

Remediation

Public Safety Remediation Projects

Examples of Public Safety Remediation Projects

Environmental Contamination Remediation Projects

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The AMLP partners with both state and federal government agencies to protect the public by closing hazardous openings on public lands, and by assisting with certain steps in chemical contamination clean-up projects. Since other state and federal agencies have established authorities under environmental cleanup and protection statutes to address contaminant remediation AMLP does not take the lead on such projects, but provides assistance where its services are a good fit to meet the overall objectives of the agency responsible for the project. Examples of program-led assistance projects that halt or prevent contamination of the environment include 1) site characterization (sampling to determine contaminant presence and extent), 2) remediation design and implementation, particularly where site revegetation is involved, and 3) remediation project management.

In 2002, the AMLP began funding legacy abandoned mine remediation projects in addition to its assessment work. By partnering with land-owning agencies and other entities, which typically contribute funds or in-kind services, the department has leveraged Federal and State dollars, remediating more hazards than it could with just the state's resources in the AMLP. Since 2006, the AMLP's primary funding to remediate physical safety hazards at legacy abandoned mines comes from a fee collected on gold and silver production in California (\$5 per ounce for gold and 10¢ per ounce for silver)* and from federal awards.

Public Safety Remediation Projects

To date, federal and state legacy abandoned mine land agencies, in partnerships with the Department, have remediated more than 1,338 of the highest risk safety hazards on state, federal, and county owned land, at a cost of around \$5 million. Remediation costs have included biological and cultural surveys, environmental documentation, and construction labor and materials. Remediation costs vary depending on the number, size, and location of features, as well as any biological and cultural resources present at a particular site. Closures target high priority mine sites identified through the assessments of legacy mined lands (typically high hazard, high public visitation areas), and consist of wire fencing; backfills; polyurethane foam (PUF) closures; bat compatible gates, cupolas, and culvert gates; fitting with concrete plugs and steel caps; and, demolition of unstable structures and trash (Figure 6). All work is conducted in accordance with CEQA or NEPA. Work is typically performed by companies under contract to the Department.

Table 1 provides examples of public safety remediation projects performed by the Department at a number of legacy abandoned mine sites on public lands that were identified as priorities in 2007.

* See *Kuehl*, Chapter 794, Statutes 2003; Public Resources Code § 2207(d)(4)(B).

Table 1. Examples of public safety remediation projects performed by the Department at priority legacy abandoned mine sites on public lands.

Mine Name or Area	County	Remediation Action
Alabama Hills Recreation Area Sites	Inyo	Closed hazardous mine openings
Keysville Recreation Area Sites	Kern	Closed hazardous mine openings
Randsburg High Use Area Sites	Kern	Closed hazardous mine openings
Rademacher Hills OHV Area Sites	Kern/San Bernardino	Closed hazardous mine openings
Coarsegold High Use Area Sites	Madera	Closed hazardous mine openings
Southern Belle	Inyo	Closed hazardous mine openings
Mountaineer	Riverside	Closed hazardous mine openings
El Mirage Recreation Area Sites	San Bernardino	Closed hazardous mine openings
Kelly	San Bernardino	Fenced hazardous mine openings
Spangler Hills OHV Area Sites	San Bernardino	Closed hazardous mine openings
Joshua Tree National Park Sites	Riverside/San Bernardino	Closed hazardous mine openings
Mojave National Preserve Sites	San Bernardino	Provided technical oversight for closure of hazardous mine openings.
Bodie Mining District	Mono	Fenced hazardous mine openings
Plumas-Eureka State Park	Plumas	Fenced hazardous mine openings
Cement Hill	El Dorado	Closed hazardous mine openings
Ford Contraband	El Dorado	Closed hazardous mine openings
Gravel Hill	El Dorado	Closed hazardous mine openings
Tipton Hill	El Dorado	Fenced hazardous mine openings
Tungsten Hills	Inyo	Closed hazardous mine openings
Naked Miner	San Bernardino	Closed hazardous mine openings
Rinconada	San Louis Obispo	Closed hazardous mine openings
Paymaster	Imperial	Fenced hazardous mine openings
Le Du	Nevada	Closed hazardous mine openings
Islander	San Bernardino	Closed hazardous mine openings
Saint Louis	San Bernardino	Closed hazardous mine openings
Salt Springs	San Bernardino	Closed hazardous mine openings
Umberci	San Bernardino	Closed hazardous mine openings
Los Padres	San Bernardino	Closed hazardous mine openings

