedrock observed in several areas of the Site. Since most volume estimates are based on surface data only and were not calculated using survey methods, the actual volume may vary significantly from the estimated volumes.

Estimated surface areas of exposed mine waste and impacted soil and rough volume estimates for soil exceeding applicable cleanup goals are provided below:

Mine Waste and soil exceeding Hazardous Waste levels: Soil impacted by lead in excess of 1,000 mg/kg or mercury in excess of 20 mg/kg covers a surface area of approximately 850 square feet (sf). Assuming these impacts reach an average depth of 1 foot results in a volume estimate of 32 cy of lead or mercury impacted soil exceeding hazardous waste levels.

Mine Waste and mining impacted soil exceeding RSLs or proposed cleanup goals: Exposed mine waste rock or impacted soil covers a total surface area of approximately 4,000 sf. Based on limited subsurface excavation and topographic surface observations, mine waste thickness may average between less than 1 foot and 2 feet in the eastern and southern portions of the Quartz Mill Site and approximately 4 feet or greater in the northwestern portion of the Site. This results in a minimum volume of 350 cy of mine waste exceeding proposed cleanup goals in these areas.

3.5 REMEDIAL ACTION GOALS

The goal of the remedial action at the Site is to reduce to acceptable levels the potential human health risk associated with the elevated metals concentrations in mine waste and affected soil where future recreational land use is anticipated. Proposed remedial actions

include excavation and off-site disposal of soil with metals concentrations exceeding hazardous waste levels and consolidation and covering of soil in areas where elevated metals concentrations exceed remedial goals. Clean imported fill material used to cover these areas is to comply with DTSC's advisory *Information Advisory Clean Imported Fill Material*. In general, metals concentrations in imported fill should be below RSLs for residential sites.

Based on the anticipated exposure frequencies and revised Lead Spread outputs, a lead cleanup goal of 270 mg/kg is proposed for the Site. Justification for this cleanup goal is presented in the Human Health Risk Assessment Appendix C. Cleanup to lead goals will significantly reduce arsenic concentrations, therefore, no arsenic cleanup goals are proposed at this time.

4. EVALUATION OF REMEDIAL ACTION ALTERNATIVES

Evaluation of remedial alternatives for the Site are discussed below.

SSI reviewed potentially applicable alternative soil remediation methods for the Site including: (1) No Action, (2) Excavation and Off-Site Disposal, (3) Excavation, On-Site Placement and Cover and, (4) Combined Approach including aspects of Alternatives 2 and 3 along with institutional controls.

The review of potential soil remediation alternatives was conducted using an evaluation equivalent to an EE/CA as required by the NCP.

4.1 OVERVIEW

Pursuant to 40 CFR Part 300.430, as determined appropriate and to the extent sufficient information is available, the short- and long-term aspects of the following three criteria were used to guide the development and screening of remedial alternatives:

Effectiveness. This criterion focuses on the degree to which an alternative reduces toxicity, mobility, or mass of contaminants through treatment, minimizes residual risks and affords long-term protection, complies with ARARs, and minimizes short-term impacts, and how quickly it achieves protection. Alternatives providing significantly less effectiveness than more beneficial alternatives are eliminated. Alternatives that do not provide adequate protection of human health and the environment are also eliminated from further consideration.

Implementability. This criterion focuses on the technical feasibility and availability of the technologies each alternative would employ and the administrative feasibility of implementing the alternative. Alternatives that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period of time are eliminated from further consideration.

Cost. Construction cost, maintenance cost and any other long-term cost to operate and maintain the alternatives were also considered. Costs that are grossly excessive compared to the overall effectiveness of alternatives are considered as one of several factors used to eliminate alternatives. Alternatives providing effectiveness and

implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated.

The analysis of alternatives under review reflects the scope and complexity of site problems and alternatives being evaluated, and considers the relative significance of the factors within each of the following criteria:

Overall protection of human health and the environment. Alternatives are assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs. The alternatives are assessed to determine whether they attain applicable, relevant and appropriate requirements under federal environmental laws and state environmental or facility citing laws or provide grounds for invoking waivers from such laws.

Long-term effectiveness and permanence. Alternatives are assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. As appropriate, the following factors are considered: (1) magnitude of residual risk (taking into account the volume, toxicity, mobility, and propensity to bioaccumulate); (2) compliance with ARARs; (3) long term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state acceptance; and (9) community acceptance.

Reduction of toxicity, mobility, or volume through treatment. The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume are assessed, including how treatment is used to address the principal threats posed by the site.

Short-term effectiveness. The short-term impacts of alternatives are assessed considering short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of

the remedial action and the effectiveness and reliability of mitigative measures during implementation; and time until protection is achieved.

Implementability. The ease or difficulty of implementing the alternatives is assessed by considering technical feasibility, administrative feasibility, and availability of services and materials.

Cost. Costs include capital costs (direct and indirect) and operation and maintenance (O&M) costs.

State acceptance. State concerns include the state's position related to the preferred alternative and other alternatives, and state comments on ARARs or the proposed use of waivers.

Community acceptance. Public review is to be performed to assess community support, reservations and/or opposition of components of the proposed remedial action.

The nine criteria listed above are categorized into three groups:

Threshold criteria. Overall protection of human health and the environment and compliance with ARARs (unless a specific ARAR is waived) are threshold requirements that each alternative must meet in order to be eligible for selection.

Primary balancing criteria. The five primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

Modifying criteria. State and community acceptance are modifying criteria that shall be considered in remedy selection.

The remedial alternative that best meets the requirements above is to be identified and presented to the public in this RAW. The RAW provides:

- Brief summary of the remedial alternatives;
- Discussion of the rationale that supports the preferred alternative;
- Summary of any formal comments received from the support agency; and
- Summary explanation of any proposed waiver from an ARAR.

4.2 REMEDIAL ACTION ALTERNATIVES

Four remedial action alternatives were considered for the Site. These alternatives consisted of:

Alternative 1: No Action
Alternative 2: Excavation and Off-Site Disposal
Alternative 3: Excavation, On-Site Placement and Cover
Alternative 4: Combined Approach, Off-Site Disposal and On-Site Placement

Specific discussion of effectiveness, implementability and cost for these alternatives is described below.

4.2.1 Alternative 1: No Action

The No Action alternative includes leaving mine waste and affected soil at the Site in their existing condition without engineering or institutional controls. Specific evaluation of this alternative is summarized below.

Effectiveness

- Does not provide adequate protection of human health and the environment
- Does not effectively reduce risks
- Does not afford short-term or long-term protection
- Does not comply with ARARs

Implementability

- Immediately implemented
- No labor, materials or equipment necessary
- Administratively infeasible based on ARARs

Cost

- No direct costs
- Unknown future costs

The No Action alternative is ineffective compared to the other remedial alternatives and does not provide adequate protection of human health and water quality. Therefore, the No Action alternative was eliminated from further consideration.

4.2.2 Alternative 2: Excavation and Off-Site Disposal

The Excavation and Off-Site Disposal alternative includes excavation of mine waste and associated soil having metals concentrations that exceed cleanup goals. Verification soil sampling and analysis would be performed to confirm that the remedial goals are achieved and to characterize the excavated material. Excavated soil exceeding hazardous waste levels would be transported to a Class I landfill. Soil exceeding remediation goals but below hazardous waste levels would be transported to a Class 2 landfill in accordance with applicable regulations. Procedures required for dust and erosion control would be addressed in a Dust Mitigation Plan (DMP). Worker health and safety would be addressed in site safety plans prepared by the parties involved. The evaluation of this alternative is summarized below.

Effectiveness

- Effectively protects human health by eliminating the potential exposure pathways.
- Short-term impacts associated with remediation would be reduced by provisions set forth in a DMP and SSP.
- Affords long-term protection of human health and the environment.
- Complies with ARARs.

Implementability

- Readily implemented; however, site access considerations would require excavation of a temporary ramp from the staging area along Providence Mine Road to the central portion of the Site to allow heavy equipment access.
- Technically feasible; however, site access and proximity of mine waste to Deer Creek and Pecks Ravine would require careful handling and stringent use of BMPs.
- Administratively feasible; however, off-site disposal location of hazardous waste will be dependent on waste characterization and landfill acceptance criteria. If soil cannot be disposed of in California, potential out of state disposal would require additional administrative evaluation.
- Likely acceptable to regulatory agencies but may not be acceptable to the local community due to visual and environmental impacts of tree removal and truck traffic. Based on preliminary volume estimates, approximately 27 truckloads for off-haul and 14 truckloads for import of clean fill would be required. The staging area for trucks would be located along the north side of the cleanup area to the west and south of the bend in Providence Mine Road. Trucks would leave the site via Providence Mine Road, Zion Street and Gold Flat Road (secondary public roads with single lanes in each direction) and enter State Highway 49 southbound, approximately 2 miles

southwest of the site.
- Can be performed in a relatively short time frame.

