

RESOLVE

Regeneration 

**A Guide for Good Samaritans to Help Remediate
Abandoned Hardrock Mines in the US**

by
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Preface

The legacy of hardrock mining has left over 500,000 abandoned mine features in the western US alone¹. Abandoned mines can pose serious environmental and public health risks. One particular concern is heavy metal pollution of waterways that are critical to ecosystems and communities. While current legislation allows state, federal and Tribal agencies to cleanup abandoned mines, many sites remain unaddressed, in part due to legal risks for outside parties to take remedial actions. In the US, what should we do when there is no responsible party left to address and pay for the cleanup of these abandoned mines? There are three, mutually reinforcing responses.

Federal and state governments can use taxpayer dollars to remediate some of these sites. While numerous cleanups have occurred, there are inherent limitations given the number of sites. Realistically, governments can only address the most urgent sites, especially those with strong political constituencies pushing for remediation. States, like Arizona, have made progress with this strategy but want to do more.

We can put a royalty on mining on federal lands to fund cleanup, like the federal policy to establish a royalty fee program on coal. Since 1977, over 370,000 acres of hazardous abandoned coal mine lands have been reclaimed using funds from fees collected on coal through grants awarded to states and Tribes—totaling more than \$6.48 billion². Reclamation efforts include mitigation of over 47,000 open mine portals/shafts, 1,050 miles of dangerous highwalls, and cleanup of 131,000 acres of toxic coal waste piles and embankments³. There is a broad consensus that royalty on hardrock mining on federal lands makes sense; for example, there is support from industry, the environmental community, Tribes, and others. But the devil is in the details; questions of “how” and “how much” have delayed this policy reform for decades, blocking opportunities for significant funding.

We can encourage public and private partnerships to voluntarily clean up some of these sites. With passage of the [Good Samaritan Remediation of Abandoned Hardrock Mines](#)

¹ US Government Accountability Office. (2020). *Abandoned Hardrock Mines: Information on Number of Mines, Expenditures, and Factors That Limit Efforts to Address Hazards* (GAO-20-238). <https://www.gao.gov/products/gao-20-238>

² US Department of Interior Office of Surface Mining and Reclamation Enforcement: <https://www.osmre.gov/programs/reclaiming-abandoned-mine-lands>

³ US Department of Interior: <https://www.doi.gov/ocl/coal-mine-reclamation-revitalization>

[Act of 2024](#) (the Act) (Public Law 118-155), signed into law on December 17, 2024, after 25 years of debate, voluntary efforts are now encouraged. The Act authorizes 15 abandoned hardrock mines to be permitted as pilot projects. The Act enables and encourages cleanup by removing legal and procedural obstacles that historically deterred voluntary efforts. It empowers qualified Good Samaritans to remediate abandoned hardrock mines to protect waterways, ecosystems, and nearby communities. The Act also permits treating or reprocessing of the historical mine waste to help offset the cost of cleanup and remediation. This opens opportunities for critical mineral recovery to support domestic supply chains and the renewable energy transition. While projects under the Act are unlikely to produce significant quantities of minerals initially, the innovation that is incentivized through the pilot program under the Act could help scale domestic supply of minerals from waste.

Cleaning up legacy sites at scale will improve the social license of the mining industry, which is essential if we are to meet our needs for critical minerals. Perhaps progress on Good Samaritan sites will create new momentum for a federal royalty and cleanup program led by the states. We hope so, for the benefit of mining-impacted communities and industry.

[RESOLVE](#) is a sustainability NGO that forges solutions to critical social, health, and environmental challenges by creating innovative partnerships where they are least likely and most needed. [Regeneration](#), founded by RESOLVE, is a social enterprise working globally to remediate abandoned mines and reprocess waste to provide critical minerals. Regeneration is well poised to facilitate public and private partnerships for abandoned mine cleanup, which can now be leveraged through the Good Samaritan program. RESOLVE, with support from Regeneration, and funding from the [Rivian Foundation](#), conducted research and stakeholder engagement to evaluate opportunities created by the Act and the conditions that could accelerate cleaning up abandoned mines. In this report, we provide a policy review and analysis to help catalyze abandoned mine cleanup through the Good Samaritan program.

Currently, with the large number of abandoned mines, there are gaps in knowledge about eligible and ideal pilot project sites under the Good Samaritan program. To help address this gap, we investigated abandoned hardrock mines in the western US through research and outreach to state, federal, and Tribal agencies. We provide an initial roster of 95

eligible sites under the Act, 10 of which are examples of “shovel ready sites” that align with the planned pilot program based on information available at the time of publication. These 10 sites are discussed in detail in the Appendix to demonstrate the need and opportunity for remediation and potentially reprocessing through the pilot program. In the context of implementing the Act, we discuss insights into current abandoned mine remediation, including two success stories from agencies cleaning up abandoned mines in Arizona, and the need for the Act to be integrated within the regulatory landscape. We suggest key considerations for Good Samaritans to select a site and apply for a permit, with a step-by-step flow chart provided in the Appendix.

Through our research, we have already identified several issues that, if addressed, may incentivize a greater level of remediation, both during the pilot program period and into the next phase of the Act’s implementation. These recommendations will: 1) empower state-led abandoned mine remediation through dedicated state-level funds; 2) create a federal insurance pool to broaden participation by mitigating financial risks for smaller entities; 3) introduce multi-site permitting to address interconnected abandoned mine clusters efficiently; 4) ensure critical minerals are prioritized for reprocessing; 5) incentivize voluntary participation of mining companies in projects; 6) support technology innovators in water treatment, tailings and waste rock reprocessing, and metals extraction; and 7) encourage government exchanges to promote policy innovation within the US and outside.

We are aware that during the twenty-five-year debate over the Act, innovators have been hard at work developing new, low-impact technologies for water treatment, tailings and waste rock processing, and metals extraction. At Regeneration, our job now is to match these technologies to the right sites to show the public, key stakeholders, and regulators what is possible today. As critical minerals are extracted from America’s mine waste and sites are restored, momentum will build. The structured pilot program under the Act will generate lessons with broader applications to access a crucial domestic supply of critical minerals from mine waste. A significant source of critical minerals is being lost, and has been left behind, in the by-product of mining operations around the country. Almost all of the critical mineral needs in the US could be met from recovering ninety percent of the by-products from existing mining operations⁴.

⁴ E. Holley et al., *Science* 10.1126/science.adw8997 (2025).

With this report we offer a resource to communities, Tribes, non-profits, the mining industry, and technology innovators to help accelerate planning and permitting for Good Samaritan sites. Regeneration is actively working with a few states and partners to prepare Good Samaritan permit applications for several sites. RESOLVE is working with a broad range of stakeholders to support planning and site identification and to encourage additional incentives and reforms.

We recognize that many played a role in passing the Good Samaritan Act. We thank all of them and wish to recognize a few: Senator Heinrich, Senator Rich, Representatives Celeste Maloy, Mary Peltola, John Curtis, Blake Moore, Russ Fulcher, Susie Lee, Jim Costa, Cathy Carlson, Trout Unlimited, Tiffany & Co., the Tiffany & Co. Foundation, the Rivian Foundation (who supported this study), leaders in the National Mining Association and the American Exploration & Mining Association, and the team at the US Environmental Protection Agency, Office of Mountains Deserts and Plains.

We recognize progress and policy innovation in other jurisdictions on abandoned mine sites, including leadership from the Ministry of Mining and Critical Minerals in British Columbia and, specifically, the Abandoned Mines Branch. We are encouraged by our discussions with leadership in Queensland and Western Australia.

Key Takeaways

- The Act provides an opportunity for Good Samaritans in the US to voluntarily clean up abandoned hardrock mine sites and treat waste without being legally responsible for the historical activities and impacts.
- We provide a partial, early roster of 95 abandoned mine sites eligible under the Act and feature 10 sites as shovel-ready for the pilot program.
- We consider how regulators and Good Samaritans can increase their awareness of how the Act fits into the current regulatory landscape to address abandoned mine remediation.
- We suggest how Good Samaritans can assess sites for eligibility under the Act, apply for a permit to access sites, and consider other permitting processes and timeline improvements based on jurisdiction.

Introduction

In the western US alone, the legacy of hardrock⁵ mining has left over 500,000 abandoned mine features. Of these, 22,500 may pose environmental hazards, according to the US Government Accountability Office (GAO), and approximately 10,000 are estimated to cause significant environmental problems that require long-term solutions, in particular for contamination of water quality³. While abandoned mines pose health and environmental concerns, the tailings, wastewater, and waste rock on these sites can also present an opportunity for treatment and reprocessing to extract minerals and fund cleanup and remediation.

Historical mining processes were often inefficient compared to today's processes, leaving behind waste with minerals and metals of interest and importance. Tailings, waste rock, and wastewater can be a source of economic and critical minerals and metals, for example, to support the energy transition. The World Bank estimates that over 3 billion tons of minerals will be needed to deploy renewable energy and energy storage. Reprocessing of waste at abandoned mines can contribute needed minerals and metals and better remediation outcomes. While reprocessing will only provide a portion of the minerals needed, it is a high value opportunity — utilizing the waste for reprocessing addresses legacy pollution.

Current mine sites on federal land fall under regulations by the Federal Land Policy Management Act (FLPMA) and require financial guarantees against future environmental liabilities. However, many hardrock mines were abandoned long before environmental laws; the responsible parties no longer exist, cannot be located, or have gone bankrupt, so they cannot be compelled or held liable to remediate sites. This leaves most abandoned mines under the responsibility of state and/or federal agencies and, when addressed, cleanup is typically paid for by taxpayer funds. Agencies address abandoned mine remediation through environmental legislation, such as the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Clean Water Act (CWA). These policies focus on addressing and managing risks; remediation under these policies limits

⁵ Hardrock mining extracts minerals and metals, such as copper and gold, from ore in solid rock formations. Mining operations can vary in scale; they were typically smaller in the early 1900s, which led to a scattering of many small abandoned hardrock mines across the US.

the involvement of external entities due to the risks of carrying historical liabilities from a site.

The Good Samaritan Remediation of Abandoned Hardrock Mines Act of 2024 (the Act) is a federal bill introduced by Senator Martin Heinrich (D-New Mexico) and Senator Jim Risch (R-Idaho) to incentivize both cleaning up abandoned mines and recovering critical resources from the mine waste. The Act begins to address the need for a dedicated federal program, specifically for abandoned hardrock mine remediation and reprocessing for restoration at scale.

Prior to the Act, the Environmental Protection Agency (EPA) established the Good Samaritan Initiative (in 2007) to reduce barriers for non-liaible parties to remediate some types of abandoned mines. Under this Initiative, the EPA provided a comfort/status letter and/or administrative settlement agreement shielding Good Samaritans from CERCLA and CWA liability. This Initiative was used by organizations like Trout Unlimited to remediate watersheds impacted by abandoned mines. However, under this initiative, Good Samaritans were not allowed to reprocess waste material to extract minerals, and the EPA applied the program to a limited number of smaller sites. In addition, any entity that owned mining claims or was interested in purchasing an abandoned mine was generally prohibited from reprocessing mine waste (unless approved as an active mining project).

The 2024 Good Samaritan Act establishes a system where interested Good Samaritans and agencies can obtain a permit to remediate an abandoned mine, and reprocess waste if funds are used to support the cleanup. While the idea of using proceeds from reprocessing waste to fund remediation has been around for decades, new demand for critical and economic metals has renewed interest in addressing abandoned mines. The Act proposes a program for 15 pilot abandoned hardrock mines to be permitted as the initial phase of testing, with the possibility of more sites following an assessment of the program's success.

A key challenge to implementing the Act is that the overall number of abandoned mines is significant, but we typically lack the detailed information necessary to plan and execute a Good Samaritan project. There are agency and NGO inventories of abandoned mines, but few specifically identify or characterize eligible projects with necessary detail. There is

a lack of analysis on abandoned mines that pose problems and where opportunities exist through the Act, especially across the western US.

We need a “shovel-ready” posture, with both a site list that identifies key site characteristics and a constituency of communities, businesses, innovators, and experts ready to accelerate remediation through the Act.

Research and Report Objectives

RESOLVE is a sustainability NGO that forges solutions to critical social, health, and environmental challenges by creating innovative partnerships where they are least likely and most needed. RESOLVE has a deep history of policy and program innovation in the mining sector, working with NGOs, communities, and companies. Regeneration, founded by RESOLVE with support from Rio Tinto, Apple, Mejuri and others, is a social enterprise that recovers metals from waste and restores old, degraded mine sites. Our Salmon Gold program is an example of innovation in this area.

RESOLVE, with support from Regeneration and funding from the Rivian Foundation, conducted research and stakeholder engagement to evaluate opportunities created by the Act and the conditions that could accelerate cleaning up abandoned mines. In this report we present our findings from outreach to state, federal, and Tribal agencies and key stakeholders. We provide a roster of abandoned mines eligible for remediation under the Act, identify ten sites as candidates for the pilot program, and discuss key considerations for implementing the Act.

Our goal is for our research and report to help shorten the project planning cycle, catalyze mining policy reforms in US and similar reforms globally, and to begin organizing a coalition of community leaders, Tribes, mining companies, technology innovators, restoration experts, and others to advance an agenda to address legacy mine sites.

