Analysis of Brownfields Cleanup Alternatives
Inactive Elgin Mercury Mine
Colusa County, California

Prepared for:
Westside Brownfields Coalition Assessment Project

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Prepared by:

Burleson Consulting, Inc.
950 Glenn Drive, Suite 245
Folsom, CA 95630
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EXECUTIVE SUMMARY
This Analysis of Brownfields Cleanup Alternatives (ABCA) compares different cleanup scenarios for the inactive Elgin Mercury Mine (Elgin Mine). It was requested by the Coordinating Committee of the Westside Subregion of the Proposition 84 Sacramento River Funding Region (Westside CC) for Integrated Regional Water Management (IRWM) planning. The Westside CC, comprises four participating regional public agencies (Lake County Watershed Protection District, Napa County Flood Control and Water Conservation District, Solano County Water Agency, and Water Resources Association of Yolo County), represents primarily the Cache Creek and Putah Creek watersheds. The Westside Brownfields Coalition Assessment Project (Project) is a special project of the Westside CC funded by a grant from the U.S. Environmental Protection Agency’s (USEPA) Brownfields Assessment Program.

Elgin Mine consists of about 5-acres of disturbed land in the headwaters of the west fork of Sulphur Creek in western Colusa County. Elgin Mine overlies a hydrothermal spring that is related to a potential source for future geothermal power production, and is located within ancestral lands of the Yocha Dehe Wintun Nation.

This ABCA is based on information summarized in Cleanup and Abatement Order (CAO) R5-2009-007 issued by the California Regional Water Quality Control Board—Central Valley Region to the property owner on August 13, 2009. Investigations of Elgin Mine have been completed by CalFed (2003), Global Geodyne, LLC on behalf of the landowner (2010), and US Geological Survey (USGS) (2013). The property manager is eager to remediate the site, but the landowner (a trust) is financially unable to comply with the CAO.

The following environmental concerns were identified in the reports referenced above:

1. Humans and biota could be exposed to mercury through inhalation, incidental ingestion and dermal contact.
2. Hydrothermal spring water interacts with waste rock at the upper mine to mobilize mercury.
3. Infiltrating water could also mobilize mercury from tailings at the retort area near Sulphur Creek.
4. Erosion of mercury containing mine waste delivers mercury from the site to downstream waters.

Three options were evaluated for the site based on effectiveness, implementability, and cost as summarized in Table ES-1:

1. No action.
2. Excavation and on-site storage in a repository with control of hydrothermal water at the collapsed adit.
3. Excavation and off-site disposal with control of hydrothermal water at the collapse adit.

Effectiveness is compared among options as the satisfaction of cleanup goals and the protection to human and environmental health/safety. Implementability addresses the technical and administrative feasibility of the option. If no corrective action is taken, Elgin Mine will continue to pose a risk to human health and the environment. To minimize the mobilization of mercury requires control of hydrothermal water at the collapsed adit to prevent its contact with disturbed material. Protection of human and ecological receptors requires sequestration of mine waste in an on-site repository, or removal of mine waste for off-site disposal.
Table ES-1  
Summary and Comparison of Cleanup Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Actions</th>
<th>Effectiveness</th>
<th>Implementability</th>
<th>Approximate Cost</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: No Action</td>
<td>None</td>
<td>Low</td>
<td>Easy</td>
<td>None</td>
<td>High potential for future liability.</td>
</tr>
<tr>
<td>2: On-site consolidation of mine waste with separation from hydrothermal spring discharge</td>
<td>Design, operate and close an appropriate repository to contain excavated mine waste at the site. Collect hydrothermal water at collapsed adit and conduct it through disturbed material to a suitable discharge location.</td>
<td>High</td>
<td>Easy</td>
<td>$790,000</td>
<td>Potential for future liability if repository cover erodes and mine waste is exposed.</td>
</tr>
<tr>
<td>3: Excavation and off-site disposal of mine waste with separation from hydrothermal spring discharge</td>
<td>Transport excavated mine waste to a permitted off-site disposal facility. Collect hydrothermal water at collapsed adit and conduct it through disturbed material to a suitable discharge location.</td>
<td>High</td>
<td>Easy</td>
<td>$1,400,000</td>
<td>Potential for future liability if disposal facility experiences a release. Increased carbon emissions and traffic hazard associated with transport to disposal facility in short term.</td>
</tr>
</tbody>
</table>
1.0 Introduction and Background

This Analysis of Brownfields Cleanup Alternatives (ABCA) compares different cleanup scenarios for the inactive Elgin Mercury Mine (Elgin Mine). It was requested by the Coordinating Committee of the Westside Subregion of the Proposition 84 Sacramento River Funding Region (Westside CC) for Integrated Regional Water Management (IRWM) planning. The Westside CC, comprises four participating regional public agencies (Lake County Watershed Protection District, Napa County Flood Control and Water Conservation District, Solano County Water Agency, and Water Resources Association of Yolo County), and represents primarily the Cache Creek and Putah Creek watersheds. The Westside Brownfields Coalition Assessment Project (Project) is a special project of the Westside CC funded by Grant No. 99T30301 from the U.S. Environmental Protection Agency’s (EPA) Brownfields Assessment Program.