Cost

- High capital costs. Planning level cost estimates indicate that the direct cost of Excavation and Off-Site Disposal of mine waste and impacted soil would be approximately $145,000. A cost estimate is provided in Table 4a. The cost estimate also includes a 20% contingency, which is primarily related to uncertainties regarding the volume estimate and off- site disposal fees. Additional costs were included for importation of clean soil to replace the off-hauled material, as well as costs associated with erosion control and re-vegetation.
- Moderately high indirect costs (approximately $65,000) associated with Excavation and Off-site Disposal include verification soil sampling and analysis, landfill characterization sampling and analysis, possible air monitoring, and reporting requirements. Engineering tasks such as the preparation of grading plans, a storm water pollution prevention plan, surveying and permitting fees are also included in the cost estimate.
- On-going costs associated with off-site disposal include re-vegetation, maintenance and monitoring.

The total cost of Excavation and Off-Site Disposal alternative exceeds the maximum budget available in the EPA Brownfields Cleanup grant. The City of Nevada City does not have other available funds for the project. Therefore the Excavation and Off-Site Disposal alternative is not an acceptable remedial alternative.

4.2.3 Alternative 3: Excavation, On-Site Placement and Cover

The Excavation, On-Site Placement and Cover alternative includes the following tasks:

- Excavation of mine waste and affected soil exceeding remedial goals;
- Placement and consolidation of the mine waste and affected soil on-site;
- Placement of imported clean fill soil in excavated areas and over areas of on- site placement of mine waste.

Based on evaluation of soil sample results and cleanup goals, approximately 350 cy of mine waste including 32 cy exceeding hazardous waste levels, would be excavated and placed as fill in an impacted area of the Site and subsequently covered with clean imported fill soil. Excavated areas would be backfilled with imported clean fill soil. Erosion

control and re-vegetation measures would be implemented. A Land Use Covenant (LUC) and Operation and Maintenance (O&M) agreement would likely be required. Worker health and safety would be addressed by SSPs prepared by the parties involved. Upon completion of these tasks, the covered mine waste locations would be suitable for open space and/or recreational land use.

Effectiveness

- Burial of the mine waste effectively reduces human health risk by eliminating potential exposure pathways (incidental ingestion, inhalation of airborne particulates, and dermal contact with the impacted soil).
- On- site burial of soil and mine waste exceeding hazardous waste levels would likely not be acceptable to regulatory agencies and may not be protective of groundwater depending on solubility analysis.
- Short-term impacts associated with remediation would be reduced by provisions set forth in a DMP and SSPs prepared by the parties involved.
- The Excavation and On-Site Placement alternative requires an LUC and O&M agreement for the proposed placement locations, which afford long-term protection of human health by restricting future disturbance.

Implementability

- Readily implemented
- Labor, material and equipment readily available
- Likely unacceptable to regulatory agencies and community

Cost

- Moderate capital costs (approximately $75,000) associated with equipment mobilization and access, excavation and on-site transportation; imported fill; fill placement, moisture-conditioning and compaction; quality assurance observation and testing, erosion control and re-vegetation. A cost estimate is presented in Table 4b.
- Moderate indirect costs (approximately $60,000) associated with engineering and construction management, and institutional controls including development of an LUC and O&M agreement, and periodic reporting.

Based on the regulatory and potential water quality issues associated with on-site burial of hazardous waste, the Excavation, On-Site Placement and Cover alternative may not be an acceptable remedial option for all mining impacted areas of the site. However, a modified version of this alternative involving off-site disposal of soil exceeding hazardous

waste levels and on-site burial of non-hazardous soil is considered in Alternative 4 outlined below.

4.2.4 Alternative 4: Combined Approach

The Combined Approach alternative includes elements of Alternative 2 and Alternative 3. Mining-impacted soil that exceeds hazardous waste levels would be excavated and disposed of off-site. Soil and mine waste with metals concentrations below hazardous waste levels would be excavated, consolidated and placed as fill on-site. Imported clean fill soil would be used to backfill the excavations and placed as cover over the on-site placement area. Institutional controls including signage and an LUC would be implemented to reduce potential exposure during future recreational use of the site. The LUC would restrict future site use to open space or recreational use. An O&M agreement would be implemented to verify that soil cover over the placement area remains intact. Worker health and safety would be addressed by SSPs prepared by the parties involved. Following implementation of these activities, the mine features area would be suitable for open space and/or recreational land use.

<u>Effectiveness</u>

- Effectively protects human health by eliminating the potential exposure pathways.
- Short-term impacts associated with remediation would be reduced by provisions set forth in a DMP and SSPs.
- Affords long-term protection of human health and the environment.
- Complies with ARARs.
- Off-site disposal of mine waste that exceeds hazardous waste levels is protective of human health and water quality.
- On site placement of mine waste that is below hazardous waste levels reduces potential for erosion of mine waste into Deer Creek and improves protection of water quality.
- Burial and covering of the mine waste with clean soil effectively reduces human health risk by eliminating potential exposure pathways (incidental ingestion, inhalation of airborne particulates, and dermal contact with the impacted soil).
- Short-term impacts associated with remediation would be reduced by provisions set forth in a DMP and SSPs prepared by the parties involved.
- Effectiveness would be confirmed by post-excavation verification soil sampling and analysis.
- The Combined Approach alternative requires an LUC and O&M agreement for the proposed placement and cover locations, which afford long-term protection of human health by restricting future disturbance.

Implementability

- Readily implemented
- Labor, material and equipment readily available
- Likely acceptable to regulatory agencies and community based on the reduction of significant human health risk in most areas, stabilization of waste adjacent to Deer Creek and installation of informational signs at site access locations regarding elevated metals concentrations and risk to human health.

Cost

- Moderate capital costs (approximately $108,000) associated with excavation, limited off-site disposal and on-site burial and imported fill placement. A cost estimate is presented in Table 4c.
- Moderate indirect costs (approximately $60,000) associated with soil sampling and disposal characterization, construction management and institutional controls.

Based on affordable costs consistent with the Brownfields Cleanup budget, relatively high levels of protection of human health and improvements in protection of water quality, the Combined Approach is considered to be an acceptable remedial alternative for the Site. More specific discussion of the preferred alternative selection is provided below.

4.3 SELECTED REMEDIAL ALTERNATIVES

Four remedial alternatives were considered for the Site: Alternative 1 - No Action; Alternative 2 - Excavation and Off Site Disposal; Alternative 3 - Excavation, On-Site Placement and Cover; and Alternative 4 - Combined Approach.

Alternative 1 - No Action would not be protective of human health or the environment, and therefore is not an acceptable alternative.

Alternative 2 - Excavation and Off-Site Disposal of all soil and mine waste that exceeds cleanup goals would be cost prohibitive and thus is not an acceptable alternative. The estimated cost of Alternative 2, approximately $145,000 plus indirect costs, exceeds the Brownfields Budget for cleanup and implementation (roughly $120,000 based on anticipated funds remaining after RAW approval and permitting). Exceeding the Brownfield Grant-funded budget is unacceptable as it would result in project termination prior to completion. EPA Brownfields project guidelines do not allow for additional grant

funding or fund extensions and the City of Nevada City does not have additional funding available to complete the project.

Alternative 3 - Excavation, On-Site Placement and Cover would provide suitable protection of human health and would be cost effective but may not be protective of water quality and would not be consistent with ARARs due to on-site burial of soil with metals that exceed hazardous waste levels.

Alternative 4 - Combined Approach is the selected remedial alternative based on affordable costs consistent with the Brownfields Cleanup budget, relatively high levels of protection of human health and improvements in protection of water quality.

The scope of Alternative 4 includes excavation of approximately 32 cy of lead or mercury-impacted soil that exceeds hazardous waste levels. The excavated, hazardous soil would be stockpiled, characterized and disposed of off-site. Additional soil and mine waste with metals concentrations exceeding cleanup goals but below hazardous waste levels (estimated at approximately 350 cy) would be excavated or consolidated and placed as fill in previously impacted areas of the site. Imported clean fill soil will be used to backfill the excavations and or cover areas that exceed cleanup goals. Clean fill soil will also be placed as cover over the on-site placement area.

Alternative 4 would provide for institutional controls, including signs informing the public of potential toxic chemical exposure risks and an LUC stipulating that areas of soil cover would not be disturbed. Land use would be restricted to open space or recreational use.

4.4 PROPOSED REMEDIAL ACTION

Proposed remedial actions at the site will be implemented as follows:

A. Hazardous Waste Removal
    1. Clear, grub and construct temporary access ramp.
    2. Excavate hazardous waste in central Quartz Mill area and stockpile in staging area.
    3. Perform verification soil sampling and additional excavation as needed to achieve remedial goals.
    4. Characterize excavated soil and dispose off-site at hazardous waste disposal facility.
    5. Backfill hazardous waste excavation and backfill with non-hazardous soil covered with clean imported soil.