Methods

Based on research and stakeholder engagement, we compiled a list of candidate sites across the western US that can be pursued as projects under the Act's pilot program (Appendix 1). From this list, we selected ten sites that we define as shovel-ready (Table 1) and wrote profiles that describe the mine history, environmental conditions, and opportunities on each site (Appendix 2).

The site selection process was conducted over two phases. In Phase 1, we generated a list of abandoned hardrock mine sites from outreach to state, federal, and local regulators and from state and federal databases. Through preliminary screening, we identified whether the abandoned mines are eligible under the Act. In Phase 2, we completed a more detailed review to select sites that are most suitable and shovel-ready for the pilot program. We recognize that as the EPA develops information on the program, some of our criteria, and thus the site list, may need to be updated. We will continue to update and hopefully expand the list.

Phase 1

The Act has four criteria that we used for the initial Phase 1 screening to identify sites eligible under the Act:

1. Abandoned: Sites must be abandoned and not currently operated. The Act defines an abandoned site as “an abandoned or inactive hardrock mine site (or an associated facility) (a) that was used for non-coal mineral production on federal land under the General Mining Law of 1872; (b) for which no responsible owner or operator has been identified⁶.”
2. Closed prior to December 11, 1980: This criterion aligns with the start date of CERCLA policy, which aims to attach a responsible party to any cleanup. Any sites with mining activity ending in 1981 or later, which fall under CERCLA law, were removed from our inventory.

⁶ Pub. Law 118-115 -Sec. 2(1).

3. No current or ongoing CERCLA action: Sites are ineligible if they fall under CERCLA and if cleanup is planned (funding has been allocated) under CERCLA authority.
4. No current state, federal or Tribal agency cleanup action: The Good Samaritan legislation excludes sites that are the subject of planned or ongoing response actions under CERCLA⁷.

Phase 2

Following the initial screening for sites eligible under the Act, we conducted a Phase 2 review to delineate ten abandoned mines we could profile as shovel-ready sites. To do this, we used six criteria⁸ that broadly consider the baseline information, accessibility, hazards, and reprocessing potential of a site:

1. Pre-existing characterization: We focused on sites where background information was available from characterization programs conducted by agencies. Typically, this meant sites flagged by agencies as needing to be addressed and were in a stage of preliminary assessment. Sites that were eligible, but did not have sufficient information, are listed in Appendix 1.
2. Land ownership status: The Act defines eligible sites as those “used for the production of a mineral other than coal conducted on federal land under [the General Mining Law of 1872]” as well as on “non-federal land.” This language suggests that sites under federal, private, state, or Tribal land ownership are eligible⁹. Mixed ownership properties were not excluded from our site selection, but they were lower in priority, due to the potential complex nature of agreements.
3. Hazards: We prioritized sites with environmental and/or human health hazards needing to be addressed. If there were impacts to the surrounding environment and community, we ranked it higher for the positive outcomes that could be created through the Act.

⁷ Pub. L. 118-115 Sec.2(1)(C).

⁸ The six criteria were established without information from the EPA on how the Good Samaritan program will be implemented.

⁹ Pub. L. 118-155 Sec. 2(1)(A)(i).

4. Reprocessing: We evaluated if sites had tailings and waste rock that could be reprocessed for critical and other minerals to fund remediation. We considered sites with waste that could be reprocessed to be more favorable to highlight the opportunity of combining reprocessing with remediation.
5. Accessibility: Although many abandoned mines are located in remote locations, sites located closer to residences and/or communities were considered a higher priority to address.
6. Interested stakeholders: If a site had existing interested stakeholders (such as an agency, Good Samaritan like Trout Unlimited, as well as Tribal interests), we ranked it higher as a potential project for the Act.

We recognize that the government or other stakeholders may use different criteria or weighting. For example, we prioritize reprocessing because we are aware of the potential to deploy new technologies to address waste and believe reprocessing waste can help scale cleanup. Others may suggest starting with projects that do not include reprocessing, at least not initially, to control risks.

Results

A preliminary abandoned mine site inventory was created with approximately 500 sites compiled from databases and reports by state and federal agencies. We engaged with over 120 regulators across 11 western US states. From our process of finding shovel-ready pilot sites, we found that many abandoned mines became excluded in Phase 1 because they did not fit criteria in the Act, or we could not find enough information on the site to determine the eligibility. Abandoned mines for which we could not gather sufficient information could still potentially be eligible under the Act. Sites were found ineligible due to several reasons, including that many of the sites are addressed by state and federal agencies under CERCLA and CWA authority (so they are not eligible sites as per the Act).

Through Phase 1 of our review, we narrowed our site list down to 95 sites as eligible under the Act. The list of 95 candidate sites is not fully comprehensive as our search does not include every state, federal, and Tribal agency. In addition, there are other sites within the

95 candidates that we did not profile, although they could be considered priorities if more information was available.

With the criteria identified for Phase 2, we selected 10 sites to profile as shovel-ready pilot sites. While the pilot program allows for 15 projects, only 10 sites were selected and profiled in this report due to time and resource constraints. We selected our 10 sites by weighing many of the Phase 2 criteria. In respect to potential hazards, most sites are relatively dry (with possible ephemeral runoff) with tailings that need to be remediated. Tailings at these sites may impact human health and the environment, particularly at sites near watersheds. If information was available, we also categorized possible reprocessing opportunities at the sites. Most of the sites are categorized as just “remediation” opportunities due to the need for additional characterization to determine whether the sites may or may not have reprocessing opportunities.

For each of the 10 sites, we reviewed information and data from agencies and other sources publicly available. All 10 sites have pre-existing characterization such as preliminary assessments and site investigations, past CERCLA actions, or historic abandoned mine reports. This information was used to write brief (3-page) profiles for each site with an overview of the site, history of past mining, environmental investigations, current site conditions, and opportunities for the site under the Act’s pilot program. The detail of each site profile varies based on how much information we could access.

The characteristics of these 10 sites are briefly summarized in Table 1 with the detailed profiles provided in Appendix 2. The remaining inventory of all 95 eligible sites are provided in Appendix 1, Table A1.

Table 1. Summary of 10 shovel-ready abandoned mine sites profiled for the Act’s pilot program. The full site profiles are provided in Appendix 2.

Site Name	State	Land Ownership	Environmental Hazards	Opportunity Category	Environmental Concern	Original Ore Body	Human/Community Concern
Wrightson Mines	Arizona	USFS	Waste rock piles	Remediation	Tailings leaching	Cu, Pb, Ag, Zn	Recreationalist exposure to contaminated soil
Grand Reef Mine	Arizona	Private	Tailings piles	Remediation, Reprocessing	Tailings impacting downstream critical fish habitat	Au, Ag, Cu	Recreationalist exposure to contaminated soils and runoff water
Katherine Mine	Arizona	NPS	Tailings piles	Remediation, Reprocessing	Tailings eroding towards major lake	Au, Ag	Contaminated drinking water wells for nearby community
English Maid Mine	Colorado	USFS	Tailings piles	Remediation	Animal exposure to tailings	Au, Pb, Ag	Recreationalist exposure to contaminated soil
Hope Mine	Idaho	Private	Tailings piles	Remediation	Tailings eroding into river	Pb, Ag, Zn	Recreationalist exposure to contaminated soil
Congo Gulch Mine (Red Boy Mine)	Oregon	Private	Adit seep, Settling ponds	Remediation, Reprocessing (from water)	Acid mine drainage impacting downstream critical fish habitat	Au, Ag	Acid mine drainage impacting downstream watersheds
Opalite Mine	Oregon	Private	Ore processing area, Waste rock piles	Remediation, Reprocessing	Highly contaminated waste that has been used as fill	Hg	Highly contaminated waste that has been used as fill
Horse Heaven Mine	Oregon	Private	Tailings and waste rock piles	Remediation	Tailings impacting downstream water quality	Hg	Contaminated drinking water wells for nearby community
Alder Mill	Washington	Private	Tailings ponds	Remediation	Upper tailings pond impacting nearby river	Au, Cu	Contaminated drinking water wells for nearby town
Metaline Mine	Washington	Private	Tailings piles	Remediation	Tailings eroding into river	Zn, Cd, Ag	Tailings eroding towards town of Metaline

Discussion of Findings

Through our research and engagement with stakeholders, we identify three key considerations to implement the Act: 1) build a practical inventory of eligible sites; 2) align the Act with existing legislation; and 3) prepare proponents for implementation of the Act. These elements are discussed below to help proponents navigate the project planning cycle under the Act.

Build a Practical Inventory of Good Samaritan Sites

With over 500,000 abandoned mine features in the US, building an inventory of eligible sites is essential to support effective use of the Act. While we have begun this effort with our compiled candidate sites in the Western US, this work should be continued. The key considerations for creating an inventory of abandoned mines are: 1) site baseline information; 2) site status with an agency; and 3) site eligibility with co-existing legislation.

Site baseline information

There are four criteria to qualify an abandoned mine site as eligible under the Act. One of the criteria is sites closed before 1980 (pre-CERCLA). Most legacy sites pre-1980 are either not inventoried in databases, or little is known about them. As a result, it can be difficult to find sufficient information to determine if a site qualifies under the Act. Understanding the eligibility of a site, as well as site characteristics, often requires working closely with the appropriate state agency and regulator. Once it is determined if a site is eligible, reviewing the history, existing physical or environmental hazards, and current remedial status will help determine what hazards can be addressed under the Act and whether the site is part of a current or planned cleanup action. After this, information on land ownership (and possible mining claims) and mine operation history should be researched so a site can be verified as abandoned and without responsible parties. Additional information, such as the ore bodies mined and waste left behind, can help determine the remediation needs and reprocessing opportunities.

Site status with an agency

Broadly speaking, abandoned mine sites within an agency portfolio can be classified into three stages: 1) inventoried without status; 2) flagged for remediation (either no cleanup at all or in need of additional cleanup); and 3) remediated. The status of a site is important to determine if there is site data available and if the site is at a stage that will qualify under the Act. Only sites in Stages 1 and 2 can qualify. Stage 2 sites are most ideal because some characterization will have been completed by an agency, thereby expediting the investigative research and sampling phase.

Typically, it is not as easy to find Stage 2 sites that have not already been addressed, unless they have a lower priority hazard. The higher the priority of a hazard on a site, the more likely it has been addressed or is being addressed by state or federal agencies. Per the

Act, eligible sites cannot be part of current or planned cleanup with respect to existing legislation. In CERCLA terms, issuing a record of decision on a remedial action signifies the beginning of cleanup action, whereas an engineering evaluation/cost analysis or a remedial investigation means the remediation has not yet been implemented. However, an evaluation/cost analysis or remedial investigation signals that a remediation plan is being formed, and funding is likely secured to implement the cleanup action. From the CERCLA pipeline, it is not known yet whether an evaluation/cost analysis stage site could still qualify under the Act, but if it did, the opportunity window would likely be shorter than a site with only a preliminary assessment.

Site eligibility with co-existing legislation

Although the Act disqualifies existing CERCLA or National Priorities List (Superfund) sites, this does not completely preclude these sites. Once a CERCLA action is completed, a site could be eligible under the Act, such as through addressing residual contamination on the site that was not fully addressed by the CERCLA action or smaller parcels of land off the site that may not have been previously addressed by the action. In other words, Good Samaritan sites could supplement CERCLA actions.

EPA time-critical (TCRAs) and non-time-critical removal actions (NTCRAs) sites fall under CERCLA action and are ineligible per the Act. TCRAs are usually addressed within a shorter timeframe due to their urgent, higher priority hazards, and NTCRAs may take a longer timeframe to be fully addressed due to lower priority hazards. Our research found that some candidate sites have past removal actions that left the site in a status of still needing remediation and possibly with an opportunity for reprocessing. These sites may have a memo documenting the completion of the removal action, but they may still be listed in an agency database if they have additional hazards that need to be addressed by further cleanup. Such sites may be great opportunities under the Act as they have information from previous investigations that can support a faster start time for a project.

Align Good Samaritan with Existing Policy

Remediation for some abandoned mines currently falls under CERCLA and CWA. The Act will need to be integrated into this regulatory landscape. The Act applies in situations where agencies are having difficulty remediating sites without potential responsible parties or available funding. A large consideration for integrating the Act with existing policy is the

liability status of the mine, including the responsible parties and potential responsible parties. If there is a responsible party or potential responsible party, the site is not considered “abandoned,” and the holder will be financially responsible for the cleanup under CERCLA, and thus not eligible for a permit under the Act. CERCLA provides defenses for “innocent landowners,” “bona fide prospective purchasers,” and “contiguous property owners.” It is not clear whether landowners who qualify for these defenses would also be eligible for Good Samaritan status under the Act. CERCLA and the Act are two separate programs. However, there can be coordination by policymakers. As distinct parallel programs, many of the steps between the two processes remain the same, such as conducting a preliminary assessment and evaluating the feasibility of different remedial options.

Prepare Proponents for Implementation of the Good Samaritan Act

Proponents can prepare to implement the Act by considering how sites can be addressed, depending on the agencies involved, jurisdiction and ownership status, funding, hazards on site, permits required, and timeframe of the project.

Agencies Involved

The EPA will be the agency responsible for reviewing and approving permits for the Act. State and other federal agencies can work with Good Samaritans to submit these applications. Regulators and state agencies can also provide guidance on the additional permits required.

Jurisdiction and ownership status

Many abandoned mines lie under mixed landownership, such as private property with surrounding federal land (e.g., owned by the US Forest Service or US Bureau of Land Management). In these scenarios, an interested Good Samaritan would need to engage with various stakeholders to evaluate site eligibility and to create an agreement to carry out a project.