Elgin Mine consists of about 5-acres of disturbed land in the headwaters of the west fork of Sulphur Creek in western Colusa County. Elgin Mine overlies a hydrothermal spring that is a potential source for future geothermal power production, and is located within ancestral lands of the Yocha Dehe Wintun Nation.

This ABCA is based on information summarized in California Regional Water Quality Control Board—Central Valley Region issued Cleanup and Abatement Order (CAO) R5-2009-007 issued to the property owner on August 13, 2009. Investigations of Elgin Mine have been completed by CalFed (2003), Global Geodyne, LLC on behalf of the landowner (2010), and US Geological Survey (USGS) (2013). The property manager is eager to remediate the site and the landowner (a trust) is financially unable to comply with the CAO.

The purpose of the ABCA is to evaluate possible remedial alternatives, based on site conditions and the anticipated reuse of the site. This evaluation will be expanded, modified if necessary, and incorporated into the final Site Cleanup Plan for review by the community, project partners, and the regulatory oversight agency.

1.1 Site Location

Elgin Mine occupies about 5-acres of assessor’s parcel numbers (APN) 018-100-002-000, 018-100-003-000, and 018-100-004-000 in Section 13, Township 14 North, Range 6 West (Mount Diablo Base and Meridian). These three parcels consist of about 200 acres in total, located in western Colusa County, CA about 23 miles west of Williams, California (Figure 1). Part of Elgin Mine is located on US Department of Interior Bureau of Land Management (BLM) lands, and part is located on privately owned lands held in a trust.

The site is located on very steep slopes forming the southwest canyon wall near headwaters of the west fork of Sulphur Creek (Figure 2). The site consists of three adits, about 500 feet of inaccessible underground workings, two surface areas disturbed by historical mining activities, remnants of a former ore processing furnace, and small area of tailings at the furnace.

Hydrothermal water discharges from one of the adits and flows across a mining disturbed area prior to entering a very steep drainage that flows into the west fork of Sulphur Creek about 0.1-mile northeast of the adit. Hydrothermal springs also discharge from numerous fractures on the steep slopes below the mine. Other features of the site include a private road that connects with a public road (Walker Ridge Road) about 0.25-mile south of the site, and three residential dwellings located about 0.1-mile south of the mine.
1.2 Ownership and Previous Use
Ownership and previous use information was obtained as part of a literature search conducted during the CalFed investigation, and record reviews during RWQCB enforcement activities. Mining began at the site in the 1870s with production of 52 flasks of mercury (76 pounds mercury per flask) recorded in 1875. Mining occurred sporadically from 1892 to 1893, 1905, and 1916 (CalFed 2003). Ore was processed on-site using a variety of crushing, sorting, and roasting devices. A roasting area and small area of tailings are present on the floodplain of the west fork of Sulphur Creek at the site (Figure 2).

The RWQCB determined that Elgin Mine owners from 1894 to 1965 included a succession of individuals and companies that no longer exist. The main adit and hydrothermal drainage are located on BLM lands. The privately-owned part of the site is currently owned by Jose Lucientes Trust. David Lucientes resides at the site and is the site caretaker. Members of the Lucientes family have owned Elgin Mine since November 1973. According to David Lucientes, his family never operated Elgin Mine or benefited from operation of Elgin Mine.

1.3 Previous Investigations
Investigations of Elgin Mine have been completed by CalFed (2003), Global Geodyne, LLC on behalf of the landowner (2010), and US Geological Survey (USGS) (2013). The investigation sample results and findings were used to prepare this ABCA.

CalFed 2003. As part of CalFeds’ Ecosystem Restoration Program, investigations of the Sulphur Creek Mercury District, including Elgin Mine, were conducted to assess ecological and human health impacts of mercury in the Bay-Delta watershed. The CalFed investigations included literature review, mapping of site features, and sampling and analysis of surface water and mine waste at the site (CalFed 2003).

CalFed sampling assessed background soils, waste rock, and tailings at Elgin Mine. Background soil was found to contain up to 330 mg/kg total mercury, waste rock contained up to 290 mg/kg total mercury, and tailings contained up to 3,030 mg/kg total mercury. A California waste extraction test (WET) leachate from waste rock at the upper mine exceeded the soluble threshold limit concentration (STLC) for mercury and this material is characterized as a hazardous waste under California regulations.

CalFed estimated that from 1,000 to 4,100 cubic yards (1,300 to 5,500 tons) of mine waste may be present at Elgin Mine and noted that this estimate is highly uncertain. CalFed concluded that at Elgin Mine:

1. Humans and biota could be exposed to mercury through inhalation, incidental ingestion and dermal contact.
2. Hydrothermal spring water interaction with waste rock at the upper mine mobilized mercury.
3. Infiltrating water could also mobilize mercury from tailings at the retort area near Sulphur Creek.
4. Erosion of mercury containing mine waste is a complete pathway from the site to downstream waters.

Global Geodyne LLC 2010. As part of efforts to assess Elgin Mine for geothermal power potential, Global Geodyne, LLC collected samples of soil, waste rock, tailings and surface water at Elgin Mine to address requirements for investigation included in the RWQCB’s CAO. Global
Geodyne’s sample locations and analytical data are available, however, no accompanying report was provided.

Global Geodyne soil waste rock and tailings analytical results were distributed across Elgin Mine, and are consistent with CalFed analytical results. Elevated mercury concentrations were detected at the areas disturbed by mining, at the retort area, and in downstream drainages.