B. Non-Hazardous Soil Excavation and On-Site Disposal
   1. Excavate soil and mine waste that exceeds lead cleanup goals.
   2. Consolidate and place excavated soil in fill placement area.
   3. Perform verification soil sampling and additional excavation as needed to achieve remedial goals.
   4. Backfill excavations and cover consolidated non-hazardous soil with clean imported soil (after all soil placement is complete).

Post -Construction Phase - Institutional Controls

A. Informational and interpretive signs
B. Land use covenant with DTSC
C. O&M agreement with DTSC

Volume Estimates for Proposed Remedial Action

The following volume estimates include total volumes for all phases of the proposed remedial action:

Soil to be excavated and hauled off site for disposal:	32 cy
Soil to be excavated and placed as fill on site:	350 cy
Imported fill soil to be placed on site:	270 cy

Figure 5 is a Proposed Work Areas Map showing approximate areas of Hazardous and non-hazardous soil excavation, consolidated non-hazardous soil placement and cover soil placement.

5. REMEDIAL PROCEDURES AND IMPLEMENTATION

The site remediation will be performed in a phased approach as outlined above. The tasks required for site remediation and project implementation include:

- Equipment Mobilization, Staging and Site Access
- Water Pollution Control and BMPs
- Temporary Access Grading
- Clearing and Grubbing
- Hazardous Waste Excavation, Stockpiling, Characterization and Disposal
- Non-Hazardous Waste Soil Excavation
- Verification Soil Sampling
- Non-Hazardous Fill Placement in designated area on site
- Import Fill and Soil Cover Placement
- Re-vegetation and Erosion Control
- Construction Management

Specific discussion of these tasks is provided below. A Soil Management Plan is attached as Appendix E.

5.1 EQUIPMENT MOBILIZATION, STAGING AND SITE ACCESS

The proposed remedial measures will require use of heavy equipment, which can access the site from the staging area adjacent to Providence Mine Road along the northern edge of the Site. Equipment will be staged on the south side of Providence Mine Road adjacent to the Site. Access to cleanup areas will be provided by temporary access roads and ramps.

5.2 TEMPORARY ACCESS GRADING

Improvements to the existing trail will be required to allow heavy equipment passage from Providence Mine Road to the Site. A temporary access ramp will be graded from the staging area up slope to the cleanup locations. Site access, staging areas and alignment of the temporary access road are shown on Figure 5, Proposed Work Area Map.

5.3 WATER POLLUTION CONTROL AND BMPS

BMPs outlined in a Storm Water Pollution Prevention Plan (if required) or Grading Plan will be implemented to control surface erosion and protect water quality during project implementation. BMPs will be required along the downhill side of all proposed excavation, grading and soil placement areas. BMPs will include installation and maintenance of reinforced silt fencing, fiber rolls, dust control, stockpile management and other applicable BMPs as necessary.

5.4 CLEARING AND GRUBBING

Areas where the proposed activities include excavation, regrading and cover soil placement, will be cleared of vegetation and moisture conditioned prior to excavation. Woody debris will be chipped and the chips stockpiled on-site for use as mulch. Trees greater than 6-inches in diameter will be left in place and protected unless removal of individual trees is necessary for excavation of hazardous waste or equipment access. The Dust Management Plan (DMP) included in Appendix F will be implemented to minimize air quality impacts.

5.5 HAZARDOUS SOIL EXCAVATION, CHARACTERIZATION AND DISPOSAL

Three locations with a total surface area of approximately 850 sf where near surface soil with hazardous levels of lead (greater than 1000 mg/kg) or mercury (greater than 20 mg/kg) has been identified will be delineated in the field prior to excavation. Soil exceeding hazardous waste levels (approximately 32 cy) will be excavated to a depth of up to 24 inches bgs and stockpiled on site. Excavation depths may be shallower in areas of shallow bedrock. Verification soil sampling (described below) will be performed to confirm that the lateral extent of soil containing lead over 1000 mg/kg or mercury greater than 20 mg/kg has been removed. Additional excavation and sampling will be performed as needed to meet remedial goals. The excavation will be backfilled with clean imported fill or consolidated non-hazardous soil covered by clean fill soil as soon as remedial goals are met. If any areas are to be left in place with soil concentrations exceeding TTLC levels, following excavation and prior to backfilling these areas, a visible barrier such as a brightly colored felt or permeable geotextile layer will be placed between any remaining soil exceeding hazardous waste levels (if any) to be left in place and the overlying backfill soil. The backfill soil covering the Hazardous Waste area excavation will be mechanically compacted to limit potential disturbance.

Stockpiled soil will be sampled in accordance with landfill disposal characterization requirements. Once landfill acceptance is granted, the soil will be loaded onto sealed containers and transported off-site to an approved hazardous waste disposal facility. Disposal sites for Hazardous Waste will be selected based on an evaluation of potential transport and disposal costs. After the soil has been excavated, sampled and characterized, SSI will coordinate with the selected disposal facility to meet all requirements. SSI will consult with DTSC prior to selection a disposal facility.

5.6 NON-HAZARDOUS SOIL EXCAVATION

Areas of soil and mine waste at the Site that exceeds the lead cleanup goal of 270 mg/kg based on previous soil sample results, will be delineated in the field prior to excavation. These areas will be excavated to a depth of 12 to 24 inches bgs, consolidated and placed as fill within the Hazardous and non-hazardous soil excavation areas as described below. Relatively level smaller areas of non-hazardous soil exceeding 270 mg/kg led in the eastern part of the site and in the Roasting Furnace area will be left in place with cover soil. Verification soil sampling (described below) will be performed to confirm that the lateral extent of contamination over 270 mg/kg lead has been removed and consolidated on site or covered with clean soil. Additional excavation and sampling may be performed as needed to meet remedial goals. The excavation will be backfilled with clean imported fill after remedial goals are met. Consolidated fill placement areas and other excavation areas remaining with lead or other metals concentrations exceeding remedial goals will be covered with at least 8-inches of clean imported fill as described below.

5.7 VERIFICATION SOIL SAMPLING AND ANALYSIS

Verification soil sampling will be performed along the perimeters and at the base of near surface excavations at the Site to confirm remedial goals are achieved. Near surface samples will be obtained from the perimeters of the excavations at a rate of one per 50 feet or a minimum of three samples per excavation and at the base of the excavations at a rate of one sample per 200 square feet of excavation surface or a minimum of one sample per excavation. No soil samples will be collected in areas where excavation has extended to bedrock.

Samples will be analyzed for total lead, arsenic and mercury by USEPA Method 6010B/7471 or using an XRF. If an XRF is used, co-analyzed samples will be analyzed by EPA Method 6010B/7471 at a rate of 30% or 7 total samples whichever is greater.

Details of the soil sampling are presented in the Verification Soil Sampling and Analysis Plan (VSAP) in Appendix G.

5.8 PREPARATION OF FILL PLACEMENT AREA FOR BACKFILL

Prior to placement of fill, the designated fill placement area (hazardous waste excavation areas) will be graded using a track-mounted excavator, bull dozer or grader to level the area or create level benches as recommended by the project engineer. Prior to fill placement, placement areas will be compacted to at least 90 percent of the maximum dry density per ASTM D1557.

5.9 FILL PLACEMENT

Non-hazardous soil and mine waste excavated from the Site will be consolidated and placed as fill in the designated fill placement areas. Fill will be placed in maximum 6-inch loose lifts and compacted in accordance with the engineers recommendations. Based on volume estimates included in this report, it is anticipated that the fill placement will cover a surface area of approximately 4000 sf and will be placed to a depth of approximately 1 to 3 feet (approximately 350 cy fill volume). If necessary to accommodate the excavated material the placement area may be gently sloped to the north at a slope of 5:1, H:V, or flatter. Figure 5 is a Proposed Work Areas Map showing excavation and fill placement areas. A detailed grading plan will be prepared by the project engineer prior to remedial implementation.

5.10 IMPORT FILL AND SOIL COVER PLACEMENT

Imported fill will be used to cover exposed areas of soil or mine waste exceeding cleanup goals remaining at the site including the designated fill placement area. Imported cover soil will be selected from a local source and will be similar to the existing site topsoil. Imported fill will be tested in accordance with DTSC's October 2001, *Information Advisory, Clean Imported Fill Material.* Fill will be placed in maximum 6-inch loose lifts to achieve a soil cover with a minimum compacted thickness of 8-inches. An estimated total of 270 cubic yards of clean fill will be placed at the site. The top four inches of imported cover soil placed in re-vegetation areas will be left relatively loose to allow vegetation growth and stabilization.

5.11 REVEGETATION AND EROSION CONTROL

Re-vegetation efforts will begin as soon as possible after excavation, slope grading and completion of soil cover placement and will include all disturbed areas including areas where cover soil is placed. A restoration biologist will be consulted regarding plant selection. Erosion control measures such as coir fiber rolls or mats will also be placed as needed on disturbed slopes prone to erosion including any areas where slopes exceed 5:1 H:V.