Mine claims

Under the General Mining Law of 1872, patented claims grant surface rights in addition to the underground mineral rights, and therefore landownership, whereas unpatented claims grant only mineral rights, meaning the claimant may differ from the surface landowner. A

Good Samaritan should conduct as much due diligence as possible into unpatented mining claims for candidate sites.

Funding

The Good Samaritan applicant must have adequate financial resources to carry out the project. The applicant themselves can provide the funding for the project, or they may apply for the permit but receive funding by additional Good Samaritans.

Hazards

The Act applies to tailings and waste rock, acid mine drainage, and mining equipment. Other hazards, such as adits, tunnels, and portals do not classify as “historic mine residue” under the Act, unless, for example, they may be discharging acid mine drainage. While these hazards can be addressed as part of the entire site remediation, a permit cannot be granted for these features alone.

Permits

The Act creates a pilot permitting program that is administered primarily by the EPA, in cooperation with federal land management agencies.¹⁰ The pilot authorizes a limited number of permits over a seven-year period, after which the program sunsets or gets reauthorized.¹¹ It also authorizes EPA to promulgate regulations necessary to carry out the permitting program, and directs the EPA to publish guidance if it does not promulgate regulations.

The Act creates two types of permits: (a) an Investigative Sampling Permit; and (b) a Good Samaritan Permit.¹² An Investigative Sampling Permit authorizes a Good Samaritan to conduct investigative sampling of historic mine residue, soil, sediment or water to determine baseline conditions and to determine whether the Good Samaritan is willing and able to perform further remediation.¹³ The EPA may only grant 15 investigative permits

¹⁰ Pub. L. 118-155 Sec. 4(a); Jason King, *Environmental Law: Good Samaritan Cleanups at Abandoned Mines*, 54 Colo. Law. 36, 40 (Apr. 2025).

¹¹ Pub. L. 118-155 Sec. 4(a)(3).

¹² *Id.* Sec. 2(9),(12).

¹³ *Id.* Sec. 4(d)(1)(A)&(B).

at a given time.¹⁴ An Investigative Sampling Permit may be converted into a Good Samaritan Permit if the applicant chooses to proceed within one year.¹⁵

A Good Samaritan Permit authorizes a Good Samaritan to remediate hardrock mine residue and to avoid liability associated with baseline conditions on the site.¹⁶ It also exempts permittees from permit requirements under the CWA or CERCLA.¹⁷ In specific circumstances, a Good Samaritan may reprocess materials recovered during remediation.¹⁸

Issuance or modification of a Good Samaritan Permit is defined as a “major federal action” that requires analysis under the National Environmental Policy Act (NEPA).¹⁹ A Good Samaritan permit may only be issued if, after conducting an environmental assessment, the lead agency issues a “finding of no significant impact” (FONSI).²⁰

Timeframe

The Act states that permits will be terminated after 18 months. Extensions can be granted for 180-day periods. Given the short time period of the permit, Good Samaritans could focus on sites that have had previous cleanup action, are well-characterized, and/or have previous work addressing hazards.

Agencies and Good Samaritan Projects

Many state and federal agencies (such as the US Forest Service, Bureau of Land Management, and National Park Service) have carried out abandoned mine cleanups. With the tens of thousands of abandoned mines across the western US, the inventorying and site characterization steps alone require funding and staffing across multiple agencies.

¹⁴ *Id.* Sec. 4(d)(2).

¹⁵ *Id.* Sec. 5.

¹⁶ *Id.* Sec. 4(n); Albert P. Barker and Bryce M. Brown, “Good Samaritan Act” Kickstarts Hardrock Mine Cleanups, 25 *Pratts Energy Law Report* 2.01 (Feb. 2025); Jason King, *Environmental Law: Good Samaritan Cleanups at Abandoned Mines*, 54 *Colo. Law.*, 36, 40 (Apr. 2025) (“Once a Good Samaritan Permit is issued, the permittee is shielded from CERCLA and CWA liability for the life of the project. . . . The Act also exempts permittees from obtaining NPDES and other environmental regulatory permits.”).

¹⁷ Pub. L. 118-155 Sec.4(n)(1).

¹⁸ *Id.* Sec. 4(n)(4)(B).

¹⁹ *Id.* Sec. 4(l)(2)(A).

²⁰ *Id.* Sec. 4(l)(2)(F).

Agencies currently address abandoned mine remediation through their own initiatives and funding, typically under contract agreements, particularly when the sites are causing contamination to watersheds. Through our engagement, we learned of various abandoned hardrock mine remediation success stories that demonstrate the positive outcomes that could be delivered through the Act. Two “success story” projects based in Arizona are highlighted below:

Pinto Creek Watershed, Arizona

Pinto Creek is a 33-mile intermittent stream that is both an ecologically and economically significant water source. The creek is fed by groundwater, snowmelt, and rainfall. The watershed provides key habitat for a variety of flora, fauna, and endangered species, such as the Mexican spotted owl, yellow billed cuckoo, and Arizona hedgehog cactus. Pinto Creek flows into Arizona’s largest lake, Roosevelt Lake, which stores drinking water for homes and businesses in the Phoenix Metro Area. Abandoned mine features and waste piles from mining were found to be contributing to elevated copper concentrations above water quality standards in Pinto Creek.

In 2001, the Arizona Department of Environmental Quality (ADEQ) began an investigation to identify sources of abandoned mine contamination into Pinto Creek. From 2006 to 2023 the ADEQ, the US Forest Service (USFS), and the Franciscan Friars of California (friars) remediated six abandoned hardrock mines in the Pinto Creek watershed. Remediation actions included excavating and removing mine waste and impacted soil, site contouring, water management, re-vegetating, and closing shafts and adits. This 17-year project cost \$2,772,866 and, as of May 2023, surface water samples in the central part of Pinto Creek were meeting water quality standards for dissolved copper.

Of the six mines remediated, funding for five of them (\$1,405,866) came from federal sources appropriated by Congress to the US Department of Agriculture Environmental Management Division and the USFS. Remediation of the other mine was funded by ADEQ through the CWA Section 319 funds awarded by the EPA. These funds require a 40% non-federal match; ADEQ sourced the extra funding from community scientist volunteer hours and state funding on other nonpoint source-related improvement projects.

Cherry Creek, Arizona

Cherry Creek Mines consists of six abandoned gold-silver mines located in the Prescott National Forest in the Cherry Mining District of Yavapai County, Arizona. The six mines (Uncle Sam, Logan, Bunker, Golden Idol, Black Hawk, and Gold Eagle) were left with various abandoned mine features including adits, shafts, and waste rock piles. The Golden Idol site was the location for a mill and cyanide leach plant. Under requirements of CERCLA, the USFS conducted a site investigation of the six mines in 2015, and an EE/CA in 2016. All six mines had arsenic and/or lead concentrations in exceedance of human health and environmental standards and four had hazardous open mine features. In particular, heavy metals were being discharged into the tributaries of Cherry Creek and the Verde River.

The USFS excavated and consolidated contaminated material from the Bunker, Golden Idol, Golden Eagle, Uncle Sam, and Logan mines. Additional stability support was added with erosion control mats and seeding in disturbed areas. Through this project, two acres of directly impacted stream channel were improved. The total cost was \$881,422.42, and the site will have annual erosion control monitoring.

What's Next: 7 Steps to Scaling Remediation of Abandoned Mine Sites

This policy analysis identifies targeted reforms that can amplify the Act's impact. In future reports we will expand on these policy recommendations. There will be many learnings through the pilot program that can help inform future policy. Our intention is to initiate a constructive exploration of these actions now, in the interest of sustaining momentum as we learn from implementation of the Act.

Through our research we have identified several issues that, if addressed, may incentivize a greater level of remediation, both during the pilot program period and into the next phase of the Act's implementation. Our recommendations are as follows:

1. Empower state-led remediation through dedicated state-level funds

Under the Act a "Good Samaritan Mine Remediation Fund... [is] to be administered by the Administrator or the applicable Federal land management agency." The fund is managed at the federal level, but not solely by the EPA. The Act creates a fund for each federal land management agency that authorizes a Good Samaritan project, as well as the EPA. The existing fund is capitalized through congressional appropriations and reprocessing proceeds. It can be topped up with donations and

any funds collected from permittees' financial assurance instruments (like bonds, or insurance). The current Fund model does not incentivize ongoing state-based abandoned mine remediation.

Future policy should explore a way to allow the proceeds from mine waste reprocessing to accrue to a state level fund (instead of a federal fund) for the purpose of ongoing abandoned mine remediation at a state level. State level funds will allow a pool of capital to be increasingly available to pursue state-based remediation of abandoned mine sites. It will incentivize remediation activities at scale, beyond the Good Samaritan pilot program. For example, private donations from people or companies seeking to clean up the reputation of the mining industry could designate funds at a state level. Congressional appropriations could also be in part delegated to state-based funds, depending on the level of activity and risk in the state.

2. Create a federal insurance pool to broaden participation by mitigating financial risk for smaller entities

The Fund does not currently cover costs arising from Good Samaritan permittees' negligence or failure to comply with permit terms. Financial assurance requirements currently limit participation to entities with sufficient balance sheets or third-party insurance, excluding smaller organizations (which includes many non-profits). Providing insurance to smaller operators could incentivize a greater rate of participation among environmentally-oriented organizations that have the capacity, but not the risk appetite to engage.

To address this gap while ensuring fiscal responsibility we recommend a policy that aims to balance risk-sharing and inclusivity. For example, a federal insurance pool funded by a combination of congressional appropriations and fees from mining permits.

3. Introduce multi-site permitting to efficiently address interconnected clusters of abandoned mines

The EPA is considering addressing multiple smaller features under one permit. This is a good idea. Currently, under the Act, the pilot program does include addressing

multiple mine impacts and does not allow for adjacent lands to be remediated under one site permit. Impacts from mining tend to extend beyond immediate site boundaries, especially in water.

The core purpose of the Act could be retained and aligned with the broader aim of meaningful remediation through our suggested reform for multi-site permitting. Allowing expansion of the area under remediation beyond the boundaries of a single abandoned mine site could be done with a focus/inclusion of other proximal mine impacted areas, ensuring that a particular water catchment is included as part of the focus area for remediation, and/or by allowing integrated permits for projects addressing multiple abandoned mine features (e.g., adjacent waste piles, adits, and tailings) under a single remediation plan.

4. *Ensure critical minerals are prioritized for reprocessing*

The Act's pilot program does not explicitly prioritize abandoned mines with critical mineral potential, despite the US importing over 50% of its critical minerals. Many legacy sites contain untapped reserves due to outdated extraction methods or past market conditions. Without strategic targeting, reprocessing efforts may focus on low-value materials, limiting both cleanup funding and mineral supply benefits.

The pilot program, and future programs, should include critical minerals as a formal criterion in evaluating and selecting sites. Applications should be encouraged that propose to remediate sites where critical minerals can be recovered safely and in accordance with environmental standards.

5. *Incentivize voluntary participation of mining companies in projects*

The Act allows for mining companies to participate in Good Samaritan partnerships. Voluntary participation should continue to be encouraged because mining companies have expertise, equipment, and resources that will ensure the success of pilots. In the future, these partnerships will help scale abandoned mine remediation efforts.

To incentivize voluntary participation, the EPA and other federal agencies can continue to organize and support workshops and technical exchanges, industry

trade associations can work to connect companies to proponents of pilot projects, and projects can be facilitated with in-state consortiums to identify and plan Good Samaritan pilot projects.

6. Support technology innovators in water treatment, and tailings and waste rock reprocessing

The Act is silent on the role that technology innovators in water treatment, tailings and waste rock reprocessing, and metals extraction can play to help target abandoned mines. Federal agencies have an opportunity to support these efforts and, in the process, de-risk the Good Samaritan program.

The EPA should encourage technology companies to participate in Good Samaritan projects. The US Government can support the cost associated with metals characterization at Good Samaritan projects through financial incentives. In tandem, where Good Samaritan projects are approved, the EPA can assess the metals characterization data and make material available to technology innovators seeking to advance technologies out of the lab.

7. Encourage government exchanges to promote policy innovation, within the US and outside, with US allies

The Act is focused, appropriately, on US abandoned mines. However, the Act creates an opportunity for the US to encourage allies to also address their abandoned mines and create new sources of critical minerals.

Regeneration is working with governments in British Columbia, Canada, and in Queensland and Western Australia on similar efforts to address orphaned sites; government exchanges can support these efforts. The US State Department should be encouraged to organize efforts through the diplomatic corps — we recommend the agency bolster its natural resource expertise.

Conclusion

The enactment of the Good Samaritan Remediation of Abandoned Hardrock Mines Act of 2024 marks a shift in how the US can address abandoned mines. By providing liability protections and permitting reprocessing of historical mine waste, the Act addresses longstanding legal and procedural barriers that have historically discouraged voluntary remediation efforts.

This report supports this path forward by providing both a practical toolkit for identifying and evaluating eligible sites, and a broader policy analysis for scaling remediation efforts, including reprocessing. The 10 sites we profiled as shovel-ready, and our broader inventory of 95 candidate sites, offer a starting point for the pilot program and an invitation for others to join in this national endeavor.

The Act establishes a promising framework to remediate orphaned mine sites at scale, while also contributing to domestic critical mineral supply chains. Effective implementation will require alignment and refinement of regulatory processes, empowering local and state actors, and support for innovation in remediation and mineral recovery technologies.