**USGS 2013.** USGS collected samples of surface water, sediment and biota at Elgin Mine in 2010 to support a BLM removal site investigation. Samples were collected upstream and downstream of mine features along the West Fork of Sulphur Creek and its Salt Branch tributary.

USGS found that total mercury increased in water and sediment from upstream to downstream from Elgin mine. USGS also found that methyl mercury in sediment increases from upstream to downstream from Elgin Mine. While methyl mercury was also higher in downstream biota than in biota upstream from Elgin Mine, USGS noted that the downstream biota samples were also downstream from the West Fork confluence with Salt Branch. Because the Salt Branch receives most of its flow from hydrothermal springs, USGS inferred that the increase in biota methyl mercury was likely associated with natural hydrothermal sources and not associated with mine waste.

### 1.4 Project Goals

The project goals are to reduce interaction of hydrothermal water with mine waste, reduce the threat of exposure to mercury in mine waste, and reduce the off-site migration of mercury in sediment and surface water. The disturbed areas, interaction of hydrothermal water with waste rock at the collapsed adit, and tailings contribute mercury to surface water and sediment in the West Fork of Sulphur Creek. These conditions present a potential barrier to reuse of the property for geothermal power production and/or recreational uses at the property. The private owner desires to reduce potential human and wildlife exposure to mercury.

### 2.0 Applicable Regulations and Cleanup Standards

This section of the ABCA describes the agency responsible for cleanup oversight, cleanup standards, and laws and regulations applicable to the cleanup.

### 2.1 Cleanup Oversight Responsibility

The California State Water Resources Control Board (SWRCB) and the Department of Toxic Substances Control (DTSC) have the authority to regulate cleanup of polluted/contaminated sites in California. In order to improve the coordination between agencies on oversight of Brownfields cleanups, a Memorandum of Agreement (MOA) was signed on March 1, 2005. The MOA describes the process and considerations used to determine the appropriate lead agency for a particular Brownfields site. The SWRCB has delegated cleanup authority to the RWQCB. RWQCB oversees cleanup of inactive mines under relevant provisions of the California Water Code, as implemented in Title 27 of the California Code of Regulations.

Elgin Mine is entered into the DTSC EnviroStor database of properties with known contamination or where there may be reasons to investigate further. The EnviroStor database provides access to detailed information on hazardous waste permitted and corrective action facilities, as well as existing site cleanup information. The Envirostor database identifies Elgin Mine as Site Number 06100004, and RWQCB as the lead agency as of March 4, 2010.
Information in the Envirostor database includes the CalFed report, the RWQCB CAO, and preliminary assessment forms completed by DTSC staff.

Future response activities such as any additional sampling and analysis, and cleanup activities should be conducted in cooperation with RWQCB.

2.2 Cleanup Standards

Metals detected above risk-based thresholds are described, and identification of cleanup standards based on water quality is described below. Risk-based thresholds selected for comparison with site data are EPA Regional Screening Levels from the composite worker soil table (RSL), DTSC California Human Health Screening Limits (CHHSL) for protection of commercial and industrial use, and BLM Risk Management Criteria for Metals at BLM Mining Sites (BLM 2004) for wildlife and livestock. Risks are characterized in accordance with BLM (2004) suggestions as follows:

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

2.2.1 Metals Detected Above Risk-Based Thresholds.

Arsenic, hexavalent chromium, and mercury were the only metals detected above risk-based screening levels in waste rock at the site. Arsenic concentrations are all similar to background values (maximum concentration detected by Global Geodyne was 5.4 mg/kg within the 4.1 to 16.04 mg/kg range of background arsenic concentrations reported in the National Geochemical Database for Colusa County).

One of 21 samples analyzed for hexavalent chromium (7.9 mg/kg) was above the EPA regional screening level (RSL) (6.3 mg/kg) and indicates a moderate risk. This sample was collected along a drainage crossing the West Fork floodplain downslope from the mine and is associated with an elevated total mercury concentration at location BHT-2 (Global Geodyne 2018). The average hexavalent chromium concentration at this location (4.8 mg/kg), and the site average hexavalent chromium concentration (1.48) are both below the RSL, indicating low risk.

Mercury was present above risk-based screening levels at the retort (up to 160 mg/kg), near the hot tub and in downslope samples (up to 140 mg/kg), in waste rock at the collapsed adit (up to 210 mg/kg), and at the shaker tables (up to 160 mg/kg). None of the concentrations detected by Global Geodyne exceeded the local maximum background concentration of 350 mg/kg (Churchill and Clinkenbeard 2003). However, the range of mercury concentrations detected at each area reflects material disturbed by mining that is likely more readily mobilized to the environment than in-place mineralized material at background sample locations. These detected mercury concentrations are less than human health risk-based thresholds (the RSL and CHHSLs), but exceed risk-based concentrations believed to be protective of wildlife and livestock. The exposure area containing mine waste accessible to most wildlife is very small with respect to foraging and living ranges, thus the site risks are likely small to terrestrial wildlife receptors.
Based on the general lack of elevated risks to humans or biota, the cleanup levels would be selected based on protection of water quality because this is the principal threat at the site, and management of mine waste in a manner protective of water quality would also minimize potential threats to human health and the environment.