5.12 CONSTRUCTION MANAGEMENT

An OSHA-certified remediation contractor will be retained to perform the tasks described above. OSHA-trained SSI employees will monitor field activities, perform environmental sampling and monitoring, and address contractor requests for information. A Site Safety Plan (SSP) included in Appendix H and discussed below, will address health and safety issues for SSI employees. Contractors will be responsible for their employees' health and safety.

5.13 SPECIFICATIONS

On-site placement and compaction of mine waste, and soil cover, erosion control and re-vegetation are to be performed in general accordance with the specifications presented below. These specifications are based on the recommendations included in the H&K geotechnical engineering recommendations for the Providence Mine Site which was completed on the adjacent site in 2013. The mine waste and impacted soil placed in the non-hazardous waste locations is to be covered with a minimum of 8 inches of imported clean soil. BMPs shall be implemented to reduce the chance of potential erosion and sediment transports as discussed below.

1. Native Soil Preparation for Fill Placement
    a. Strip and remove organic debris from the existing ground surface.
    b. Scarify native soil to a depth of 2 inches below the existing ground surface, and then uniformly moisture condition to within approximately 2 percentage points of the American Society for Testing and Materials (ASTM) D1557 optimum moisture content.

2. On-Site Placement of Excavated Mine Waste
    a. Maintain moisture content in mine waste and associated soil to minimize the generation of visible dust during preparation, placement and compaction.

b. Avoid contact with mine waste and associated soil.
c. Mine waste and associated soil shall be uniformly moisture-conditioned to the ASTM D1557 optimum moisture content or within approximately 3 percentage points above optimum moisture content.
d. Fill shall be constructed by placing uniformly moisture-conditioned soil in maximum 8-inch-thick loose lifts (layers) prior to compacting.
e. Fill shall be compacted to a minimum relative compaction of 90 percent of the ASTM D 1557 maximum dry density.

3. Imported Cover Soil Placement
   a. Cover soil shall be imported from an approved source.
   b. Cover soil shall be uniformly moisture-conditioned to within two percentage points of the ASTM D1557 optimum moisture content.
   c. Cover soil shall be constructed by placing uniformly moisture conditioned soil in maximum 8-inch-thick loose lifts (layers) prior to compacting.
   d. Total compacted fill thickness shall be a minimum of 8 inches
   e. Cover soil shall be compacted to a minimum relative compaction of 90 percent of the ASTM D1557 maximum dry density. The upper 4 inches of cover soil shall be compacted to a minimum relative compaction of 80 percent of the ASTM D1557 maximum dry density to allow plant root penetration.

4. Erosion Control
   Exposed fill surfaces and disturbed areas to be hydroseeded with an appropriate seed mixture compatible with the soil and climate conditions of the site as recommended by the project horticulturist.
   b. Coir fabric, jute netting, tackifiers and/or binding agents shall be placed on the seeded slopes to retain the seed on the slope.
   c. Fiber rolls shall be installed along the down gradient perimeter of all disturbed areas in accordance with the project plans. Additional fiber rolls shall be placed on slopes steeper than 5:1, H:V, with a maximum spacing of 5 vertical feet. Fiber rolls shall be installed along the same contour elevation.

5. Re-vegetation
   a. Re-vegetation of soil cover areas shall be coordinated by a horticulturist consultant or contractor immediately following completion of fill placement by the earthwork contractor. All container plants will be California Native species selected based on local climate conditions.

5.14 INSTITUTIONAL CONTROLS

Signs will be placed at the site access points at the eastern and northern edges of the Site to inform the public that mine waste with elevated metals concentrations is present on the site. DTSC will be consulted regarding sign language. To provide additional human health protection, LUCs will be established for areas of the site where elevated

concentrations of COPCs will remain in place under proposed soil or existing vegetative cover. Future land use will be restricted to recreational use or open space. DTSC will likely require an O&M agreement to include yearly monitoring and reporting of the integrity of the fill and signage. SSI does not anticipate that permanent fence installation will be required.

5.15 LAND USE COVENANT AGREEMENT FOR ON-SITE PLACEMENT AREA

An LUC agreement and O&M agreement are recommended for the on-site placement area and all areas where mine waste is to be left in place beneath cover soil or vegetation. LUC agreements are intended to protect public health and the environment by: 1) preventing inappropriate land use, 2) increasing the probability that the public will have information about residual contamination, 3) disclosing information for real estate transactions about residual contamination, 4) ensuring that long-term mitigation measures are carried out by protecting the engineering controls and remedy; and 5) ensuring that subsequent owners assume responsibility for preventing exposure to contamination.

5.16 DEED RESTRICTION

No specific deed restriction has been proposed for the site at this time. SSI anticipates that details of a deed restriction will be negotiated between the City of Nevada City and DTSC based on the outcome of the site cleanup.

Deed restriction pertaining to the project would comply with the following general provisions:

1. No activities that will disturb the mine waste within the on-site placement area or beneath other covered areas (e.g., excavation, grading, removal, trenching, filling, earth movement or mining) shall be allowed on the property without a soil management plan approved by DTSC.
2. Restriction of the land use within the on-site placement area is to be established by LUC agreement between the property owner and DTSC. Successive owners, heirs and assignees are to be expressly bound by the covenant.
3. Prior to the sale, lease or sublease of the property containing the on-site placement area, the owner, lessor, or sublessor shall give the buyer, lessee, or sublessee notice that hazardous substances are located in the area.
4. The land use controls shall be incorporated by reference in each and all deeds and leases for the property.

5. The owner shall provide notice to DTSC not later than 30 days after any conveyance of any ownership interest in the property containing the on-site placement area (excluding mortgages, liens, and other non-possessory encumbrances). DTSC shall not, by reason of the covenant, have authority to approve, disapprove, or otherwise affect proposed conveyance, except as otherwise provided by law or by administrative order.
6. The LUC shall be recorded in the County of Nevada.
7. The terms of the deed restriction run with the land and will continue in perpetuity unless a variance is granted or unless terminated.
8. An O&M agreement will establish requirements for monitoring, and reporting.
9. Periodic monitoring of the cover soil and vegetation and annual reporting to DTSC will continue to be required after any future recreational development is complete. Periodic monitoring of sign posting, and annual reporting to DTSC will be required.

5.17 OPERATIONS AND MAINTENANCE AGREEMENT

DTSC may require an O&M agreement adopted from the Hazardous Waste Control Law, as set forth in CCR Title 22, including Sections 66264.147, 66265.143, 66265.145 and 66265.147. The O&M Agreement is to be discussed with DTSC after approval of the RAW or at the completion of the site cleanup activities.

6. SITE SAFETY PLAN

SSI prepared a Site Safety Plan for use of SSI employees at the site. The SSP provides information regarding potential chemical and physical hazards that may exist at the site and describes safety measures to be followed by field personnel during remedial activities. The SSP conforms to requirements of Hazardous Waste Operations and Emergency Response, Title 8 CCR, Section 5192 and Title 8 CCR, Section 5155. Appendix H presents the SSP. A Hospital Route Map is included.

Remediation contractors and subcontractors selected to perform work associated with the remediation are responsible for their own health and safety and will be required to prepare an SSP for their activities. At a minimum, contractors and subcontractors are to adhere to the requirements and safety measures in the SSP prepared by SSI. SSI is not responsible for the safety of contractors and site visitors.

All personnel working at the site shall have completed 40 hours of comprehensive health and safety training, which meets the requirements of 29 CFR 1910.120.

During the remedial activities, soil moisture content is to be maintained to reduce the potential for dust generation and the need for respiratory protection. Details are provided in the DMP (Appendix F) and SSP (Appendix H).

Based on the required application of water for dust suppression during soil excavation, airborne levels of metals are expected to be low and air monitoring may not be necessary if soil moisture is maintained. If visible dust is generated during excavation or placement of the mine waste, air monitoring is to be performed, and additional dust suppression is to be performed as required to maintain dust concentrations below acceptable levels.

7. PUBLIC PARTICIPATION

SSI will work with DTSC to conduct the appropriate and necessary public participation activities prior to and during the proposed removal action. Appendix I is a copy of the Community Profile Report prepared by SSI for the project.

8. REMEDIAL ACTION REPORTING

The results of the remedial activities will be presented in a post-remediation report. The purpose of that report is to describe remedial activities and to document compliance with this RAW. The report will present:

- Summary of remedial activities performed;
- Description and basis for deviations, if any, from this RAW;
- Limits of excavation and volume of soil excavated;
- Results of the verification soil sampling and laboratory analyses;
- As-built drawings of the on-site placement area;
- Summary of construction quality assurance performed during placement and compaction at the approved on-site burial location; and
- Summary of site restoration activities.

The post-remediation report will be presented to DTSC for review. Provided that the RAOs are achieved, the post-remediation report will request a No Further Action decision or Site Certification from DTSC.

9. LIMITATIONS

The following limitations apply to the findings, conclusions and recommendations presented in this plan:

SSI's professional services were performed consistent with the generally accepted engineering principles and practices employed in northern California. No warranty is expressed or implied.