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Appendices

Appendix 1: Inventory of Eligible Good Samaritan Sites

Table A1. Sites in western US that may be eligible under the Act.

Site Name	State	Hazards	Remedial Status
Exposed Reef Mine	Arizona	Adit with discharge, Open shaft, Tailings and Waste rock piles	Current Site Investigation by Arizona DEQ
Sheldon Mine	Arizona	Waste rock pile, Nearby impaired creek	Current Site Investigation by Arizona DEQ
European Mine	Arizona	Adits, Open shaft, Waste rock piles	Current Site Investigation by Arizona DEQ
Climax Mine	Arizona	Adit with discharge, Open shaft, Tailings Piles, Foundations of former structures	In need of Site Investigation
Black Pearl Mine	Arizona	Adit with discharge, Open shaft, Tailings Piles, Foundations of former structures	In need of Site Investigation
Issaquah Mine	Arizona	Seep below mine	In need of Site Investigation
Arizona Victory Copper	Arizona	Tailings Piles	In need of Site Investigation
Sunnyside Mine	Arizona	Dry adit, Open shaft, Waste rock piles	In need of Site Investigation
Binghampton and Copper Queen Mine	Arizona	Tailings and Waste rock piles, Smelter ruins	Pre-CERCLA Screening completed by Arizona DEQ
Hidden Treasure and Golden Fleece	Arizona	Shafts, Tailings and Waste rock piles	Pre-CERCLA Screening completed by Arizona DEQ
Homestead Patented	Arizona	Shafts, Tailings and Waste rock piles	Pre-CERCLA Screening completed by Arizona DEQ
Radcliff Group Mine	Arizona	Shafts, Tailings and Waste rock piles	Pre-CERCLA Screening completed by Arizona DEQ
Ruby Mine	Arizona	Tailings and Waste rock piles	PA/SI completed by Arizona DEQ in 2022
Buckskin-Pruitt Mine	Nevada	Old milling equipment, tailings ponds	PA/SI for Buckskin Mine completed by BLM in 2019
Yellow Pine Mine	Nevada	Dry mill tailings	In need of Site Investigation
Nivloc Mine	Nevada	Eroded tailings, Mill foundations	In need of Site Investigation
Sixteen-to-One (Sunshine Mine)	Nevada	Possible contaminated spring	In need of Site Investigation
Tybo Silver District	Nevada	Tailings, Sulfide deposit that could possibly create acid mine drainage	In need of Site Investigation

Uncle Sam claims	Nevada	Waste rock leaching into Hot Creek	In need of Site Investigation
Mercury Mountain Mines	Nevada	Unknown	In need of Site Investigation
Nevada Scheelite	Nevada	Tailings that continue for miles, Mill foundations	PA/SI completed by NDEP in 2023
Ramsey Comstock Mine	Nevada	Tailings piles	In need of Site Investigation
Antelope Springs Mining District mercury mines (Pershing Quicksilver)	Nevada	Heap leach pad, Underground contamination	In need of Site Investigation
Dean Morning-Star Mine	Nevada	Mill tailings in drainage	PA/SI for Dean Mine & Mill completed by NDEP in 2017
Adelaide Crown Mine Group	Nevada	Tailings piles (impoundment and wall), Mill foundation	PA/SI completed by BLM in 2021
Pansy Lee Mine	Nevada	Mill tailings dumped in drainage for miles	In need of Site Investigation
Ten Mile Mine	Nevada	Waste rock dumps, possible tailings	In need of Site Investigation
Silver Butte Mine	Nevada	Mill tailings in drainage	In need of Site Investigation
Spring City Mines	Nevada	Mill tailings in drainage	In need of Site Investigation
Solid Silver Mine	Nevada	Mill tailings in drainage	In need of Site Investigation
Jumbo Mine	Nevada	Tailings, Tailings heap leach pad, Waste rock dump	In need of Site Investigation
Rocky Gulch Hwy 225 Mine	Nevada	Tailings by river	In need of Site Investigation
Minnesota Mine	Nevada	Processed tailings	PA/SI completed by BLM in 2022
Atlas Mine	Colorado	Open moderate/heavy flow adit discharge into nearby creek, Steep eroded waste piles, Miscellaneous Debris	Pre-CERCLA Screening completed by USFS in 2018
Greyhound Mine	Colorado	Localized waste pile, High flowing adit that discharges over waste pile and wetlands, soaks into ground	Pre-CERCLA Screening completed by USFS in 2018
Larson Bros Mine	Colorado	Waste rock pile, Moderate flow adit discharge that creates standing water pond on waste pile and flows into forest	Pre-CERCLA Screening completed by USFS in 2018
Lower McIntyre Mine	Colorado	Steep waste rock pile adjacent to gulch (no erosion), Moderate flow adit with discharge in constructed rock channel	Pre-CERCLA Screening completed by USFS in 2018

Garibaldi Mine	Colorado	Steep eroded waste rock piles, Tailings in ponded areas, Collapsed portal with significant discharge draining over waste pile into wetland	Pre-CERCLA Screening completed by USFS in 2018
Black Hawk Mine	Colorado	Steep eroded waste rock piles, Eroded tailings, Significant flow adit with discharge over dirt road, downstream piles and into waterbody	Pre-CERCLA Screening completed by USFS in 2018
Shoemaker Nunn Mine/Mill	Colorado	Mine/waste pile along active dirt road, Pond and draining seeps flowing from top of waste to waterbody at base	Pre-CERCLA Screening completed by USFS in 2021
Burke Mine/Mill	Colorado	Washed out tailings with several seeps at base, Mill foundations	Pre-CERCLA Screening completed by USFS in 2018
GTS Mine	Colorado	Eroded waste rock piles, Moderate flow adit discharge over waste pile into wetland, Miscellaneous debris	Pre-CERCLA Screening completed by USFS in 2023
San Pedro Mine	Colorado	Large sloped waste rock pile eroding onto jeep road, Moderate flow adit draining into pile, Seep at base of pile flowing into wetland	Pre-CERCLA Screening completed by USFS in 2023
Zanett Mine	Colorado	Steep, heavily eroding waste rock pile, Lower waste rock pile, Portal with low flow rate drainage	Pre-CERCLA Screening completed by USFS in 2023
Victor Mine	Colorado	Steep waste pile with loose soil slumping into surrounding habitat, High flow adit discharge and waste pile runoff draining into river	Pre-CERCLA Screening completed by USFS in 2020 and PA/SI in progress
Snowflake Mine	Colorado	Steep eroded small waste rock piles, Seep (trickle) through waste piles and discharging into wetland, Pond at base of pile	Pre-CERCLA Screening completed by USFS in 2023, PA/SI in progress
Finn Boy #2 Mine/Mill	Colorado	Waste rock pile/Tailings eroding onto road and cliff, Small seep from base of pile flowing down road	Pre-CERCLA Screening completed by USFS in 2023, PA/SI in progress

Tomboy Mine	Colorado	Tailings piles, Mill foundations	Pre-CERCLA Screening completed by USFS in 2022, PA/SI in progress
Tronox Unknown O6 Mine	Colorado	Dry collapsed adits, Waste rock piles, Seep from base of waste pile	PA/SI completed by USFS
Hawkeye Mine	Colorado	Dry adit, Waste rock dump with runoff into perennial stream, Debris piles	Assessment Summary Reports Complete in 2005 but no EE/CA
Silver Mountain Mine	Colorado	Partially collapsed adit, Waste rock dump, Cabins, Collapsed mill, Miscellaneous debris	Assessment Summary Reports Complete in 2005 but no EE/CA
Topeka Mine	Colorado	Waste rock dump, Partially collapsed adit discharge channeled through upper dump and diverted along lower dump	Assessment Summary Reports Complete in 2005 but no EE/CA
Vernon Mine	Colorado	Waste rock pile, Adit discharge that infiltrates waste pile and flows into creek	Assessment Summary Reports Complete in 2012 but no EE/CA
Pass-Me-By Mine	Colorado	Tailings piles, possibly more features	In need of Site Investigation
Gold Creek Area Mines	Idaho	Covered mine waste repository, 16 waste dumps, 9 adits with flowing water, 2 tailing sites, Multiple ore piles (Shoshone Mill), Open pits and trenches	PA/SI completed by Idaho DEQ in 2019
West Fork Mine	Idaho	Waste rock dumps, Open and collapsed adits and shafts (no discharge), pits, large trench	PA/SI completed by Idaho DEQ in 2021
Solid Muldoon Mine	Idaho	Waste rock dumps, Open and collapsed adits, Mill foundations	PA/SI completed by Idaho DEQ in 2013
Bassett Gulch Mill	Idaho	Waste rock, Tailings, Tailings ponds, Mill foundations	PA/SI completed by Idaho DEQ in 2000
Silver King Mine	Idaho	Caved tunnel, Waste rock piles	PA/SI completed by Idaho DEQ in 2015. In Voluntary Cleanup Program but no remediation
Hoodoo Mine	Idaho	Tailings eroding into river	PA/SI completed by USFS in 2011

Gilmore Townsite	Idaho	Collapsed features, Open adits, Waste dumps, Buildings	EPA Removal Action completed, Survey of landowners in area completed in 2023
Nicholia Smelter	Idaho	Slag and waste on dirt road and creek	In need of Site Investigation
Cinnabar Mine	Idaho	Covered tailings and armored channel but some tailings still entering river	Awaiting action from EPA on NPL decision but up for Good Sam eligibility if not placed on NPL
Copper Belle Mine 1	Washington	Open wet adit, Open dry adit, Open dry prospect, Waste rock piles, Debris piles, Waterwheel structure	Initial Investigation completed by Washington Dpt of Ecology in 2007
Copper Belle Mine 2	Washington	Open wet adit, Open dry adit, Open dry prospect, Waste rock piles, Debris piles, Waterwheel structure	Initial Investigation completed by Washington Dpt of Ecology in 2007
Bella May Upper Mine	Washington	Closed and open dry adits, Adit with puddles, Closed and open dry shafts, Waste rock piles, Blocked dry prospects	Initial Investigation completed by Washington Dpt of Ecology in 2007
Blue Bucket Mine	Washington	Closed shafts, Partially blocked shaft, Closed dry shafts, Blocked dry prospects, Dry trench	Initial Investigation completed by Washington Dpt of Ecology in 2007
Blue Bucket Mill	Washington	Possible mining-related pond, Buildings remains	Initial Investigation completed by Washington Dpt of Ecology in 2007
Rainy Mine	Washington	Open adit, Partially closed adit, Small exploration cuts and pits, Waste rock piles, Structure remnants	NTCRA completed in 2009. Further cleanup could be addressed by Good Sam
Mammoth Mine	Washington	Trench, Waste rock pile, Groundwater wells for monitoring	Initial Investigation completed by Washington Dpt of Ecology in 2006
Allis Mine	Washington	Waste rock pile, Boulder pile	Initial Investigation completed by Washington Dpt of Ecology in 2006
Washington Mine	Washington	Large open flooded adit, Apparent prospect test pit, Ferricrete deposits, Seasonally wet area	Initial Investigation completed by Washington Dpt of Ecology in 2006
Robert E Lee Mine	Washington	Collapsed adit, Waste rock pile	Initial Investigation completed by Washington Dpt of Ecology in 2006

Flusey Hoopala Mine	Washington	Open dry adit, Dry prospect piles, Waste rock piles, Debris pile	Initial Investigation completed by Washington Dpt of Ecology in 2007
Antimony Queen Mine	Washington	Collapsed and open adits, Steeply sloped waste rock piles that slid into nearby creek	Site Hazard Assessment completed by Washington Dpt of Ecology in 2010
Comstock Mine	Washington	Adits, Shaft, Ponds, Pit, Waste rock piles, Buildings	Initial Investigation completed by Washington Dpt of Ecology in 2006
Shoemaker Mine	Washington	Dry adits, Waste rock piles, Dry prospect, Buildings, Debris piles	Initial Investigation completed by Washington Dpt of Ecology in 2006
Brook Mine	Washington	Shaft with water, Fine grain tailings pile	Site Hazard Assessment completed by Washington Dpt of Ecology in 2008
Lead Trust Mine	Washington	Adits, Open pit (glory hole), Waste rock piles	Initial Investigation completed by Washington Dpt of Ecology in 2006
Republic Mine	Washington	Collapsed and open dry adits, Stagnant ponds, Waste rock piles	Initial Investigation completed by Washington Dpt of Ecology in 2006
Nancy Creek Mine	Washington	Open dry adit, Waste rock pile	Initial Investigation completed by Washington Dpt of Ecology in 2007
Red Mountain Mine	Washington	Open historic 11,000 ft. tunnel adit with discharge, Caved adit, Open newer adit with discharge, Waste rock piles, Mill foundations	Inactive and Abandoned Mine Lands Report by Washington Dpt of Natural Resources
Bonanza Upper Mine	Washington	Shafts, Waste rock piles	Site Hazard Assessment completed by Washington Dpt of Ecology in 2007
Deep Creek Mine	Washington	Open adit with water, Collapsed adit, Dry shaft, Pond connected to adit, Wetland seeping into ground, Prospect test pits, Waste rock piles, Debris piles, Collapsed buildings	Initial Investigation completed by Washington Dpt of Ecology in 2006
Golden Zone Mine	Washington	Adits with water, Dry adits, Waste rock piles	Site Hazard Assessment completed by Washington Dpt of Ecology in 2012
Sullivan Mine	Washington	Adits, Shaft, Drum, Waste rock piles	Initial Investigation completed by Washington Dpt of Ecology in 2006

Advance Mine	Washington	Collapsed adit, Seeps, Waste rock piles	Initial Investigation completed by Washington Dpt of Ecology in 2006
Lead King Mine	Washington	Closed adit, Shaft with water, Dry prospect, Waste rock piles	Initial Investigation completed by Washington Dpt of Ecology in 2007
Pilot Hill Mine	Washington	Collapsed adit, Open shaft, Waste rock piles	Site Hazard Assessment completed by Washington Dpt of Ecology in 2012
Alder Mine	Washington	Acid mine drainage	Washington Dpt of Natural Resources has reports, Dpt of Ecology plans to sample
Princess Maude Mine	Washington	Small, dry open pits, Waste rock piles	Initial Investigation completed by Washington Dpt of Ecology in 2006
Red Shirt Mill	Washington	Tailings still present even after interim cleanup action	Interim remedial action by the Washington Dpt of Ecology in 2003

Appendix 2: Site Profiles

Alder Mill, Washington

Overview

The Alder Mill site is an abandoned flotation mill that operated from 1949-1952 and concentrated ore from various gold (Au) and copper (Cu) mines. The site is on private property in Okanogan County, approximately 0.4 miles from the Town of Twisp, Washington, and adjacent to the Methow River (Figure 1). Historically, there were two unlined tailings ponds. The lower tailings pond was excavated and remediated in 2004. The upper pond remains on site, covering an area of 10 acres, and poses an ongoing concern for contamination to the surrounding environment and water sources. The tailings contain potentially economically recoverable Cu, zinc (Zn), and nickel (Ni). Alder Mill is a Good Samaritan candidate site due to the potential for metal recovery from waste and the need for restoration to reduce heavy metal contamination to the Methow River and nearby domestic drinking water wells.