2.2.2 Water Quality Based Cleanup Standards
As noted above, CalFed results identified threats to water quality, and USGS confirmed a local increase in total mercury within surface water and sediment attributable to the mine site. These findings are consistent with the CAO determination that Elgin Mine is a source for mercury to the West Fork of Sulphur Creek.

The CAO also found that the interaction of hydrothermal springs with mine waste is a source of anthropogenic loading (of mercury) to Sulphur Creek.

The TMDL assigned a load reduction of 95 percent from current loads to Elgin Mine. According to the CAO, completion of cleanup activities in accordance with approved work plans would result in compliance with requirements to reduce mercury loading from Elgin Mine and progress toward achieving numerical water quality objectives identified in the CAO.

2.3 Laws and Regulations Applicable to the Cleanup
Site cleanup and redevelopment should be conducted in compliance with applicable laws and regulations applicable to the release of hazardous substances at abandoned mine sites.

This section summarizes potential federal and State of California requirements. Three categories of environmental requirements, chemical-, location- and action-specific, are described below including an analysis of the exemption of mining wastes from regulation as a hazardous waste under Section 3001(a)(3)(A)(ii) of the Resource Conservation and Recovery Act (RCRA) (Bevill Amendment exemption) and under the California Health and Safety Code, Section 25143.1(b)(1) and (2).

2.3.1 Chemical-Specific Requirements
Chemical-specific requirements are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. The medium to be addressed at Elgin Mine is mine waste.

Potential state requirements for Sulphur Creek are the RWQCB Basin Plan, and Resolution 92-49. Identification of surface water requirements depends on the beneficial uses of the water. Beneficial uses of surface waters in California are identified in water quality control plans, known as Basin Plans. Basin Plans are adopted and amended by RWQCBs with input from the public, environmental review by the state, and approval by the State Water Resources Control Board. Basin Plans are regulatory references for meeting the state and federal requirements for water quality control. The Basin Plan for the Central Valley RWQCB (Central Valley RWQCB 2004) identifies that beneficial uses for the lower two miles of Sulphur Creek do not include municipal supply and consumption of aquatic organisms (Resolution No. R5-2007-0021). Elgin Mine is located upstream from this reach of Sulphur Creek and the Basin Plan does not specifically identify the existing beneficial uses for upper Sulphur Creek.

2.3.2 Location-Specific Requirements
Location-specific requirements are restrictions on the conduct of activities solely because they are in specific locations. Special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. The Endangered Species Act of 1973 (ESA), the Archeological
and Historic Preservation Act, the Fish and Wildlife Coordination Act, the Migratory Bird Treaty Act, and various California natural resource laws are potential requirements. Each is summarized below.

**Endangered Species Act of 1973.** The ESA, 16 United States Code (USC) Chapter 35, was enacted to protect the ecosystems upon which endangered and threatened species depend, and to conserve and recover endangered and threatened species. The ESA applies to actions taken or funded by federal agencies. Though there is no direct evidence that any threatened or endangered plant or animal species occurs along any segment of the surface water migration pathway, the area of the site is potential (elevation) habitat for numerous special status species, including the threatened California red-legged frog (*Rana aurora draytonii*). The area also provides potential (elevation) habitat for the protected bald eagle and California spotted owl, in addition to many other resident and migratory birds. Underground mine workings that remain open may also shelter bats.

**National Historic Preservation Act.** Section 106 of the National Historic Preservation Act, 16 USC Section 470s (NHPA), requires Federal agencies to take into account the effects of their undertakings on historic properties and afford a reasonable opportunity for comment on such undertakings.

The section 106 process seeks to accommodate historic preservation concerns with the needs of federal undertakings through consultation among the agency officials and other parties with an interest in the effects of the undertaking on historic property, establishes procedures to provide for preservation of historical and archeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. If any action would cause irreparable loss or destruction of significant scientific, prehistoric, historical, or archeological data, it would be necessary to follow the procedures in the statute to provide for data recovery and preservation activities. Cultural resource surveys would be conducted if required to determine how to comply with the NHPA.

**Fish and Wildlife Coordination Act.** The Fish and Wildlife Coordination Act, 16 USC Section 661, was enacted to protect fish and wildlife when federal actions result in the control or structural modification of a natural stream or body of water. The statute requires federal agencies to take into consideration the effect that water-related projects would have on fish and wildlife and then act to prevent loss or damage to these resources.

**Migratory Bird Treaty Act.** The Migratory Bird Treaty Act, 16 USC Section 703, establishes federal responsibility for the protection of international migratory bird resources. It prohibits at any time, using any means or manner, the pursuit, hunting, capturing, killing or attempting to take, capture, or kill any migratory bird.

**California Wildlife Statutes.** California Fish and Game Code Section 3005 prohibits the taking of any mammal or bird with poison. California Fish and Game Code Section 5650 makes it unlawful to “deposit in, permit to pass into, or place into waters of the state…substances or materials deleterious to fish, plant life, or bird life.”

**California Lake and Streambed Alteration Program.** California Fish and Game Code Sections 1600 through 1616 prohibit alteration of streambeds or impeding natural flow in streambeds absent an agreement with the California Department of Fish and Wildlife (CDFW).
2.3.3 Action-Specific Requirements

Action-specific requirements are technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances. These requirements are triggered by the particular activities selected. This section summarizes the general action-specific requirements for the alternatives.