These services were performed per SSI's agreement with SSI's client. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of our services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this plan. This plan is solely for the use of our client unless noted otherwise. Any reliance on this plan by a third party is at the party's sole risk.

If changes are made to the nature or design of the project as described in this plan, then the conclusions and recommendations presented in this plan should be considered invalid by all parties. Only SSI can determine the validity of the conclusions and recommendations presented in this plan. Therefore, SSI should be retained to review all project changes and prepare written responses with regards to their impacts on SSI's conclusions and recommendations. However, SSI may require additional field work and laboratory testing to develop any modifications to the plan. Costs to review project changes and perform additional fieldwork and laboratory testing necessary to modify SSI's recommendations are beyond the scope of services presented in this plan. Additional work will require an approved scope of services, budget, and authorization to proceed.

SSI is not responsible for the health and safety of non-SSI personnel, on or off the project site.

The analyses, conclusions and recommendations presented in this plan are based on site conditions as they existed at the time SSI's investigations were performed. Changes in the conditions of the property can occur with the passage of time. The changes may be due to natural processes or to the works of man, on the project site or adjacent properties. In addition, changes in applicable or appropriate standards can occur, whether they result from legislation or the broadening of knowledge. Therefore, the recommendations presented in this plan may need to be revised based on site conditions or regulatory requirements.

10. REFERENCES

Bean, Edwin (1867). Bean's History and Directory of Nevada County.

California Department of Conservation, Division of Mines and Geology, (1992). Geologic Map of the Chico Quadrangle.

California Environmental Protection Agency, Department of Toxic Substances Control (October 2001) Information Advisory, Clean Imported Fill Material.

California Environmental Protection Agency, Regional Water Quality Control Board (June 1989). The Designated Level Methodology.

California Environmental Protection Agency, Regional Water Quality Control Board (September 15, 1998). Fourth Edition of the Water Quality Control Plan for the Sacramento and San Joaquin River Basins.

California Environmental Protection Agency, Regional Water Quality Control Board (August 2003). A Compilation of Water Quality Goals.

California Environmental Protection Agency, State Water Resources Control Board (October 28, 1968). Resolution No. 68-16, Policy with Respect to Maintaining Higher Quality Waters in California.

California State Mining Bureau (1918). Mines and Mineral Resources of Nevada County.

California State Mining Bureau (1940). State Mineralogists Report XXXVI.

Friends of Deer Creek (2006) Phase 2 Environmental Site Assessment of the Providence Mine Site

Holdrege and Kull (January 2013) Geotechnical Engineering Recommendations for the Providence Mine Remediation Site.

Lindgren, Waldemar (1896). Nevada City Special Folio, California: U.S. Geological Survey Folio 29.

Sanborn Fire Insurance Maps of Nevada City (1885, 1891, 1912).

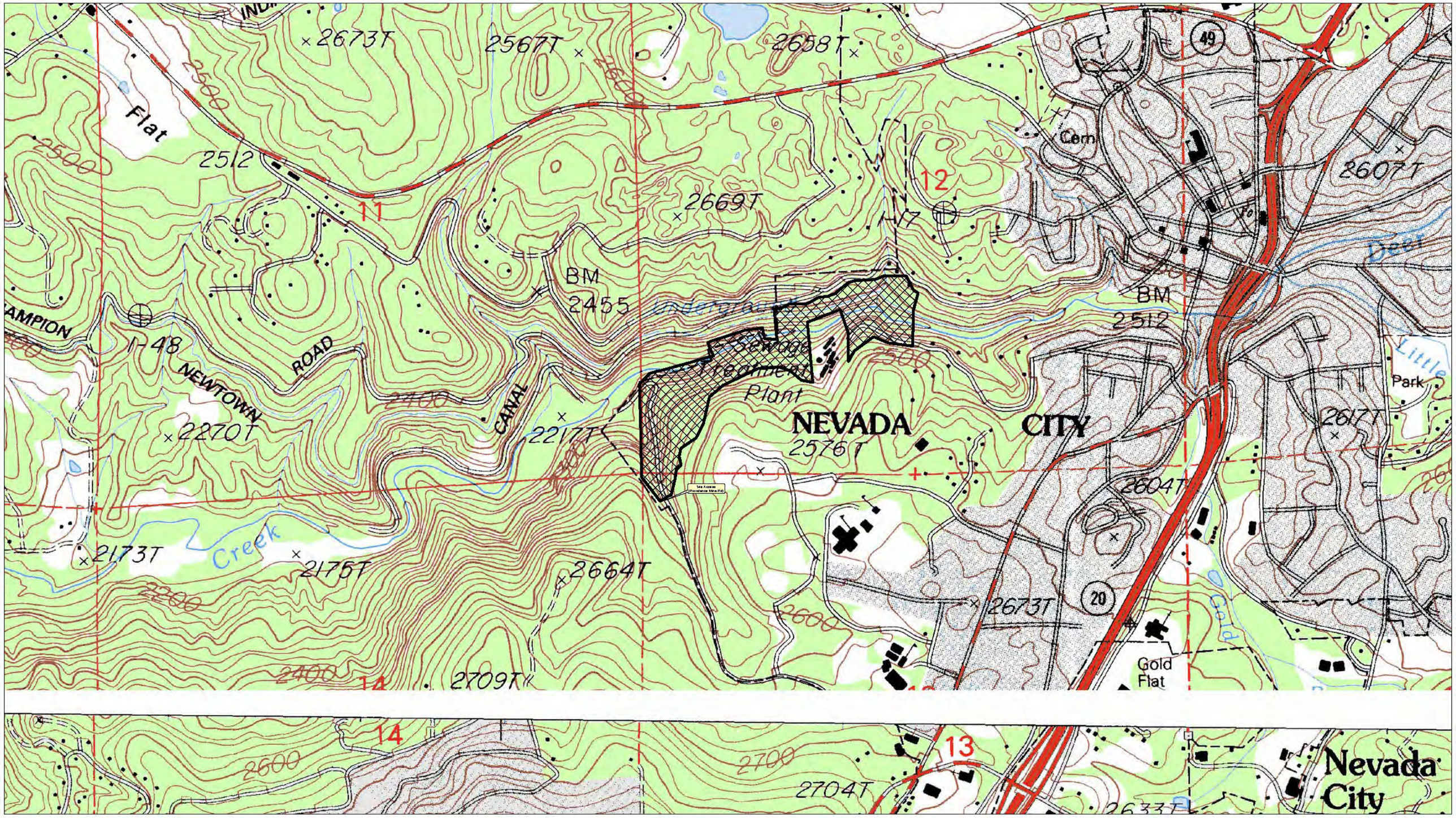
Sierra Streams Institute (February 2014) Site Characterization Report and Final Removal Action Workplan for the Providence Mine Site APN 05-100-87 Nevada City, California

Sierra Streams Institute (December 2015) Soil Investigation Report for the Environs Mining Legacy Project, Nevada City Environs Property
Tuminas, A. (1983). Geologic Map of the Grass Valley - Colfax Area.

United States Department of Agriculture Soil Conservation Service and Forest Service (reissued August 1993). Soil Survey of Nevada County Area, California.

United States Geological Survey (1995 Provisional Edition). Nevada City Quadrangle California, 7.5 Minute Series Topographic Map.

Uren, Chas., C.E. (1897). Map of the Vicinity of Grass Valley and Nevada City.