Figure 1a, 1b: Google Earth Aerial Image of Alder Mill. 1a is zoomed into the site and 1b is zoomed out. Retrieved January 14, 2025.

Mine History

The Alder Mill was constructed to process ore for various mines in the area, including Cu from the Alder Mine. From 1949-1952, ore was crushed in the mill and processed using flotation techniques. The tailings were disposed into two unlined ponds, the upper and lower (Washington Department of Ecology, 2002). The lower tailings pond (mill pond) was adjacent to the mill buildings. The upper tailings pond is situated in the bed of an intermittent stream, and is approximately 650 ft long, 150 ft wide, and an average of 12 ft deep. Reports suggest that the tailings were deposited to the lower pond and then pumped uphill to the upper pond. Estimates from 1995 indicated the upper tailings contained approximately 43,200 yd³ of material, with significant concentrations of cyanide, As, Cu, Ni, Pb, and Zn. Samples collected at depths of approximately 6.5 ft in the tailings indicated an average (n=4) Cu concentration of 1000 ppm (Peplow and Edmonds, 1998).

Environmental Investigations and Current Conditions

Historically, groundwater contamination from the tailings has been a concern both in the vicinity of the site and for nearby private residential groundwater wells. Runoff events from heavy rainfall have also resulted in the release of heavy metals from the tailings to the nearby Methow River and contamination of drinking water wells (Environmental Protection Agency (EPA), 2004).

Between 2002 and 2004, the EPA and Alder Gold & Copper Company partially remediated the site. The mill buildings were removed and material in the lower tailings (mill pond), along with contaminated soil, was excavated and transported to a landfill (EPA, 2004). The pond was covered with soil and re-vegetated. The upper tailings pond was not remediated and remains on site. Records from the State of Washington Department of Ecology indicate the upper pond still presents a concern for heavy metal contamination to the surrounding environment and water sources, including the Methow River. The population of the nearby town, Twisp was 992 in 2020, and numerous residents in the area have private drinking water wells that have been contaminated by heavy metals from the Alder Mill site. The Methow River watershed hosts a unique, diverse ecosystem. The state has ongoing efforts to protect the watershed and species that rely on it such as, mule deer and steelhead and salmon that have been listed as threatened and endangered in the watershed.

Site Opportunity

Alder Mill is an ideal pilot site under the Good Samaritan program as there is a relatively high need for restoration, and a possible pathway to achieve this through reprocessing the tailings. Under the Act, restoration of the upper tailings pond and surrounding environment could be supported by reprocessing the waste, potentially recovering Cu and other

minerals and metals. The Washington Department of Ecology has been working with the private owners of this property; with a Good Samaritan, it may be possible to achieve closure for the site (Rice, 2024). Restoring the upper tailings pond would allow the Alder Mill site to be fully remediated and closed. Restoration would help to protect the Methow River watershed, the species that relies on it, and reduce health risks from groundwater contamination from the upper tailings.

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Congo Gulch Mine, Oregon

Overview

Congo Gulch (or Red Boy) Mine is a former gold (Au) and silver (Ag) mine located on private property in the Granite Creek Mining District near Granite, Oregon and the Umatilla National Forest (UNF) North Fork Day Ranger District. The site consists of an abandoned mill and cyanide plant, two waste rock piles, a main adit seep collection system and seven settling ponds. Congo Gulch Mine is accessed from US Forest Service Primary Road (FR) 10 west. Congo Gulch Mine is a Good Samaritan pilot site candidate as the acid mine drainage (AMD) risks flowing into downstream watersheds necessitate restoration work.

Mine History

Gold was discovered near Congo Gulch Mine in 1886. Development for the mine began around 1890 by E.J. Tabor and J.H. Robbins, who later formed the Congo Gulch Consolidated Gold Mines Company (Department of Geology and Mineral Industries (DOGAMI), 1939; San Francisco Call, 1903). Between 1890-1898, the mine produced 13,600 tons of ore, then from 1898-1901, production increased to 70,000 tons (Swartley, 1914). After a halt in 1903, production continued at a decreased capacity from 1904-1912. Oregon Bureau of Mines and Geology reported very little ore remained in 1917, and Congo Gulch Mine was completely shut down in the 1920s (National Park Service, 1983). Small-scale milling operations were reported briefly in 1940 but ceased during World War II. While no information on the mine operations could be found between 1946-1991, separate dredging activities for gold mining were conducted near Clear, Granite and Bull Run Creeks from 1938-1950 (DOGAMI, 1953). In 1992, Congo Gulch Mine was purchased by a private owner as an active, patented mining claim. The current owners operate a small-scale ore processing facility from surface mining conducted upslope of the mill area on Congo Gulch Hill (Cascade Earth Services (CES), 2013).

Environmental Investigations and Current Conditions

Congo Gulch Mine is located northwest of the confluence of Congo Gulch and Clear Creek. Congo Gulch flows into Clear Creek, which discharges into Granite Creek approximately two miles downstream of the site. Granite Creek discharges into North Fork John Day River approximately nine miles downstream of the site. Clear Creek supports two threatened fish species (Middle Columbia River steelhead and bull trout) and six other native fish species including the Chinook salmon, summer steelhead and westslope cutthroat trout. The downstream North Fork John Day River also supports seasonal habitats for some of these species.

Numerous environmental concerns have been identified at this site, the largest being the heavily contaminated adit seep and settling ponds that could directly flow into Clear Creek via Congo Gulch when the pipeline system gets compromised (Figure 1). Seep from the main adit flows year-round into the pipeline and settling pond that discharges into the upper end of the adjacent Bluebird Mine wetland treatment pond. Although replaced in 2013, the pipeline system is known to plug on a yearly basis, which causes the adit seep to discharge over a waste rock pile into Congo Gulch. The Oregon Department of Environmental Quality (ODEQ) is planning to partner with USFS to repair a culvert to contain seepage at the bottom of the settling ponds in the fall of 2024 (Thoms, 2024).

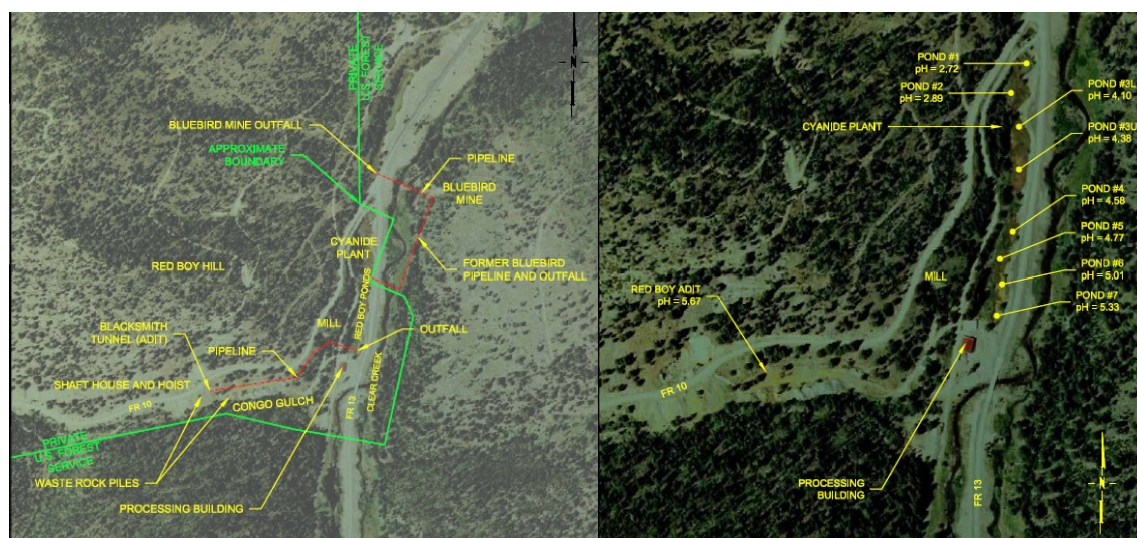


Figure 1: Congo Gulch Mine Site Features and Pond System (CES, 2013).

The pipeline system for Congo Gulch Mine is periodically maintained to mitigate downstream impact into Congo Gulch and Clear Creek; however, the adit seep and settling ponds still remain environmental hazards (Figure 2a, 2b). In 2012, an Expanded Preliminary Assessment/Engineering Evaluation (PA/EE) conducted for the North Fork John Day Watershed Council (NFJDWC), surface water samples from the adit showed arsenic (As), aluminum (Al), cadmium (Cd), copper (Cu), iron (Fe), manganese (Mn), nickel (Ni), and zinc (Zn) concentrations in exceedance of the Oregon and Environmental Protection Agency (EPA) human health comparison criteria. The Congo Gulch Mine ponds contained As, Cd, cobalt (Co), Cu, Mn, Ni, thallium (Th), and Zn elevated above background and state and federal comparison criteria. The seven ponds also displayed acidic conditions indicated by low pH. The pH decreased from the first pond (Pond #7) to the last pond (Pond #1). From 2013 to 2015, a bench- and pilot-scale passive treatment system with organic matter and limestone was used to treat the Congo Gulch Mine water prior to discharge to the Bluebird Mine wetland. However, this system did not address the

acidity or metal concentrations discharging to the wetland and water contamination is an ongoing concern.



Figure 2: Photographs of part of the lowest settling pond (left) and of the Blacksmith tunnel adit (right) (CES, 2013).

In addition to water contamination, another environmental concern at Congo Gulch Mine is the large volume of tailings and waste rock piles in the stream channel at Congo Gulch. Waste Rock Pile #1 is approximately 15,000 yd³ and covers 0.9 acres north of the adit, extending downslope to the Congo Gulch. Waste Rock Pile #2 is approximately 20,000 yd³ and covers 11 acres southeast of the adit (Figure 3); this waste pile has partially eroded into Congo Gulch. Two smaller tailings piles are near the mill and cyanide plant.



Figure 3: Photograph of overflow from adit across Waste Rock Pile #2 (CES, 2013).

The 2012 PA/EE discovered both waste rock piles had As concentrations in exceedance of the Oregon risk-based concentrations (RBCs), EPA Regional Screening Levels (RSLs) for Industrial Soils, and EPA Ecological Screening Levels (plants). Elevated concentrations of Cr (603 mg/kg), Mn (2,570 mg/kg), Ni (665 mg/kg), vanadium (58.3 mg/kg) and Zn (203 mg/kg) were also detected exceeding ODEQ Background Soil Concentrations for

Clear Creek Basin. The tailings had ~470 mg/kg total As, also exceeding the Oregon and EPA standards.

Site Opportunity

The heavily contaminated acidic water at Congo Gulch Mine remains an environmental threat. Sampling on-site or downstream of the site has not occurred since the pipeline replacement in 2013. While pilot-scale passive treatment of the acid mine drainage was conducted in 2014, this method failed to remove most of the metals of concern (CES, 2015). The tailings and waste rock piles need to be remediated to fully close the site. These waste rock and tailings piles may not have high enough metal concentration for reprocessing, but the metals dissolved in the adit seep and settling ponds could be recovered with water treatment technologies. The pond sediment may also contain a source of additional metals. Allowing for additional pilot-scale metal removal and recovery could provide ground for field testing any innovative treatment technologies that would aid in mine reclamation.