Colusa County Air Pollution Control District (APCD) rules and regulations include prohibitions against emissions that create a nuisance. Use of machinery to implement remediation activities at the Reed Mine would comply with current APCD rules.

**Clean Water Act.** The CWA contains permit requirements for discharges to waters of the United States. For those alternatives that would involve discharge to surface water, the substantive requirements of 40 Code of Federal Regulations (CFR) Part 122 are potential requirements.

The US Army Corps of Engineers (USACE) and the EPA regulate the discharge of dredged or fill material into waters of the United States under Section 404 of the CWA. The purpose of the CWA is to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters.” Section 404 of the CWA prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE. Pending a formal wetlands delineation, all wetlands are considered potentially jurisdictional by the USACE. In addition, Section 401 of the CWA (33 USC 1341) requires any applicant for a federal license or permit to conduct any activity that may result in a discharge of a pollutant into waters of the United States to obtain a certification that the discharge will comply with the applicable effluent limitations and water quality standards. A Water Quality Certification or waiver pursuant to Section 401 is required for Section 404 permit actions; this certification or waiver is issued by the RWQCB.

**Clean Water Act Permit Requirements for Storm Water Discharges.** Any on-site discharge of storm water runoff associated with construction of the proposed remedy must meet the substantive requirements of the General National Pollutant Discharge Elimination System Permit for Storm Water Discharges Associated with Construction Activity, Order 2009-0009-DWQ, issued by the SWRCB pursuant to its delegated authority under the CWA.

**Off-Site Disposal of Mine Waste.** Off-site disposal of mine wastes would require compliance with California and federal transportation requirements and compliance with relevant disposal criteria. In particular, RCRA land disposal restrictions require that wastes be analyzed for the potential to create leachate using the toxicity characteristics leaching procedure (TCLP) prior to off-site disposal.

2.3.4 Mining Waste Regulations

All of the mine wastes at Elgin Mine are the result of mineral extraction or beneficiation at the site. Under RCRA Section 3001(a)(3)(A)(ii), 42 USC 6921(a)(3)(A) (ii) (also known as the "Bevill Amendment"), EPA has exempted most mining wastes from regulation as hazardous waste. Exempted material includes waste generated from the extraction and beneficiation of minerals, and some mineral processing wastes (including amalgam) (see 40 CFR Section 261.4(b)(7)).

**State Exclusion of Mining Waste from Regulation as Hazardous Waste.** California's Health and Safety Code recognizes the Bevill Amendment exclusion, so that wastes that would otherwise be regulated by the California Hazardous Waste Control Law, the California analogue
to RCRA, are instead subject to the requirements of Water Code Section 13172, detailed in 27 CCR Section 22470. Under Health and Safety Code Section 25143.1(b)(1 and 2) as stated below:

“Wastes from the extraction, beneficiation, and processing of ores and minerals that are not subject to regulation under Subchapter III (commencing with Section 6921) of Chapter 82 of Title 42 of the USC are exempt from the requirements of this chapter, except the requirements of Article 9.5 (commencing with Section 25208) and Chapter 6.8 (commencing with Section 25300). The wastes subject to this subdivision are subject to Article 9.5 (commencing with Section 25208) and Chapter 6.8 (commencing with Section 25300) if the wastes would otherwise be classified as hazardous wastes pursuant to Section 25117 and the regulations adopted pursuant to Section 25141.”

Waste rock at Elgin Mine is Bevill exempt and will be managed in accordance with the California Water Code. Calcine tailings at Elgin Mine that exceed toxicity criteria based on the site characterization data are not subject to the Bevill exemption and would be managed in accordance with California and federal hazardous waste control laws. Available data show that calcine tailings at Elgin Mine do not exceed toxicity criteria for a hazardous waste and should be considered to be Bevill exempt. Any material subject to off-site disposal would be resampled and analyzed as part of the profiling process and will be disposed of based on profile sample results.

**Surface Mining Control and Reclamation Act.** The Surface Mining Control and Reclamation Act (SMCRA), 30 USC Section 1201, establishes a nationwide program for the protection of human health and the environment from the adverse effect of surface coal mining operations. Although SMCRA addresses abandoned coal mines, it may be relevant and appropriate to cleanup of other types of mining sites. In its Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Compliance with Other Laws Manual, EPA explained that SMCRA may be relevant and appropriate at (1) sites with sulfide-containing geologic materials and where there is a release or threat of release of acid and at (2) sites subject to erosion and thus releases are contaminated by heavy metals. The following regulations, which provide guidelines for post-mining rehabilitation and reclamation of surface mines (Part 816) and underground mines (Part 817) may be potentially appropriate (EPA 1988):

- 30 CFR 816.43/817.43 – standard for diversions of flow from disturbed areas
- 30 CFR 816.56/817.56 – post mining rehabilitation of sedimentation ponds, diversions, and impoundments
- 30 CFR 816.97/817.97 – protection of fish and wildlife
- 30 CFR 816.111/817.11, 816.114/817.114, and 816.116/817.116 – revegetation requirements

**California Mining Waste Regulations.** Pursuant to California Water Code Section 13172, the State of California has adopted regulations designed to address the management of mining waste. These regulations are found at 27 CCR 22470 through 22510. The regulations establish three groups of mining waste:

- Group A – mining waste that must be managed as hazardous waste provided the RWQCB finds that such mining wastes pose a significant threat to water quality.
• Group B – mining wastes that consist of or contain hazardous wastes that qualify for a variance, provided that the Water Board finds that such mining wastes pose a low risk to water quality, or mining wastes that consist of or contain nonhazardous soluble pollutants of concentrations that exceed water quality objectives for, or could cause, degradation of waters of the state.