Sierra Streams Institute
Environs Property
Providence Quartz Mill Site

Legend

Nevada City Environs Property

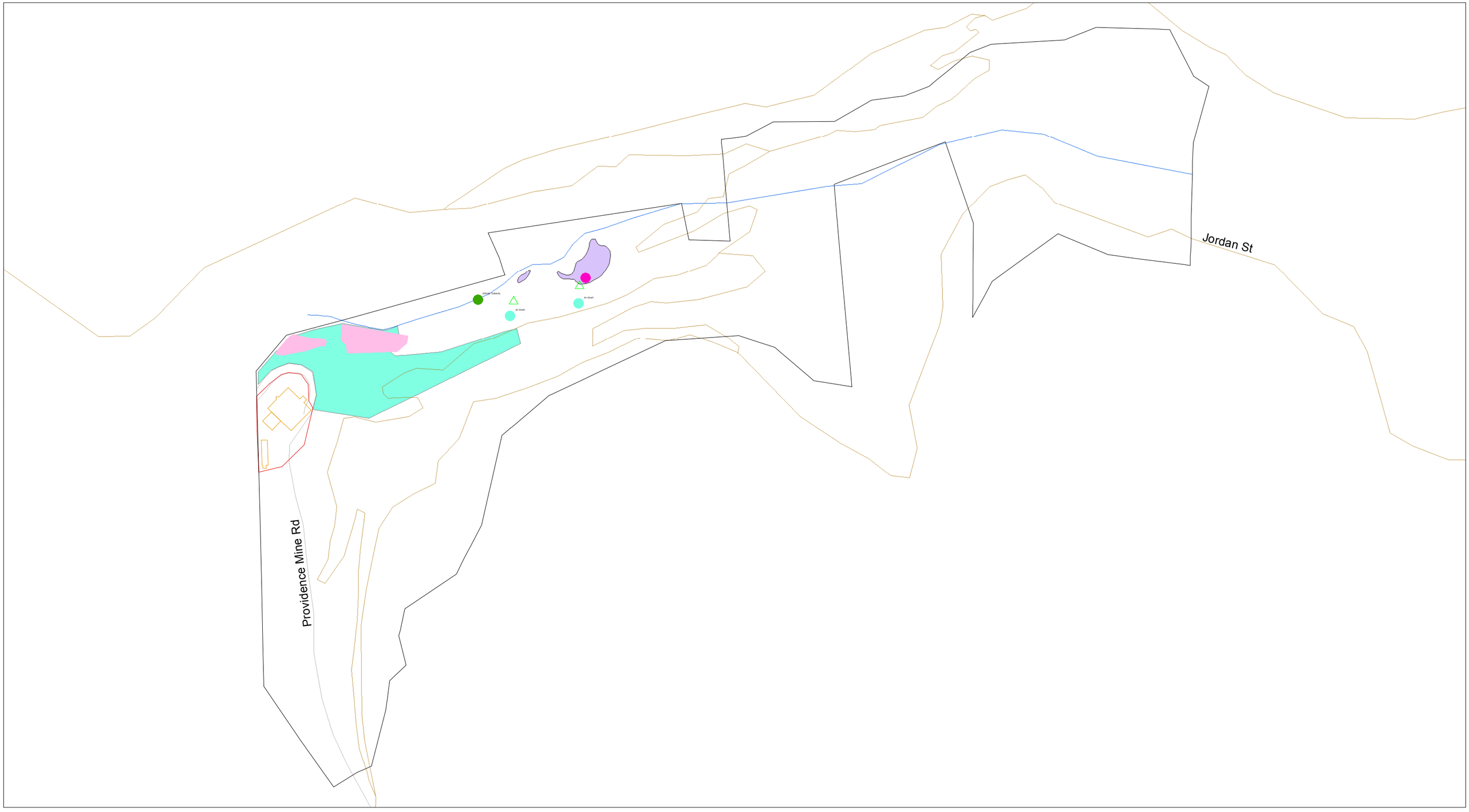
N

1 inch = 833 feet

Miles

0 0.075 0.15 0.3

Figure 1: Project Location Map



Legend

- Environs Parcel
- SNC Providence Project Boundary
- Providence Mine Brownfield Site
- Providence Quartz Mill Site
- Providence Mine Road
- Deer Creek
- Deer Creek Tribute Trail
- Quartz Mill Features
- Adit Pipe
- Air Shaft
- Drain Tunnel
- Mine Adit
- Waste Rock Piles