New Deal	San Bernardino	Fenced hazardous mine openings
Delwisch	El Dorado	Closed hazardous mine openings
Blue Light	Orange	Closed hazardous mine openings
Yaney	Inyo	Closed hazardous mine openings
Goat Basin	San Bernardino	Closed hazardous mine openings
Lucky Jim	San Bernardino	Closed hazardous mine openings
Blue Gouge	El Dorado	Closed hazardous mine openings
Texas	El Dorado	Closed hazardous mine openings
Silver King	Los Angeles	Closed hazardous mine openings
Fairview	Placer	Closed hazardous mine openings
Arrastre	San Bernardino	Closed hazardous mine openings
High Commission	Sierra	Closed hazardous mine openings
Enterprise	Trinity	Closed hazardous mine openings



Figure 6. Examples of closure techniques for remediating hazardous mine openings.

Since its inception, the AMLP has increased the number of on-the-ground remediations through key partnerships with other state, federal, and local agencies. From 1997 to 2015, the Department has closed 1,338 hazardous mine openings.

Examples of public safety remediation projects



California State Lands Commission - Safety Closures

The Department is currently working with the California State Lands Commission (CSLC) to perform remediation of safety hazards and further characterization of potential contaminant hazards at mine sites on CSLC properties that were already assessed in the Department’s 2009 report, *Inventory and Assessment of Abandoned Mines on State-Owned Lands*. Under the partnership between the Department and CSLC, the CSLC may be able to address all of its high priority safety hazards and complete characterization of its contaminant hazards within a few years. Currently, the Department has committed \$140,000 from the Abandoned Mine Reclamation and Mineral Fund and CSLC has provided \$44,000 to fund 18 closures of dangerous adits and shafts on CSLC lands. With adequate support from the AMRMF and adequate staffing at CSLC to complete required closure project planning processes, such as consultations with the California Department of Fish and Wildlife and the State Historic Preservation Office, the CSLC will be able to fully address its abandoned mine liabilities over the next few years.

Additional examples of safety closures from around the state include backfills, cupolas, bat gates, culverts and polyurethane foam (PUF).

Environmental Contamination Remediation Projects

The Department has conducted or participated in a number of remediation strategies to mitigate environmental hazards associated with abandoned mines. Since other state and federal agencies have established authorities under environmental cleanup and protection statutes to address contaminant remediation, AMLP does not take the lead on such projects, but provides assistance where its services are a good fit to meet the overall objectives of the agency responsible for the project. Examples of program-led assistance projects that halt or prevent contamination of the environment include 1) site characterization (sampling to determine contaminant presence and extent), 2) remediation design and implementation, particularly where site revegetation is involved, and 3) remediation project management.

The California State Lands Commission and the Department have partnered to inventory and remediate dozens of hazardous mine openings. Photo: Jon Mistchenko, DOC (2015)

Table 2 provides examples of public safety remediation projects performed by the Department at a number of legacy abandoned mine sites on public lands that were identified as priorities in 2007. Table 2. Examples of environmental contamination remediation projects performed by the Department at priority legacy abandoned mine sites on public lands.