• Group C – wastes from which any discharge would be in compliance with the applicable water quality control plan, including WQOs other than turbidity.

Classification of the mining waste as hazardous under the Hazardous Waste Control Act is used to determine which group designation is appropriate. Material from Elgin Mine may be classified as either Group B, or Group C wastes, depending on the level of threat to water quality under site conditions. The regulations contain specific requirements on siting, construction, monitoring, and closure and post-closure maintenance of existing and new units. These requirements apply to alternatives that involve the creation of an on-site disposal unit or closure of existing units.

3.0 Evaluation of Brownfields Cleanup Alternatives
Each of the suggested actions was considered with respect to site conditions and the criteria of effectiveness, implementability, and cost, as suggested in “Guidance for Conducting Non-Time Critical Removal Actions under CERCLA” (EPA 1993), described in the following paragraphs.

Effectiveness Evaluation. The ability of the process to protect human health and the environment is reviewed during an evaluation of the effectiveness of a technology (EPA 1993). Protection is achieved by reducing the toxicity, mobility, or volume of metals in mine waste over a short-term and long-term period while complying with applicable or relevant and appropriate environmental requirements.

Effectiveness relates to the potential of a technology to achieve the cleanup goals, considering the chemical and physical characteristics of the source and site conditions. Potential impacts to human health and the environment during the construction and implementation phase as well as the reliability of the process with respect to the site conditions are also considered. The evaluation considered effectiveness as low, moderate, high, or uncertain.

Implementability Evaluation. The technical and administrative feasibility of constructing, operating, and maintaining the technology is considered during an evaluation of the implementability of each suggested technology (EPA 1993). Technical feasibility considers whether the technology applies to and can be properly constructed and operated at the site. The evaluation considers long-term operation, maintenance, and monitoring of the technology as it would be implemented. Administrative feasibility considers regulatory approval and scheduling constraints, as well as the availability of disposal services, disposal locations, and the necessary construction expertise and equipment. This evaluation considered implementability as easy, moderately difficult, or difficult.

Cost Evaluation. The types of costs assessed include the following:

• Capital costs, including both direct and indirect costs (excluding permitting and design costs)
- Annual operation and maintenance costs, including the monitoring cost to evaluate long-term effectiveness
- Net present worth of capital, operation and maintenance costs, and periodic costs

In accordance with EPA guidance (EPA 1993, 2000), these engineering costs are estimates that are expected to be within plus 50 to minus 30 percent of the actual project cost (based on 2018 dollars). Cost estimates were prepared in accordance with EPA guidelines (EPA 2000) using engineer’s estimates, historical costs for similar projects, and vendor quotes. Changes in the cost elements are likely to result from new information and changing economic conditions (energy costs, labor and equipment availability, new regulations).

The present worth cost of each alternative provides the basis for the cost comparison. The present worth cost represents the amount of money that, if invested in the initial year of the action at a given interest rate, would provide the funds required to make future payments to cover all costs associated with the alternative over its planned life. The present worth analysis was compared for all alternatives using a 5 percent discount rate (the historical average) over a period of 5 years.

Estimated costs do not include costs associated with permitting, environmental evaluations to comply with the National Environmental Policy Act (NEPA), California Environmental Quality Act (CEQA), or design costs. Permitting, NEPA/CEQA evaluations and design will be undertaken as part of detailed planning after identification of the alternatives and before implementation of remediation.

3.1 Cleanup Action Objectives
The results of CalFed (2003), Global Geodyne (2010), and USGS (2013) investigations have identified the presence of mercury in mine waste at Elgin Mine that is mobilized to Sulphur Creek through erosion and transport, and interaction with hydrothermal spring discharge. The objective of the cleanup at Elgin Mine is to reduce or prevent potential risk to human health and/or the environment from mercury in mine waste.

3.2 Remediation Technologies
This evaluation of alternatives is based on the Interstate Technology Regulatory Council mining waste decision tree (https://www.itrcweb.org/miningwaste-guidance/decision_tree.htm ). The Council’s decision tree was developed to provide an overview of technologies that can be used to address mining wastes, and provides a guide to identify a set of treatment technologies that can be used at a particular site such as Elgin Mine.

The decision tree was approached with the understanding that there is not an immediate need to act at Elgin Mine. The decision tree includes both solid mining waste and mining-influenced water technologies.

Each of the suggested actions was considered with respect to site conditions and the criteria of effectiveness, implementability, and cost, as suggested in “Guidance for Conducting Non-Time Critical Removal Actions under CERCLA” (EPA 1993).
3.3 Identification and Evaluation of Cleanup Alternatives

Based on the planned reuse, three options were evaluated – No Action, On site consolidation of mine waste with separation from hydrothermal spring discharge, and Excavation and off-site disposal of mine waste and control of hydrothermal spring discharge.

Evaluation criteria include effectiveness, implementability, and cost as described above. Costs are summarized in Table 1 below.