Sierra Streams Institute
Providence Quartz Mill Cleanup

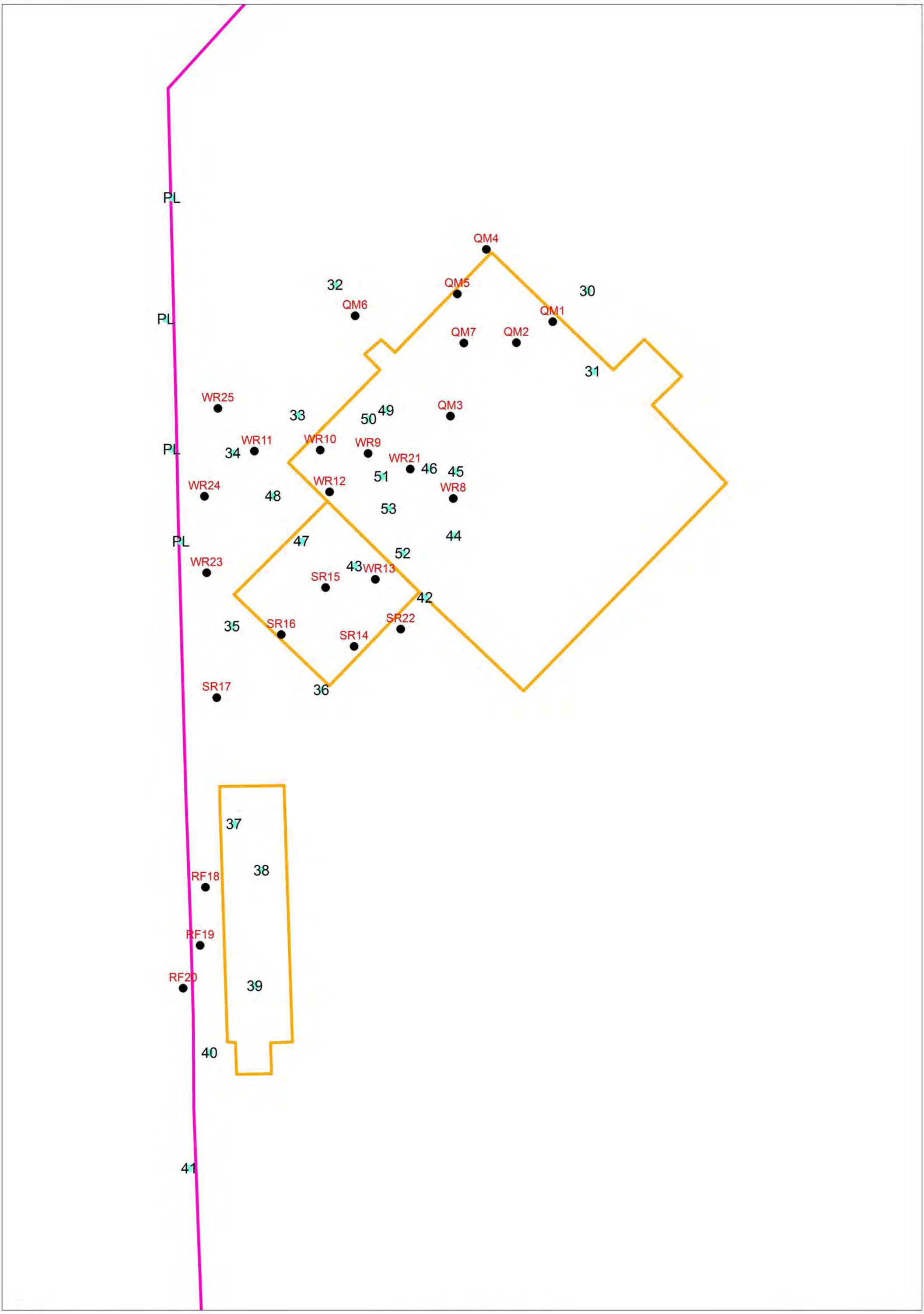
Figure 2: Site Map

N

0 100 200 400

Feet

1 inch = 250 feet

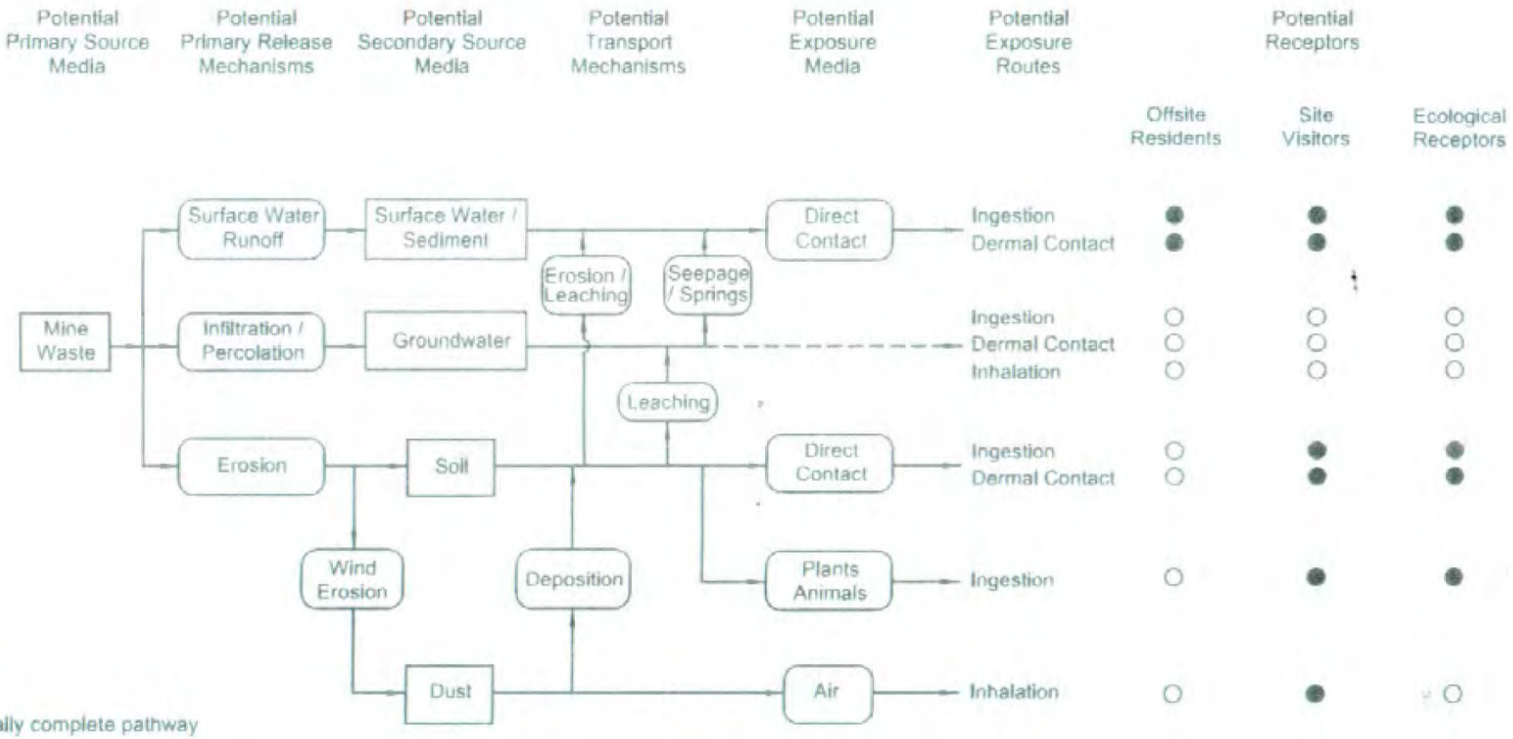


Sierra Streams Institute

Providence Quartz Mill Site

Figure 3: Sample Location Map

TYPICAL TRANSPORT MECHANISMS AND EXPOSURE MEDIA FOR HUMAN AND ECOLOGICAL RECEPTORS



Legend

- Potentially complete pathway
- Potentially incomplete pathway
- ● Potentially complete exposure route
- ○ Potentially incomplete exposure route

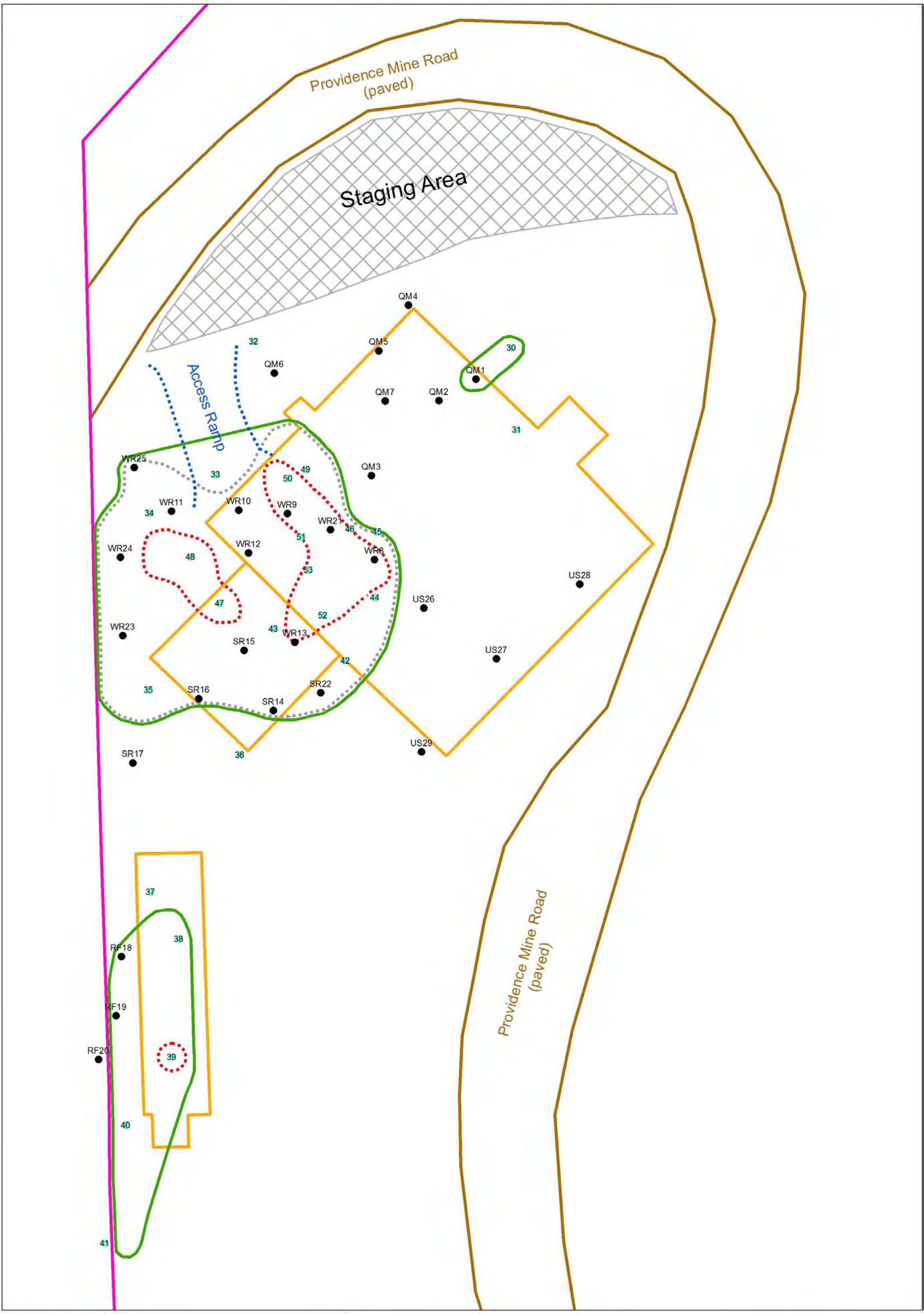
Figure adapted from "Risk Management Criteria for Metals at BLM Mining Sites", Technical Note 390, October 2004, BLM/RS/ST-97/001+1703, Figure 1.

HOLDREGE & KULL
CONSULTING ENGINEERS • GEOLOGISTS
NEVADA CITY • TRUCKEE • YUBA CITY • CHICO • JACKSON

CONCEPTUAL SITE MODEL DIAGRAM
PROVIDENCE MINE SITE
NEVADA CITY, CALIFORNIA

DRAWN BY:	DEVITT
CHECKED BY:	MUIR
H&K PROJECT:	3991-01
DATE:	MAY 2013

FIGURE 4



Sierra Streams Institute

Providence Quartz Mill Site

Figure 5: Proposed Work Areas Map

Table 1. Environs Soil Sample Analyical Results

Providence Stamp Mill Area					
Sample number	Sample Depth (ft)	As (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	Cd (mg/kg)
QM-1	0 - 0.5	20	430	14	2.8
QM-2	0 - 0.5	13	98	1.5	<1.0
QM-3	0 - 0.5	13	190	3.8	1.4
QM-4	0 - 0.5	13	89	0.74	1.8
QM-5	0 - 0.5	15	89	0.86	2.7
QM-6	0 - 0.5	17	140	3.5	3.3
QM-7	0 - 0.5	11	74	1.4	2.1
WR-8	0 - 0.5	91	1800	44	5.8
WR-8B	0 - 0.5	57	1400	100	6.9
WR-9	0 - 0.5	56	1000	15	11
WR-9-.75'	0.5 - 0.75	53	1500	26	13
WR-9-1.5'	1.25 - 1.5	52	1400	26	10
WR-10	0 - 0.5	21	340	7.5	6.1
WR-11	0 - 0.5	38	750	11	8.1
WR-12	0 - 0.5	21	580	9.7	8.9
WR-21	0 - 0.5	250	20000	11	5.5
WR-21-1'	0.75 - 1.0	210	19000	19	6
WR-23	0 - 0.5	40	790	9.7	5.5
WR-24	0 - 0.5	43	930	19	8.4
WR-25	0 - 0.5	16	150	1.7	2.7
SR-13	0 - 0.5	40	1000	23	19
WR-13B	0 - 0.5	36	970	14	19
SR-14	0 - 0.5	19	150	2.2	<1.0
SR-15	0 - 0.5	18	800	6.1	11
SR-16	0 - 0.5	15	180	3.2	1.0
SR-17	0 - 0.5	11	93	1.1	<1.0
SR-22	0 - 0.5	68	740	4.5	11.0
RF-18	0 - 0.5	22	270	6.4	<1.0
RF-19	0 - 0.5	19	240	10	<1.0
RF-20	0 - 0.5	22	350	18	1.4
Surrounding Property					
Sample number	Sample Depth (ft)	As (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	Cd (mg/kg)
US-26	0 - 0.5	14	15	ND <0.10	1.1
US-27	0 - 0.5	12	12	ND <0.10	ND <1.0
US-28	0 - 0.5	12	15	ND <0.10	ND <1.0
US-29	0 - 0.5	7.8	14	ND <0.10	ND <1.0
RSL/CA RSL	--	0.07	80	18	1.7
TTLC	--	500	1000	20	100
Site Specific Cleanup Goal	--	--	270	--	--