Mine Name	County	Remediation action
Leviathan	Alpine	Revegetation test plot construction and monitoring
Sulfur Bank	Lake	Revegetation test plot construction and monitoring
Spenceville	Nevada	Establish conditions, evaluate strategies, feasibility study, develop design, create biddable plans
Walker	Plumas	Open stope backfill study
Walker Mine Tailings	Plumas	Revegetation test plot construction and monitoring
Gambonini	Marin	Revegetation test plot construction and monitoring
Zaca	Alpine	Bat gates installed on two adits
Lower Brush Creek	Sierra	Trash removal
Robinson	Plumas	Preliminary Appraisal/Site Investigation

Examples of environmental contamination remediation projects



Vegetation test plot on 100-acre tailings pond at Walker Mine in Plumas National Forest in Plumas County. Photo: Sarah Reeves, DOC (2015).

Walker Mine Tailings Revegetation Study and Dust Mitigation Project - The Walker Mine Tailings, part of the 2007 priorities list, is a 100 acre mine tailings located on the Plumas National Forest, east of Quincy in Plumas County. The Walker Mine produced significant quantities of copper during its operation between 1915 and 1941. The tailings from a mill located at the mine were deposited in a drainage, filling the drainage with fine-grained, sandy, silty, and clayey tailings. Under its Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

program, the USFS must minimize release of contaminants from the tailings adjacent Dolly Creek and Little Grizzly Creek and eliminate exposure of the public and on-site workers to fugitive silica-laden dust blown by wind from the tailings surface. OMR is performing a study of soil and vegetation conditions on the tailings in order to prepare a revegetation and mulching plan under a \$449,789 agreement with the USFS.



Robinson mine and stamp mill in Plumas National Forest in Plumas County. Photo: David Tibor, DOC (2014).

Robinson Mine Preliminary Assessment and Site Investigation - The Department has partnered with the USFS and obtained a \$75,000 grant from the Sierra Nevada Conservancy's Proposition 84 grant program to develop a Preliminary Assessment and Site Inspection (PA/SI) for the historic abandoned Robinson Mine and stamp mill, a mine on the 2007 priorities list. The Robinson Mine is located in the Plumas National Forest, southwest of Quincy in Plumas County,

California. The mine site is immediately adjacent to Frazier Creek, which is located in the Middle Fork Feather River watershed. The Robinson Mine site is being remediated by USFS under its CERCLA program due to contamination from mercury used at the mill to extract gold. If contamination levels indicate the need, an Engineering Evaluation / Cost Assessment will also be completed, with additional funding from USFS and Office of Mine Reclamation. Environmental sampling of the site was completed in fall 2015.



Mercury-laden sediment discharges from massive hydraulic gold mine in Malakoff Diggins State Historic Park. Photo: Jon Mistchenko, DOC, (2014).

Malakoff Diggins State Park and Humbug Creek Watershed - The AMLP is assisting Malakoff Diggins State historic Park, located in Nevada County, with the Malakoff Diggins Hydraulic Mine Feasibility Study¹, led by The Sierra Fund and a multi-agency project team. AMLP is directly assisting the Park with evaluating visitor protection at several deep shafts along a heavily used park trail and contributed data to the sediment erosion study for the park's primary hydraulic mine pit. AMLP used \$28,000 from the AMRMF to provide the aerial LiDAR map of the main hydraulic pit

and Humbug Creek watershed, which will be used along with ground-based LiDAR (performed by the U.S. Geological Survey) to measure erosion rates and sediment sources in and around the main hydraulic pit. AMLP staff are evaluating ways to improve visitor safety around the shafts along the major drain tunnel that can discharge mercury-laden sediment directly into Humbug Creek, a tributary to the South Yuba River. Most of the shafts are located directly adjacent to the visitor trail. Some are flooded or have failing fencing, and one shaft drains water across and down a segment of the trail, which makes the trail muddy and unsafe for park visitors. The park is making a new trail design to relocate this trail segment with funding assistance from AMLP and reviewing a remediation proposal from an AMLP contractor to address the shafts and discharge opening of the drain tunnel.