Table 1. Estimated Costs for Remediation Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Plan and Permit</th>
<th>Excavate and Transport</th>
<th>Manage Hydrothermal Water</th>
<th>Monitoring and Maintenance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 No Action</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>2 On-Site Repository</td>
<td>$200,000</td>
<td>$390,000</td>
<td>$142,000</td>
<td>$58,000</td>
<td>$790,000</td>
</tr>
<tr>
<td>3 Off-Site Disposal</td>
<td>$120,000</td>
<td>$1,080,000</td>
<td>$142,000</td>
<td>$58,000</td>
<td>$1,400,000</td>
</tr>
</tbody>
</table>

Alternative 1 – No Action

The No Action Alternative is included as a baseline for comparison to the other proposed alternatives. The No-Action Alternative assumes that the site conditions will remain unchanged, and none of the proposed actions listed in the other alternatives would be initiated.

**Effectiveness:** This alternative would not provide for mitigation of the actual or potential risks posed by the presence of mercury in waste rock and tailings at the site. The current site conditions have been documented to add mercury to the West Fork of Sulphur Creek. If no corrective action is taken, the site will continue to pose a risk to human health and the environment, and is not protective.

**Implementability:** This alternative is easily implemented; however, this alternative is not responsive to the CAO and would not be acceptable to the RWQCB.

**Cost:** No costs would be incurred during the implementation of this alternative.

Alternative 2 – On-site consolidation of mine waste with separation from hydrothermal spring discharge

On-site consolidation of the mine waste would require planning, design of an on-site repository, excavation and transport of mine waste to the repository, repository closure, and site restoration. Separation of mine waste from hydrothermal spring discharge would require conveying hydrothermal discharge from the collapsed adit in a lined channel or pipeline that prevents contact between the hydrothermal fluids and material disturbed by mining. These activities require maintenance and monitoring to ensure long-term effectiveness. Future site development would be restricted through institutional controls to preserve the repository integrity, and to preserve the system used to separate hydrothermal fluids from mine waste.

**Effectiveness:** Contaminated media would remain at the site, but would no longer pose a significant threat to water quality or human health and the environment. During remediation
workers could be exposed to mercury, however requirements for training and worker protection would prevent such exposures.

*Implementability:* This alternative is readily implemented after appropriate planning and permitting are completed.

*Cost:* Capital costs are estimated at $732,000 and the present worth costs including five years of maintenance are estimated at $58,000. The total estimated five-year present worth cost is $790,000.

**Alternative 3 – Excavation and off-site disposal of mine waste and control of hydrothermal spring discharge**

Excavation and off-site disposal of the mine waste would require planning, excavation and transport of mine waste to a properly permitted off-site disposal facility, and site restoration. Control of hydrothermal spring discharge would require conveying hydrothermal discharge from the collapsed adit in a lined channel or pipeline that prevents contact between the hydrothermal fluids and material disturbed by mining. These activities require maintenance and monitoring to maintain long-term effectiveness. Future site development would be restricted through administrative controls to preserve the system used to separate hydrothermal fluids from mine waste.

*Effectiveness:* Most mine waste would be removed from the site, and would no longer pose a significant threat to water quality or human health and the environment. Residual mine waste would be covered and stabilized to prevent direct contact and erosion. During remediation workers could be exposed to mercury; however, requirements for training and worker protection would prevent such exposures. During transport of material for off-site disposal, this alternative would consume fuel and create carbon emissions, and pose a traffic hazard associated with overland transport.

*Implementability:* This alternative is readily implemented after appropriate planning and permitting are completed.

*Cost:* Capital costs are estimated at $1,342,000 and the present worth costs including five years of maintenance are estimated at $58,000. The total estimated five-year present worth cost is $1,400,000.

### 3.4 Comparison of Alternatives

**Alternative 1:** *No Action* would not meet goals or satisfy the CAO for this project and is therefore dismissed without additional evaluation.

**Alternative 2:** *On-site consolidation of mine waste with separation from hydrothermal spring discharge* is expected to meet the project goals and comply with the CAO and is therefore considered a more preferable option than Alternative 1. This alternative does not entail increased traffic hazards and does not result in increased carbon emissions due to off-site transport. This alternative does result in the need for land use restrictions, however, such restrictions are not inconsistent with potential future use of the property for geothermal power production and/or recreation. If a suitably designed repository can be cited at the property, this alternative is preferable to Alternative 3.

**Alternative 3:** *Excavation and off-site disposal of mine waste and control of hydrothermal spring discharge* is expected to meet the project goals and comply with the CAO and is therefore
considered a more preferable option than Alternative 1. This alternative entails increased traffic hazards and results in increased carbon emissions, compared with Alternative 2, due to off-site transport. This alternative also results in the need for land use restrictions, however, such restrictions are not inconsistent with potential future use of the property for geothermal power production and/or recreation. This alternative is not expected to result in significantly more protection of human health and the environment than Alternative 2 and costs significantly more. Therefore Alternative 2 is preferred over Alternative 3.

3.5 Consideration of Climate Change Impacts
Scientific evidence demonstrates that the climate is changing at an increasingly rapid rate, outside the range to which society has adapted in the past. These changes can pose significant challenges to EPA’s ability to fulfill its mission. EPA must adapt to climate change if it is to continue fulfilling its statutory, regulatory, and programmatic requirements. EPA is therefore anticipating and planning for future climate changes to ensure it continues to fulfill its mission of protecting human health and the environment even as the climate changes.