Cleaning up Congo Gulch Mine is of interest to many organizations including ODEQ, EPA, USFS, and water treatment technology vendors. Trout Unlimited (TU), a watershed restoration NGO, is a possible Good Samaritan also interested in this site due to downstream Clear Creek and North Fork John Day River being valuable trout habitat. The NFJDWC has been involved in Congo Gulch Mine in the past organizing cleanup work and may also be interested in funding some remediation work as a Good Samaritan. The main barrier to cleanup actions for this site is funding. Currently, ODEQ, USFS and TU have been identified as possible funding sources, but a complete remediation of the site may be unlikely from just one of these sources. Alternatively, due to the scale of this site, Congo Gulch Mine could be addressed by dividing the cleanup effort into smaller projects. For example, the Good Samaritan pilot project could involve addressing the adit seep and settling ponds, while successive Good Samaritan projects could involve stabilizing/capping the waste rock piles. While it may be a complex site, Congo Gulch Mine provides a great opportunity to treat a heavily contaminated “wet” site through the Good Samaritan pilot program.

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English Maid Mine, Colorado

Overview

English Maid Mine is an abandoned gold (Au), lead (Pb) and silver (Ag) mine located in US Forest Service (USFS) land (Uncompahgre National Forest (UNF)) in Ouray County, Colorado. The site is relatively remote and is accessed from Ouray, Colorado by traveling Colorado Highway 550 southbound to Ironton and onto Corkscrew Gulch Road. The environmental hazards at English Maid Mine consist of a gated draining adit and a ~1,357 yd³ waste rock pile (Figure 1). This site is a Good Samaritan candidate because the leachate from the adit and the waste rock pile needs to be remediated to prevent possible impacts to downstream surface water.



Figure 1: Site Features and Sampling Locations at English Maid Mine (Applied Intellect (AI), 2020).

Mine History

English Maid Mine is situated on the northwest side of the San Juan caldera, where Miocene-aged volcanic flows were deposited unconformably against the steep slopes of the caldera wall (USGS 1973). The deposits in the vicinity of the mine consist of Quaternary-aged talus underlain by Tertiary rocks of Henson Formation. Numerous vertical faults also occur in the vicinity. No reports on operational history, ore production, or historical mine ownership could be located from the US Geological Survey (USGS) Mineral Resource Data System, USFS and Colorado Geological Survey (CGS) AML Inventory, or other public databases.

Environmental Investigations and Current Conditions

English Maid Mine is located adjacent to an unnamed ephemeral drainage that trends westward into Corkscrew Gulch, which flows into Red Mountain Creek approximately 2.5 miles west of the site. A 2020 Preliminary Assessment and Site Inspection (PA/SI) by the USFS found the ephemeral drainage to be dry but identified this as a probable point of entry (PPE) to downstream Corkscrew Gulch (Figure 1). The draining adit on-site did not have measurable flow and therefore was not observed to be flowing into Corkscrew Gulch; however, a small pool of water was formed when the adit floor was dug up. This water was recorded as acidic (pH of 2.75) and its total metal concentrations exceeded both US Environmental Protection Agency (EPA) tapwater screening levels (SLs) for the following metals: aluminum (Al), antimony (Sb), arsenic (As), cadmium (Cd), cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn). These metals exceeded tapwater SL by exceedance factors (EF) as low as 2.6 (Zn) to as high as 620 for As. The total metal concentrations with these exceedances were 32.1 ug/l As, 82.8 ug/l Cd, 128 ug/l Pb, 176 ug/l Co, 2.16 mg/l Cu, 15.5 mg/l Zn, 24.8 mg/l Mn, 58.5 mg/l Al, and 183 mg/l Fe. While not observed during the PA/SI, this adit leachate has been hypothesized to seasonally flow into the PPE drainage during spring periods of snow melt. Additionally, sediment collected at the same adit water sampling location was seen to exceed National Park Service (NPS) Screening Level Ecological Risk Assessment (SLERA) Ecological Screening Values (ESVs) for As, Cu, Fe, Pb, Mn, selenium (Se) and Zn.

The other environmental hazard of concern at English Maid Mine is the waste rock pile located directly west of the adit on-site. Soil samples from the waste rock pile were measured to exceed EPA Recreational and Industrial SLs for As and Pb. The same soil samples exceeded either or both EPA Birds and Mammals and Plants and Invertebrates Soil SLs for Sb, As, Cd, Cu, Pb, Mn, Se, and Zn. A summary of these notable concentrations are 15.2 mg/kg Sb, 87.5 mg/kg As, 2.18 mg/kg Cd, 90.2 mg/kg Cu, 2460 mg/kg Pb, 464 mg/kg Mn, 3.01 mg/kg Se, and 549 mg/kg Zn. Additionally, synthetic precipitation leaching procedure (SPLP) was performed to assess leaching potential of the waste rock, but since none of the metals exceeded the 20x EPA MCL, the metal levels were not predicted to adversely affect groundwater quality. The waste rock pile was observed to have eroded downstream, and storm events were expected to increase runoff of the rock as sediment into the PPE streambed.



Figure 2: Base of waste rock pile (AI, 2020).

The environmental hazards at English Maid have the potential to affect human and ecological receptors. The waste pile has a “complete” pathway for ecological receptors and, the adit sediment and adit water have “potentially complete” pathways. Based on the MCL and ecological SL exceedances in the adit water, this surface water pathway was evaluated to be significant for both humans and wildlife.

Site Opportunity

English Maid Mine presents an opportunity for a Good Samaritan project as the hazards that require remediation could possibly be completed in the shorter timescale under the Act. The waste rock pile could be explored as a reprocessing opportunity. The adit leachate may also present an opportunity to pilot test water treatment technologies that could remove and simultaneously recover metals.

The Uncompahgre Watershed Partnership may be interested in supporting restoration of this site. This NGO produces annual reports on the water quality of the Uncompahgre Watershed and has carried out a mine remediation project in the Upper Uncompahgre Watershed (UWP, 2018). The 2020 USFS PA/SI noted this organization as a community interest.

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Grand Reef Mine, Arizona

Overview

Grand Reef is a former small scale underground lead (Pb), silver (Ag) and copper (Cu) mine in Laurel Canyon of the Aravaipa Mining District, Graham County, Arizona. The mine was the largest Ag producer and second largest Pb producer in Arizona in the early 1900s. The mine contains 4000 ft of workings however minimal external infrastructure remains on site. Grand Reef mine lies on private property to the west of Coronado National Forest, overlapping a biological hotspot in Arizona. Elevated concentrations of Cu and Pb on site indicate there may be value in reprocessing waste to support restoration. As a Good Samaritan site, restoration of the Grand Reef site would support creating and conserving habitat for critical species in the larger Aravaipa Watershed.



Figure 1: Photograph of the remains of Grand Reef Mine as seen from Laurel Wash.

Mine History

The ore body is hosted in the Pinal Schist and limestone; associated rocks include the Horse Mountain volcanics and Goodwin Canyon Quartz Monzonite. The ore control is breccia in the Grand Reef Fault within rhyolite porphyry which is intruded by granite. The site was first discovered in the 1890s and was patented in 1899 (Minor, 1921). Production began in 1915 and the mine's initial development resulted in a small 20-people settlement in Cottonwood (Hadley, 1991). In 1919, Grand Reef was bought by Aravaipa Leasing Company (subsidiary of American Lead and Zinc Company) (Simons, 1964). The mine saw

its largest production period in the 1920s before the Great Depression, and resurged as World War II approached (Hadley, 1991). During World War II, Grand Reef produced a surplus of Pb, Cu and Zn, which was later remined. By 1941, the mine had produced over 40,000 tons of ore with a reported average grade of 9% Pb, 2% Cu, and 7 oz/t Ag (Simons, 1964). From 1942-1957, Athletic Mining Company operated several mines and received ore from other mines in the area, milling material at a central facility in Klondyke and producing a flotation concentrate. Today, dispersed tailings piles, boilers and scattered structures remain today around the site (Ellingson, 1980) on private and public land. The parcel of land the mine sits on is currently owned by the Latter-day Saints Church (Graham County, 2025).

Environmental Investigations and Current Conditions

Grand Reef mine, in the Aravaipa Mining District, overlaps a biological hotspot in Arizona. Grand Reef is adjacent to Laurel Canyon Creek (Laurel Creek), which flows into the greater Aravaipa Creek. Various groups have assessed the tailings, waste rock, streambed sediment, and soil on and around the Grand Reef mine in the last 20 years as part of a larger effort to understand heavy metal contamination in Aravaipa Creek. In 1999, the University of Arizona collected samples from tailings and waste rock, reporting concentrations Pb from 6,500 mg/kg to 48,600 mg/kg, Cu from 1,198 mg/kg to 11,130 mg/kg, and iron (Fe) from 12,600 mg/kg to 60,000 mg/kg (Torre de Alvaraz Morfin, 1999). In 2008, the United Research Service Corporation (URS) collected samples from tailings and measured Pb from 13,000 mg/kg to 170,000 mg/kg (Arizona Department of Environmental Quality, ADEQ, 2008). In 2011, the EPA also investigated Pb contamination and recommended further investigation of soils to evaluate potential impact to residences near Laurel Creek.

Due to its larger watershed, Aravaipa Creek has been a greater focus of remedial efforts than Laurel Creek, its tributary. Aravaipa Creek is home to seven native fish species, two of which are endangered (Alexandre et al., 2023). In 2014, URS's final remedial investigation for Klondyke Tailings WQARF found that most of the contamination in Aravaipa Creek is attributed to the Klondyke Tailings adjacent to the creek. However, Grand Reef mine and the neighboring historic Dogwater mine, both located in a tributary to Aravaipa Creek, have been confirmed as secondary sources of contamination due to sediment washing during flood events (URS Corporation, 2014). The Klondyke tailings are managed by the ADEQ and have been armored and capped. However, contamination to Aravaipa Creek from tailings on Grand Reef mine remains unaddressed. The University of Arizona, Bureau of Land Management, US Fish and Wildlife Service, and Nature Conservancy were working to quantify the source of heavy metals in Aravaipa Creek and the impacts to aquatic biota. While water concentrations of heavy metals in Aravaipa

Creek may not be as significant, it is suspected that dust from Grand Reef Mine could be contributing to fish uptake of heavy metals (Reinthal, 2024).



Figure 2: View of Grand Reef tailings within Laurel Wash on Arizona State Trust Land.

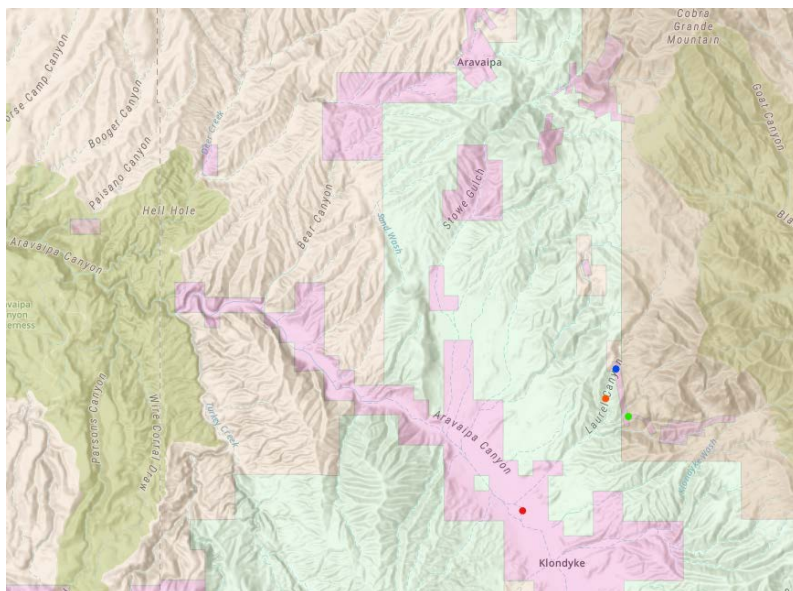


Figure 3: Regional setting of important features related the Grand Reef mine. Blue dot=Grand Reef Mine, Orange=Tailings, Green=Dogwater Mine, Red=Klondyke Tailings Facility. Pink polygons indicate private land holdings.

Site Opportunity

The federal, state, and academic interest in protecting Aravaipa Creek indicates positive engagement could be received if a reprocessing and restoration project were to occur for Grand Reef. The historic levels of Cu in the tailings suggest additional sampling and an estimation of the volume of material should be completed to consider reprocessing waste. Restoration work would likely need to expand along Laurel Creek (also including Dogwater mine) and include other sources of contaminants around Klondyke. A larger scale project could address all AMLs in the Aravaipa Mining District with remining and restoration. This would allow a more sustainable solution by managing all sources of contamination to the watershed and providing habitat restoration for critical species.

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Hope Mine, Idaho

Overview

Hope Mine is an abandoned lead (Pb), silver (Ag), and zinc (Zn) mine located on private property four miles north of Clark Fork, Bonner County, Idaho. The mine has approximately 20,000 yd³ mill tailings pile, several waste rock piles, eight adits, an 850 ft shaft, and mill foundations. Access is via U.S. Highway 16, approximately 4 miles north of Clark Fork. The Idaho Department of Environmental Quality (IDEQ) has identified the site as a concern for human health and the environment, recommending further characterization and monitoring be completed to support restoration. Through the Good Smartian Act, the waste could be reprocessed, particularly for Pb and Zn, to fund restoration and achieve better closure outcomes.

Mine History

Mineralization at Hope Mine is a mildly deformed and extensively faulted Striped Peak Formation consisting of thin-bedded shaly argillite and thicker bedded siltite and quartzite. Ore deposition occurs along the low angle thrusts producing narrow seams of bedded fissure replacement ore.