¹ Funded by a Department of Water Resources Integrated Regional Water Management Plan Proposition 84, Round 2 Implementation Grant, entitled "Cosumnes, American, Bear, Yuba Headwaters Resilience and Adaptability Program.

Bodie State Historic Park (SHP) - In the late 1800s to early 1900s, the town of Bodie in Mono County was part of a major gold mining district. In 1962, the town and adjacent area became Bodie SHP, which is owned and managed by the Department of Parks and Recreation (State Parks). The park is preserved in a state of “arrested decay,” and a critical priority for State Parks is to maintain the appearance and historical setting of mining, including structures, artifacts, tailings, and other cultural resources. As a consequence of mining and gold processing, however, Bodie was contaminated by lead (used in the assay process, which allows for measuring the amount of gold in an ore sample), mercury (used as amalgamate with gold to enhance recovery), and arsenic (commonly associated with gold deposits and occurring naturally in the area).



In 2007, the Department, using funds appropriated by the State Legislature to “remediate specified chemical hazards” (Assembly Bill 1801, Item 3480-001-0035, 2006), partnered with State Parks and a U.S. Environmental Protection Agency Region 9 Emergency Response Section (USEPA) team to investigate, characterize, and remediate chemical hazards at Bodie SHP generated by historic mining activities. The USEPA’s sampling and remediation procedures were designed to fully characterize and remediate contaminants and protect human health, while project activities were reviewed and monitored by park archaeologists to preserve cultural resources and artifacts. The project, completed in 2009, included the following tasks.

- Installed a modified radon extraction system to reduce mercury vapor concentrations inside the Standard Mill and remediated lead-contaminated soil on slope below the Mill (placed filter fabric and clean fill, revegetated slope, and installed fences to reduce disturbance).
- Remediated lead-contaminated soil from Assay building areas (removed top foot of soil in and around buildings; replaced soil with clean fill).
- Removed lead contaminated dust in Wheaton-Hollis Hotel using a HEPA vacuum.
- Controlled erosion of mine tailings adjacent to Bodie Creek by building a diversion channel lined with rocks collected onsite to carry runoff away from the tailings, by constructing weirs to slow stream flows, and by composting and revegetating the tailings to promote native plant growth.



A lined diversion ditch (right side of photo) prevents runoff from eroding mine tailings. Photo: Greg Marquis, DOC, (2009).



Open mine pit drained acidic water into Little Dry Creek. Photo: DOC (2001).



Treated mine waste was used to backfill the pit, and then the site was recontoured, covered with topsoil and revegetated. Photo: DOC (2004).

Spenceville Mine Acid Mine Drainage and Pit Reclamation Project - Spenceville Mine was a copper mine that operated from 1875 through 1918 in Nevada County. Problems with the abandoned open-pit mine included acid mine drainage (AMD) and the forming of an open pit lake in the abandoned mine workings. The mine water had a pH of about 2.5 with elevated levels of iron, copper, and zinc. During high precipitation, water from the pit overflowed into Little Dry Creek, which is under the jurisdiction of the Department of Fish and Wildlife (CDFW). Under contract with CDFW, the Department developed a strategy to mitigate the AMD and reclaim the mine site to a safe and stable condition. The Department's objective was to identify and select a low-cost, low-maintenance treatment strategy that would: (1) prevent future discharges to state waters by cleaning up and containing AMD and associated heavy metal problems onsite; (2) provide a stabilizing vegetative cover; and (3) meet Central Valley Regional Water Quality Control Board (RWQCB) requirements. The Department's

contract work included three phases:

- **Phase 1.** Evaluate existing site conditions and the adequacy of existing information on the site contained in previous studies. Gather additional site data, as needed.
- **Phase 2.** Multiple tasks, including: evaluate alternative control strategies; conduct a feasibility study; develop conceptual design criteria for alternative strategies; estimate capital, operating, and maintenance costs for the proposed alternatives; select an abatement and remedial strategy based on the feasibility study and testing; and prepare a preliminary design report for the recommended source control and cleanup alternative.
- **Phase 3.** Develop biddable plans and specifications for the selected strategy.