In February 2013, EPA released its draft Climate Change Adaptation Plan to the public for review and comment. The plan relies on peer-reviewed scientific information and expert judgment to identify vulnerabilities to EPA’s mission and goals from climate change. The Region 9 Plan identifies vulnerabilities in Region 9, including lack of rainfall and the prospect of future droughts, reduction in groundwater supply, temperature increase and its impact on urban areas, wildfire prevalence, agricultural, and habitat loss and ecosystem shift. Priority is being placed on mainstreaming climate adaptation within EPA and encouraging adaptation planning across the entire federal government.

Cleanup at Elgin Mine would attempt to anticipate the impacts of climate change by revegetating disturbed areas using locally adapted native strains of drought and fire-resistant plants to provide genetic resiliency in the face of climate change effects.

3.6 Green and Sustainable Remediation Guidance
When implemented effectively, green and sustainable remediation practices enhance the environmental benefits offered by federal cleanup and redevelopment programs such as the EPA Brownfields Program. The principles governing green and sustainable remediation for EPA cleanup programs have been outlined in greater detail, but generally seek to “optimize environmental performance and implement protective cleanups that are greener by increasing our understanding of the environmental footprint and, when appropriate, taking steps to minimize that footprint.”

The following benefits can be reached through preferential use of green remediation approaches:

- Waste production and use of materials can be minimized.
- Impacts to water quality and water resources can be avoided.
- Air emissions and greenhouse gas production can be reduced.
- Natural resources and energy can be conserved.
3.6.1 Administrative Suggestions
Emphasis should be placed on selecting contractors (and their subcontractors) that follow green remediation best management practices. Use of contractors that place priority on clean fuel and emission technologies should be encouraged. Redevelopment plans and future use of the site should guide the type of sampling and remediation, ensuring efficient and sustainable methods. Reports, both draft and final documents, should be submitted in digital format, rather than as printed copies. Outreach to local communities should optimize the use of electronic media and centralized communication.

3.6.2 Operations Suggestions
The following suggestions about operations should be considered to help achieve green and sustainable remediation at the site:

- Sustainable practices, such as utilizing existing structures, native vegetation, and natural attributes on-site, should be encouraged.
- Passive technologies such as those relying on gravity to move water will be sought to minimize long term energy consumption.
- Environmentally preferable products, as outlined in EPA’s Environmentally Preferable Purchasing guidance (http://www.epa.gov/epp), should be utilized, including environmentally friendly electronics, recycled products, and energy-efficient lighting.
- Mobilization during field efforts should use fuel-efficient and/or alternative fuel vehicles, encourage carpooling, and should avoid environmentally sensitive areas when placing operations centers and command posts.
- Waste should be minimized, through conservation efforts, recycling, and reuse of items. The following procedures can be followed to minimize waste:
  - Field screens should use non-invasive technologies where feasible, such as ground penetrating radar, seismic refraction/reflection, electromagnetic survey, electrical resistivity tomography, and borehole radar tomography.
  - Quantity of field samples should be minimized, and mobile laboratories should be prioritized.
  - Drilling and excavation activities should incorporate clean fuel and emissions controls, including idle reduction devices, use of ultra-low sulfur diesel and/or fuel-grade biodiesel, advanced emission controls, EPA or California Air Resources Board verified emission control technology, and the performance of routine engine maintenance.
  - Efficiency during transport and disposal operations should be maximized, and practices such as back-loading should be used whenever possible.
3.6.3 Bioremediation Considerations

Bioremediation is a natural process which relies on bacteria, fungi, and plants to degrade, breakdown, transform, or essentially remove contaminants from soil and water. Bioremediation options potentially provide a low cost, non-intrusive, natural method of addressing soil contamination at a site. More information about bioremediation alternatives can be found at http://www.epa.gov/tio/download/citizens/a_citizens_guide_to_bioremediation.pdf.

Bioremediation potential of the site should not be examined or considered because mercury methylation is subject to uncertain impacts via changing the vegetation community.

4.0 Limitations and Additional Assessment Needs

The CAO, along with CalFed (2003), Global Geodyne (2010), and USGS (2013) reports, provide valuable characterization of current and historical conditions of Elgin Mine, including a summary of historical site use, previous investigations, regulatory involvement, and site reconnaissance.

These investigations documented the presence of mercury in mine waste, and that the interaction of hydrothermal fluids with mine waste mobilize mercury to Sulphur Creek. These investigations and this ABCA can provide mitigation guidance but are not removal characterizations; information therein represents the site-specific recognized environmental conditions and opinions of the environmental professional.

Additional information necessary to complete detailed planning and design of a removal action includes verification of the regulatory classification of the mine waste. Design requirements for a repository are dependent on results of chemical analyses that are not currently available.

5.0 References Cited


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Figures
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**Figure 2**

**Elgin Mine Features**

WESTSIDE MINES

Source: ESRI Data Viewer, 2018; Cal DWR, 2018; Churchill & Clinkenbeard, 2003; Global Geodyne, 2011

**LEGEND**

- **Collapsed Adit**
- **Sample (Churchill & Clinkenbeard, 2003)**
- **Sample (Global Geodyne, 2011)**
- **Hydrothermal Pool**

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