In 1923, high grade lead-silver ore was recovered through a small hand sorting operation. In 1927, Hope Mining Co. was formed and installed a mill on site to concentrate the lower grades of ore. Ore was also processed from the nearby lead-silver Whitdelf Mine and Lawrence Mine. Production totaled 24 million pounds of Pb, one million pounds of Ag, and 774,000 pounds of Zn (Anderson, 1947). Production of ore continued until 1944 and then stopped because of labor shortages. In 1964, most of the milling and mining equipment had been removed from the site, and caving and flooding had sealed off much of the mine.

Environmental Investigations and Current Conditions

In 2016, the IDEQ requested a Preliminary Assessment/Site Inspection (PA/SI) for Hope Mine. During this investigation, it was found that Lightning Creek, which runs adjacent to Hope Mine, was being contaminated by metals from the tailing piles. Lightning Creek is a tributary to Clark Fork River which flows to Lake Pend Oreille, the largest lake in Idaho that has numerous fish species and is used for recreation. The tailings had eroded into Lightning Creek over time (Figure 1, 2) and Pb levels downstream exceeded cold water biota chronic standards. The waste piles also exceeded EPA regional screening levels for antimony (Sb), arsenic (As), iron (Fe), Pb and manganese (Mn). Although groundwater was not analyzed in the PA/SI, the reported indicated potential concerns as the City of Clark Fork has a drinking well located near Lightning Creek that serves approximately 570

people. Threatened species in the vicinity of the mine include the Yellow-Billed Cuckoo, Canada Lynx, Grizzly Bear and Bull Trout, and the Woodland Caribou is an endangered species.



Figure 1: Approximate extent of tailings pile erosion into Lightning Creek over time based on past aerial photos (IDEQ, 2016).



Figure 2: Cut bank where tailings erode into Lightning Creek (IDEQ, 2016).

Hope Mine has eight adits. Adit #1 is 300 ft north of the mill (Figure 3). The road leading from Adit #1 to the mill site is built from a waste pile (which exceeded RSLs). Adits #2-8 are approximately 1000 ft northeast of the mill and tailings pile in a forested area. In the 2016 PA/SI, these adits were found to be mostly dry, except for Adit #3 and 4. Standing water in Adits #3 and #4 did not flow into surface water or contact waste piles.



Figure 3: Photograph of Adit #1 opening (IDEQ, 2016)

In the 2016 investigation, samples were collected from tailings, waste rock, and waste dump material. Elevated concentrations, particularly for Zn up to 10,800 mg/kg and Pb up to 41,100 mg/kg in the waste dump, indicate there could be potential for reprocessing to support restoration of Hope Mine.

Site Opportunity

Hope Mine is a Good Samaritan candidate site that would benefit from restoration for the community and environment. No remedial work has been completed since the 2016 PA/SI. However, there is a need to stabilize the tailings to prevent future erosion into Lightning Creek, and to reduce potential risks from recreational use of the site. Reprocessing the tailings under the Good Samaritan Act would also provide a pathway to support the restoration work.

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Horse Heaven Mine, Oregon

Overview

Horse Heaven Mine is an abandoned mercury (Hg) mine on private property covering approximately 40 acres in eastern Jefferson County, Oregon. The site is remote, located 17 miles east of Ashwood, Oregon; it is near the westside of the Blue Mountains and north of the Ochoco Mountains. The eastern boundary of Horse Heaven Mine borders federal Bureau of Land Management (BLM) property, and the north, west and south boundaries are owned by the Young Life (Jefferson County, 2024). The workings at the site consisted of a large calcine tailings pile, a southern tailings pile, and two waste rock piles. In addition, there are glory holes, adit portals, a furnace, and numerous housing structures across the site. Horse Heaven Mine is a Good Sam candidate site because despite institutional controls being implemented for the site, its tailings and waste rock piles need remediation.

Mine History

In 1933, a mercury ore deposit was discovered in autobrecciated rhyolite plug deposits (biotite rhyolite) beneath the capping clays of the Clarno formation. The following year, the Number One level of Horse Heaven Mine was developed by R.R. Whiting and C.C. Hayes. The ore rock consisted primarily of cinnabar and was processed through a furnace located on the site. In 1936, Horse Heaven Mines (subsidiary of Sun Oil Company) operated the mine. A fire in 1944 destroyed the furnace, power plant, and other structures, leading to mine closure the following year. The mine transferred to different ownership (Cordero Mining Company) between 1945-1958, and it reopened in 1955 with a 30-ton rotary furnace plant. Between 1955-1958, the major pillars supporting the slopes and incline were removed and the most productive part of the mine caved, making it inaccessible. Total production of Hg is estimated to be 654 tons before the mine finally ceased operations in 1958. This mine was the third largest producer of Hg in Oregon (ODEQ, 2024).

Environmental Investigations and Current Conditions

Horse Heaven Mine sits on a small drainage divide trending northwest-southeast on the northwest facing slope of Horse Heaven Mountain. Surface flow patterns around mine tailings piles are relatively undeveloped because of this divide and low rainfall in this area. If and when overland surface flow occurs, they will move in normally dry rills/swales into three separate drainage sub-basins: 1) Horse Heaven Drainage Swale — southwest flow to intermittent Horse Heaven Creek to Muddy Creek to Mays Reservoir to John Day River 2) Northeast Drainage Swale — northeast flow to small drainage channel (4,800 ft.) to White Rock Gulch to Cherry Creek to John Day River 3) Southeast Drainage Swale — southeast flow to small drainage channel to White Rock Gulch. The depth to groundwater is unknown; anecdotal evidence from exploration and dewatering activities at the mine

suggest groundwater resides below depths of mine workings, which extend to 150-200 feet.

The site has numerous tailings and waste rock piles, as well as glory holes, adits, a furnace and other structures. A 2004 Ecological and Human Health Risk Assessment (HHRA) for the Oregon Department of Environmental Quality (ODEQ) surveyed soil samples from various locations on Horse Heaven Mine. The HHRA found the largest (calcine) tailings pile contained 19,300 mg/kg sulfate and up to the following metal concentrations: 120 mg/kg mercury (Hg), 72.3 mg/kg zinc (Zn), 32 mg/kg copper (Cu), 27.6 mg/kg nickel (Ni), 20.2 mg/kg chromium (Cr), and 9.9 mg/kg arsenic (As). The characteristics of the upper and southern tailings piles were similar, with the highest concentration of Hg followed by lower but present concentrations of Zn, Cu, Ni, Cr and As. The D-tube furnace, located in a sparsely vegetated area between the calcine and upper tailings piles, presented some of the highest heavy metal concentrations. This location recorded up to 2,740 mg/kg Hg, 375 mg/kg Cu, 267 mg/kg Zn, 109 mg/kg Ni, 104 mg/kg Cr, 65.6 mg/kg As, and 27.8 mg/kg As.



Figure 1: Photograph of a glory hole on-site (SGI, 2008a).

The tailings remain on-site, actively eroding (Thoms, 2024). In addition to the tailings, storm runoff from the site has been identified as an environmental hazard (SGI, 2004). In the 2004 HHRA, the drainage swales were found to be dry with the formation of occasional pools of water under heavy rain or flash flood events. Similarly, streams were found to be infrequent and intermittent. However, if streams are present, there is

opportunity for it to impact critical fish habitat; ODEQ's GIS identified sensitive salmon habitat nearby this site (ODEQ, 2024).

The HHRA assessed possible human and ecological receptors that could be exposed to Hg contamination. Terrestrial animals such as the meadow vole, red-tailed hawk and coyote were evaluated; but based on the small extent of elevated contamination, lack of Hg uptake by edible plants, and large home range of predatory species, it was determined the mine would not likely impact terrestrial species. For human receptors, the occasional resident, camper and hiker receptors were evaluated with pathways such as incidental ingestion, dermal contact and inhalation of dusts from soil. The HHRA determined that while ecological receptors may not warrant further actions, further actions may be required in the D-Tube furnace area to limit human (camper or resident) exposure to Hg.

From these recommendations, Horse Heaven Mine has been addressed by some remedial action between 2006-2007 (SGL, 2008b). In Phase 1 of the remedial design/remedial action (RD/RA), adits and portals were closed (with bat gates) and fencing and signage installed to limit site access. In Phase 2, the D-Tube furnace area was first capped with portions of the calcine tailings pile (Figure 2a). A drainage berm and settling basin were constructed on-site and on adjacent BLM property to limit overland migration of mine waste offsite. Site topography was graded to reduce the amount of surface water runoff from tailings entering Cherry Creek and Horse Heaven Creek (Figure 2b). Additionally, deed restrictions were implemented on the mine.

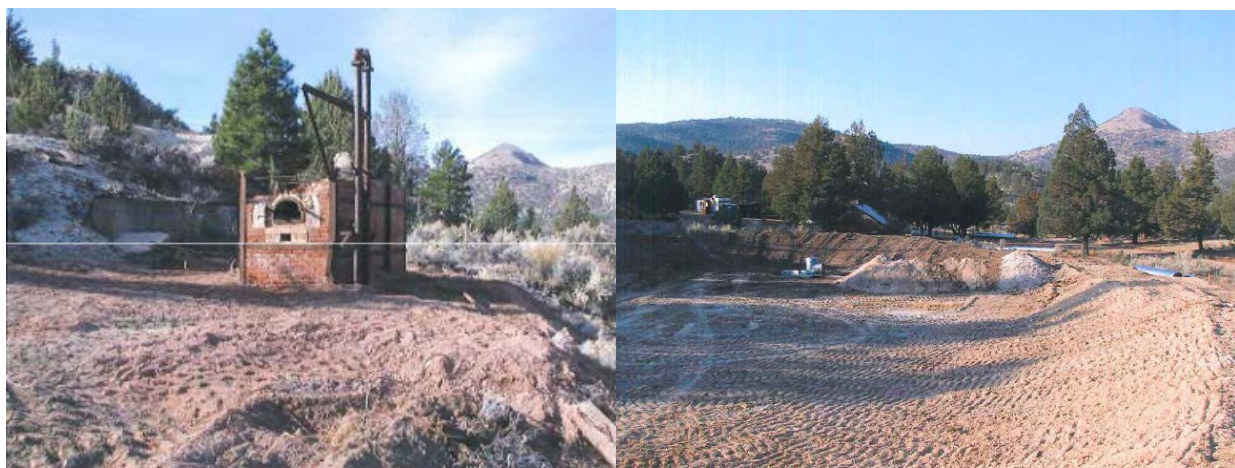


Figure 2a: Photograph of D-Tube furnace after capping (SGL, 2008a)

Figure 2b: Photograph of the completed subbasin closest to the residence on-site (SGL, 2008a).

Site Opportunity

Horse Heaven Mine could be a Good Samaritan site because the existing tailings piles and possible runoff from the site need to be fully remediated. While stormwater basins have been constructed, surface runoff may still be entering downstream water bodies that serve the local community and support critical fish habitat. Surface water runoff could be further monitored both on-site and downstream of the site. For the tailings on-site, capping and stabilization could be done to prevent further erosion. A Good Samaritan would need to work with Young Life and the BLM.

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Katherine Mine, Arizona

Overview

Katherine Mine is a former gold (Au) and silver (Ag) mine located in Lake Mead National Recreation Area (administered by the National Park Service (NPS)) in Mohave County, Arizona. The abandoned mine has a large, dewatered tailings impoundment over 26 acres with extensive underground workings, surface openings, and remnants of a cyanide mill (Figure 1). The site is located 6 miles north of Bullhead City, Arizona and Laughlin, Nevada, and 1.5 miles east of Lake Mohave. The small community of Katherine is located at the east end of the mine with a drinking water well serving this community. NPS has expressed concern that Katherine Mine has contributed to contamination of the drinking water well. Katherine Mine is a candidate Good Samaritan pilot site given the need for restoration and the opportunity to reprocess the waste, which can only be achieved through the Good Samaritan Act.

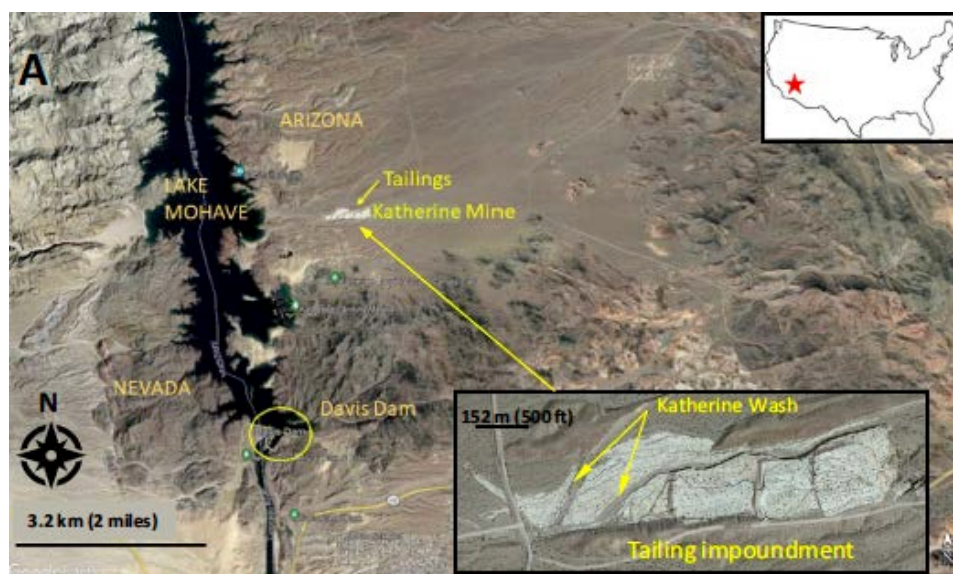


Figure 1: General location of Katherine Mine tailings from Google Earth (Karacan et al., 2023).