Upon completion of Phase 3, CDFW contracted with a private firm to implement site remediation and with the Department to provide an Engineer-In-Charge to oversee the contractor's work.



Ore and waste rock piled adjacent to mine pit. Walker mine. Photo: Jon Mistchenko, DOC (2003).

Walker Mine Pit Backfill Project - The Walker Mine pit backfill project was part of an effort by the Central Valley RWQCB to mitigate water quality impacts of this abandoned Plumas County copper mine. Previous RWQCB efforts included construction in the 1980s of a concrete seal near the mill site to stop discharges of acidic waters into an adjacent creek and the construction in the 1990s of drainage channels to capture and redirect runoff away from pits connected to underground workings. In 2003, the RWQCB

contracted with the Department to conduct site-specific studies to evaluate the potential impacts of backfilling the pits and modifying channels where adjacent springs were not fully captured. The Department conducted field and office studies throughout 2003 and 2004, prepared plans and contract documents to implement a pit backfilling and channel modifications project, and prepared a final report that presented the findings and recommendations from its investigations.

Gambonini Mercury Mine - During historic mining at the Gambonini Mercury Mine, located in Marin County, mine wastes were placed in a steep canyon covering an area of about 11 acres. Consequently, large quantities of mercury-laden sediment would discharge each year into Salmon Creek—a tributary to Walker Creek and Tomales Bay. Threats to the beneficial uses of these waters included degradation of fish spawning areas in Walker Creek and bioaccumulation of mercury by wildlife and fish in Tomales Bay. Under contract with the San Francisco Bay RWQCB, the Department provided revegetation, erosion, and construction monitoring, and consulted on creek remediation options.



Final grade with drainage ditches and native vegetation. Gambonini Mine. Photo: DOC (2005).



Settling ponds and pit showing test plots and drainage ditches. Leviathan Mine. Photo: DOC (2002).

Leviathan Mine - Leviathan Mine is an abandoned open-pit mine in Alpine County, high on the eastern slope of the Sierra Nevada southeast of Lake Tahoe that was placed on the USEPA National Priority List (Superfund) in May 2000. The Toiyabe National Forest surrounds the site. Although some mining for copper minerals took place onsite since the 1860s, major environmental problems originated during the open-pit sulfur mining that occurred from 1951 through 1962. Several hundred acres of eroding disturbance remain at the mine as a consequence of the historic mining operations. This disturbance consists of

the open pit, overburden, and mining waste piles. Barren conditions of the site have increased AMD generation, pollutant transport, and slope instability resulting in discharges to Leviathan and Aspen Creeks of low pH AMD containing high concentrations of dissolved sulfate, arsenic, nickel, aluminum and iron. Under contract with the Lahontan RWQCB, the Department performed geophysical surveys, revegetation monitoring, and provided botanical expertise for revegetation and weed control strategies. C

Sulphur Bank Mercury Mine - Sulphur Bank Mercury Mine, once one of the largest producers of mercury in California, was initially mined for sulfur from 1865 to 1871. Mercury ore was mined intermittently by underground methods from 1873 to 1905. The site periodically was opened for pit mining from 1915 to 1957, when it became inactive. Approximately 120 acres of mine tailings and waste rock and an open, unlined mine pit (called the Herman Impoundment) were located on the property. After mercury was found in the tailings and bottom sediments in



Harmon Impoundment and mine waste at Sulphur Bank Mine. Photo: DOC (1999).

Clear Lake, and high levels of mercury were detected in fish from the lake, the State issued an advisory against eating fish from the lake. Under contract with the USEPA, the Department performed statistical analyses of data, revegetation monitoring, and provided botanical expertise for revegetation and weed control strategies.