Notes:
mg/kg = milligrams per kilogram
TTLC = Total Threshold Limit Concentration
Exceeds TTLC or STLC
Exceeds RSL/CA RSL
ft = feet below ground surface

Table 2- Total and Soluble Metals Analytical Results of Selected Samples

Sample Name	EPA 6010B/7471				DI WET + EPA 6010B/7471			
	Total Arsenic (mg/kg)	Total Lead (mg/kg)	Total Cadmium (mg/kg)	Total Mercury mg/kg)	Soluble As (ug/L)	Soluble Pb (ug/L)	Soluble Cd (ug/L)	Soluble Hg (ug/L)
QM-10	na	340	na	na	na	<500	na	na
QM-12	na	580	na	na	na	<500	na	na
QM-1B*	na	430	na	14	na	14.8	na	0.487
WR-12B*	na	580	na	9.7	na	<10	na	2.79
RF-18b	17.8	233	<2.0	7.34	<10	<10	<10	<0.200
WR-12b	30.5	577	6.1	14.6	<10	16.4	<10	0.251
WR-11b**	25.3	370	5.1	6.06	<10	<10	<10	<0.200
					STLC WET/ TCLP (ug/L)			
WR-8B	57.0	1,400	6.9	100	na	na	na	5.4/<0.20
WR-21	250	20,000	5.5	11	1.0	560,000/ 230,000	na	na
TTLC	500	1000	100	20				
STLC					5000	5000	1000	200
MCL					10	15	5	2

Notes:

mg/kg = milligrams per kilogram

ug/L = microgram per liter

* Total metals results from original samples QM-1 and WR-12

Sample RF-18b = colocated sample with RF-18

Sample WR-12b = colocated sample with WR-12

Sample WR-11b = colocated sample with WR-11

na = not analyzed

TTLC = Total Threshold Limit Concentration

STLC = Soluble Threshold Limit Concentration

MCL = Maximum Contaminant Level (California EPA)

Exceeds TTLC or STLC

Exceeds MCL

**Sample WR-11b also analyzed for Hexavalent Chromium by EPA Method 7196: Results = 2.10 mg/kg

Table 3
XRF Sample Results for Selected Metals (ppm)

Date	Sample Matrix	SAMPLE	Pb	Pb Error	As	As Error	Hg	Hg Error	Cd	Cd Error
6/16/17 10:26	Soil	30	169.2	6.25	31.09	5.24	<LOD	5.01	<LOD	12.41
6/16/17 10:32	Soil	31	40.36	3.46	15.68	2.98	<LOD	4.52	<LOD	11.31
6/16/17 10:38	Soil	32	137.7	5.66	23.19	4.7	<LOD	4.97	<LOD	11.86
6/16/17 10:43	Soil	33	143.6	5.76	26.41	4.82	<LOD	4.89	<LOD	12.09
6/16/17 10:49	Soil	34	914.6	13.6	70.44	11	7.55	3.6	<LOD	11.81
6/16/17 10:55	Soil	35	577.1	11.08	53.76	9.02	5.37	3.53	<LOD	11.73
6/16/17 11:01	Soil	36	170.2	6.49	12.65	5.19	<LOD	5.12	<LOD	12.26
6/16/17 11:07	Soil	37	53.34	4.26	16.04	3.6	<LOD	5.64	<LOD	12.73
6/16/17 11:12	Soil	38	226.3	7.28	26.57	5.95	<LOD	5.32	<LOD	12.43
6/16/17 11:17	Soil	39	226.3	7.29	32.66	6.06	366.87	8.28	<LOD	11.94
6/16/17 11:23	Soil	40	784.3	13.31	52.48	10.7	7.67	3.79	<LOD	12.98
6/16/17 11:29	Soil	41	101.4	4.94	24.41	4.19	<LOD	4.8	<LOD	11.68
6/16/17 11:37	Soil	42	683.7	52.06	<LOD	62.97	<LOD	22.79	nr	nr
6/16/17 11:48	Soil	43	555.5	11.02	65.34	9.07	9.32	3.73	16.16	8.52
6/16/17 11:52	Soil	44	19.68	3.67	22.53	3.5	<LOD	6.1	nr	nr
6/16/17 12:02	Soil	45	18.52	3	16.44	2.72	<LOD	4.94	<LOD	12.06
6/16/17 12:07	Soil	46	35.54	3.46	19.98	3.1	<LOD	4.87	<LOD	12.28
6/16/17 12:12	Soil	47	476	9.92	41.17	8.04	25.44	3.84	<LOD	12.23
6/16/17 12:17	Soil	48	3478	28.41	<LOD	32.79	19.13	4.55	<LOD	13.17
6/16/17 12:23	Soil	49	513.7	10.58	33.85	8.5	15.07	3.78	<LOD	12.63
6/16/17 12:29	Soil	50	2194	21.19	167.24	17.15	9.55	3.88	<LOD	12.24
6/16/17 12:35	Soil	51	536.2	10.63	44.28	8.6	<LOD	5.38	<LOD	12.91
6/16/17 12:40	Soil	52	2628	24.8	183.93	20.01	12.29	4.69	27.21	8.9
6/16/17 12:46	Soil	53	1309	16.77	79.74	13.47	12.26	4.15	<LOD	13.28

Notes:
ppm= parts per million
LOD= level of detection
nr= not reported
Pb= Total Lead- parts per million (ppm)
Error= range of uncertainty in result
As Total Arsenic (ppm)
Hg= Total Mercury (ppm)
Cd= Total Cadmuim (ppm)
Exceeds TTLC (Hazardous waste level)
Exceeds Secondary Lead Cleanup Goal (270 ppm)

Providence Quartz Mill Brownfields Cleanup
City of Nevada City
Alternative 2: Excavate & Dispose All Mine Waste
Preliminary Cost Estimate

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Construction Fence	400	LF	$4	$1,600
3	Fiber Rolls	400	LF	$5	$2,000
4	Tree Protection	4	EA	$100	$400
5	Tree Removal (6-12" Dia.)	4	EA	$250	$1,000
6	Clearing & Grubbing	1	LS	$7,500	$7,500
7	Excavation & Stockpiling	350	CY	$7	$2,450
8	Soil Characterization, Sampling & Analysis	1	LS	$10,000	$10,000
9	Nonhazardous Waste Disposal	25	TONS	$20	$500
10	Class 1 Waste Disposal	48	TONS	$475	$22,800
11	Class 2 Waste Disposal	465	TONS	$75	$34,875
12	Import Fill Placement (cover soil)	263	CY	$35	$9,188
13	Hydroseed	10,000	SF	$0.75	$7,500
14	Container Planting	200	EA	$5.00	$1,000
15	Wood Chip Mulch	3,800	SF	$1.25	$4,750
				Subtotal	$120,563
				20% Contingency	$24,113
				Total	$144,675

Providence Quartz Mill Brownfields Cleanup
City of Nevada City
Alternative 3: On Site Excavation & Placement
Preliminary Cost Estimate

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Construction Fence	400	LF	$4	$1,600
3	Fiber Rolls	400	LF	$5	$2,000
4	Tree Protection	4	EA	$100	$400
5	Tree Removal (6-12" Dia.)	4	EA	$250	$1,000
6	Clearing & Grubbing	1	LS	$7,500	$7,500
7	Excavation & Grading	350	CY	$20	$7,000
8	Soil Characterization, Sampling & Analysis	1	LS	$5,000	$5,000
9	Import Fill Placement (cover soil)	263	CY	$35	$9,188
10	Hydroseed	10,000	SF	$0.75	$7,500
11	Container Planting	200	EA	$5.00	$1,000
12	Wood Chip Mulch	3,800	SF	$1.25	$4,750
				Subtotal	$61,938
				20% Contingency	$12,388
				Total	$74,325

Providence Quartz Mill Brownfields Cleanup
City of Nevada City
Alternative 4: Combined Approach
Preliminary Cost Estimate

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Construction Fence	400	LF	$4	$1,600
3	Fiber Rolls	400	LF	$5	$2,000
4	Tree Protection	4	EA	$100	$400
5	Tree Removal (6-12" Dia.)	4	EA	$250	$1,000
6	Clearing & Grubbing	1	LS	$7,500	$7,500
7	Excavation & Stockpiling	32	CY	$30	$960
8	Soil Characterization, Sampling & Analysis	1	LS	$10,000	$10,000
9	Nonhazardous Excavation & Grading	350	CY	$20	$7,000
10	Class 1 Waste Disposal	48	TONS	$475	$22,800
11	Import Fill Placement (cover soil)	270	CY	$35	$9,450
12	Hydroseed	10,000	SF	$0.75	$7,500
13	Container Planting	200	EA	$5.00	$1,000
14	Wood Chip Mulch	3,800	SF	$1.25	$4,750
				Subtotal	$90,960
				20% Contingency	$18,192
				Total	$109,152