Mine History

Gold was discovered in 1900 in a small outcrop of Precambrian granite, which protrudes through Quaternary alluvium (Lausen 1931). Tertiary andesite and rhyolite are also present nearby (also overlain by Quaternary alluvium). The alluvium was deposited by the Colorado River (to the west of the mine) and is composed of moderately cemented clay, sand, gravel, and volcanic and granitic fragments. Development for Katherine Mine began in 1903, but production was intermittent through 1930 due to several bankruptcies and idle times caused by fluctuations in gold price (Karacan et al., 2023). The Katherine mill, built in 1925,

processed Katherine Mine ore and ores from other mines in the Union Pass-Katherine Mining District at a 150 ton/day capacity (then after, 260 ton/day) until WWII (Iverson, 1995). Mining was primarily conducted by shrinkage stope methods. Ore was crushed and pulverized, then a slurry (with added cyanide and lime) was created to leach precious metals. This was then recovered using a Zn precipitate. A total of 880,000 tons of ore was processed at Katherine Mill between 1925-1943, with approximately 400,000 tons sourced from Katherine Mine (Iverson, 1995).

Environmental Investigations and Current Conditions

Katherine Mine does not have headwaters upstream however, ephemeral streams transect the tailings and flow west into Lake Mohave. Groundwater flows westwards towards the lake. NPS had originally expressed concern that cyanide and heavy metals could be released via 1) water from Katherine Wash (which bisects tailings) and, 2) windblown contamination (Iverson, 1995). In 1993 and 1994, NPS collaborated with the US Bureau of Mines (USBM) to conduct extensive geochemical sampling to determine presence and transport of heavy metals, and a geotechnical investigation of the sloped tailings to determine stability and physical extent of metal contamination. The investigation found that heavy metal and cyanide concentrations in the tailings were below maximum acceptable contaminant levels, but beryllium (Be) was detected at unexpectedly high concentrations (~57 ppm) in select samples. The investigation also determined that 49,000 yd³ of the original 587,000 yd³ (estimated) tailings had eroded through Katherine Wash into Lake Mohave by stormwater runoff. Additionally, the mill ruins contained elevated concentration of cyanide, Be, lead (Pb) and zinc (Zn).



Figure 2: Photo of Katherine Mine tailings facing east to the southern Black Mountains (Karacan et al. 2023).

Exposure to heavy metals at this site remains a concern due to frequent visitor traffic in the Lake Mead National Recreation Area, and the potential contamination of the local drinking

water well. Katherine Mine remains in remedial investigation status within NPS's cleanup unit awaiting funding for additional work. Arizona Department of Environmental Quality (ADEQ) has also identified Katherine Mine as a site for future remedial work (Muilenberg, 2024).

Reprocessing waste at this site has been of interest since at least the 1970s. In 1980, Arizona Bureau of Geology and Mineral Technology and University of Arizona published a report on metal recovery via leach tests from mine dumps including Katherine Mine tailings (Rabb, 1980). The US Geological Survey (USGS) has recently been surveying Katherine Mine tailings as part of a broader program on characterize resource potential in waste. Karacan et al. (2023) published a geostatistical study that examined spatial variability and uncertainty in evaluating metal concentrations in the tailings. They found that copper (Cu), Pb and Zn were the most abundant elements followed by Au and Ag at Katherine Mine.

Site Opportunity

Katherine Mine is an ideal Good Samaritan pilot site because it would present a reprocessing and restoration opportunity. Currently, reprocessing is not allowed on NPS land because 1) new mining is prohibited on NPS land and, 2) only active mining permits prior to NPS land designations are observed. However, the Good Samaritan Act would allow the opportunity for reprocessing mine waste on NPS land through the Good Samaritan permit. As a Good Samaritan site, Katherine Mine presents a possibility for a unique collaboration between NPS, ADEQ, USGS and a Good Samaritan.

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Metaline Mine, Washington

Overview

Metaline Mine, known as the Lower Bell May Mine, is an abandoned zinc (Zn), cadmium (Cd) and silver (Ag) mine located on private property along the Pend Oreille River, Ferry County, Washington. The site covers approximately 4.75 acres and lies 0.8 miles south of Metaline, Washington. The workings at Metaline Mine consist of five waste rock piles totaling ~35,300 yd³ and an open 11 ft by 11 ft adit that discharges directly into Pend Oreille River. The site is accessed from Metaline, Washington by State Road 31 and an unmarked gravel road. Metaline Mine is part of a group of historic mines in the district that include Bella May Upper Mine, Blue Bucket Mine, and Bella May/Blue Bucket Mill Site. Out of these sites, Metaline Mine has the largest volume of waste rock and lies closest to a surface waterbody and residences. This mine is a Good Samaritan candidate site because the tailings piles need remediation to prevent impacts to nearby watersheds.

Mine History

The ore deposit for Metaline Mine is galena at the surface (Hart Crowser, 2006). Mining for the Bella May and Blue Bucket Mines began in 1886 as small operations. Between 1936-1937, American Zinc, Lead, & Smelting Co. developed the western workings of the Metaline Mine to operate at a larger scale. Between 1906-1951, Metaline Mine produced a total of 37M lbs Zn, 10M lbs Pb, and 430,000 tons of ore. The greatest production years for the mine were from 1937-1947. In 1950, the operator of the mine changed and in 1953, the mine became idle possibly due to caving of the main adit. As of 2007, Cominco American Inc. and Shoshone Tree Farms Inc. were listed as current owners.

Environmental Investigations and Current Conditions

The town of Metaline is 0.8 miles directly north of the site, with the closest residence at approximately 0.4 miles north of the mine. Pend Oreille River runs adjacent east of the site, flowing northward towards the town of Metaline (Figure 1). The main adit at Metaline Mine discharges directly into Pend Oreille River at a rate of 120 gallons per minute (gpm).

Five waste rock piles of various sizes are located on-site. Waste Rock Piles #1, #2, and #3 (1,250 yd³; 3,150 yd³ and 24,250 yd³ respectively) sit adjacent to Pend Oreille River (Figure 2a-c). Waste rock pile #4 (6,670 yd³) is not along the river but extends from Waste Rock Piles #2 and #3. Waste Rock Pile #5 is the smallest of the five (3 yd³) and sits between the upper and lower access road entrances. While no active seepage from the waste rock piles were observed during a 2007 site visit, Waste Rock Piles #1-#4 showed evidence of surface water runoff east towards Pend Oreille River. The 2007 Initial Investigation Report (IIR) found concerning levels of heavy metals in the waste rock piles on Metaline Mine. Soil

samples from Waste Rock Piles #1-#4 revealed arsenic (As) concentrations as high as 31.6 mg/kg, Cd as high as 32.7 mg/kg, Pb as high as 1970 mg/kg; all exceeded the Model Toxics Control Act (MTCA) Method A criteria (Hart Crowser, 2007). The ecological protection criteria were also in exceedance for Zn of up to 8440 mg/kg, nickel (Ni) of up to 46.5 mg/kg and mercury (Hg) of up to 1.76 mg/kg.



Figure 1: Vicinity Map of Bella May (Lower) Mine and other mines (Hart Crowser, 2007).



Figure 2a (left): Photograph of Waste Rock Pile #1 facing south.

Figure 2b (middle): Photograph of Waste Rock Pile #2 facing south.

Figure 2c (right): Photograph of Waste Rock Pile #3 facing north.

Metaline Mine's adit water was not found to exceed any chronic and acute surface water quality standards. However, due to the waste rock piles being located on the bank of Pend Oreille River, leaching of heavy metals into the river has been raised as an environmental concern. The 2007 IIR suggested that Pb and Cd may fail toxicity characteristic leaching

procedure (TCLP) tests for dangerous waste, though additional sampling would be needed. Pend Oreille River is known as habitat to the threatened bull trout, which could make them possible aquatic receptors.

Site Opportunity

Metaline Mine was investigated in the 2007 IIR in addition to Bella May (Upper) Mine, Blue Bucket Mine and Blue Bucket Mill. While Metaline Mine was highlighted in this site profile, these other mines have potential to qualify as Good Samaritan projects as well. Bella May (Upper) Mine is also particularly relevant because it contains much higher heavy metal concentrations that could be considered for reprocessing potential. Remedial work at Metaline Mine would most likely involve stabilizing the waste rock piles, especially securing the river-facing ones from eroding further into the river. This cleanup action is necessary to reduce impacts on the community of Metaline.

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Opalite Mine, Oregon

Overview

Opalite Mine is a former mercury (Hg) mine on privately owned, patented mining claims in the southern end of Malheur County, Oregon (Opalite mining district). The mine is in the McDermitt Caldera, an area that contained four large mines (Opalite, Bretz, McDermitt, and Cordero Mines) that supplied a significant quantity of mercury in North America between 1917-1989 (Figure 1). The remaining workings at Opalite Mine include a glory hole (open pit), four large trenches around the glory hole, two adits, and numerous shafts. The site also has an ore processing area, approximately 190,000 yd³ burned ore piles and waste rock piles near the adits. The site can be accessed by Disaster Peak Road and an additional network of primitive Bureau of Land Management (BLM) and Malheur County roads. Opalite Mine is a Good Samaritan pilot site candidate because of the need for remedial work and a possible opportunity for reprocessing.

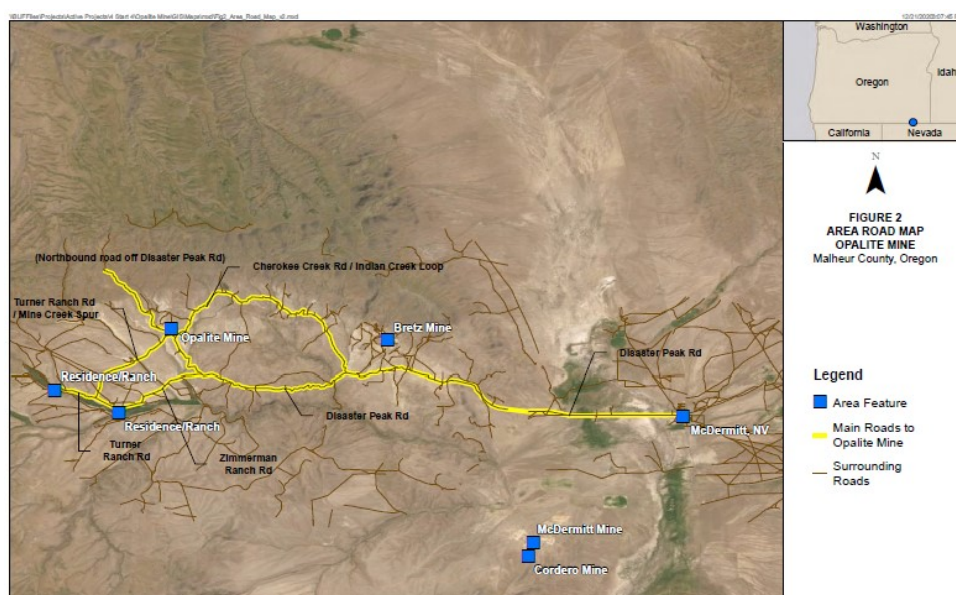


Figure 1: Road map of Opalite Mine showing other mines in Opalite mining district (EPA 2020).

Mine History

The Opalite Hg deposit was discovered in 1924 and the Mercury Mining Syndicate began developing the mine the following year (Schuette 1938). The glory hole method was used to drive adits and tunnels horizontally beneath the ore body, with raises and inclines driven upward to remove near-surface ore. Bretz Mine is located closest to Opalite Mine, approximately 8 miles due east. In 1926, a furnace was constructed to process ore

recovered from Opalite Mine, as well as ore concentrates from nearby Bretz Mine; the furnace could process 80-100 tons of ore/day (Brooks, 1963; Ecology & Environment, 2005). Between 1927-1961, Opalite Mine produced approximately 940,000 lbs of Hg total, with most production occurring before 1943 (Weston, 2002). As of 2005, most of site area was owned by Bradley Mining Company, with surrounding land parcels owned by Owyhee Caldera Minerals (E&E, 2005).

Environmental Investigations and Current Conditions

The climate of Opalite Mine is arid with sparse vegetation. Mine Creek flows southward along the west side of the site, and an unnamed tributary of Cowboy Creek flows southeastward along the east side of the site. Overland runoff from the unnamed tributary to Cowboy Creek has not been identified, but overland runoff is known to flow into Mine Creek by two pathways: 1) a northern flow path that originates near the waste rock pile at Tunnel No. 1 portal and flows past the northern burned ore pile area southwest and 2) a southern flow path that originates near the southern burned ore pile and runs southwest across an unpaved access road (Weston, 2002). Flow from Mine Creek reaches McDermitt Creek during periods of high runoff, usually 1-2 weeks per year. McDermitt Creek is known as habitat for the threatened Lahontan cutthroat trout, as well as other trout species, sucker species, speckled dace, and hybrids (Weston, 2002; E&E, 2005).

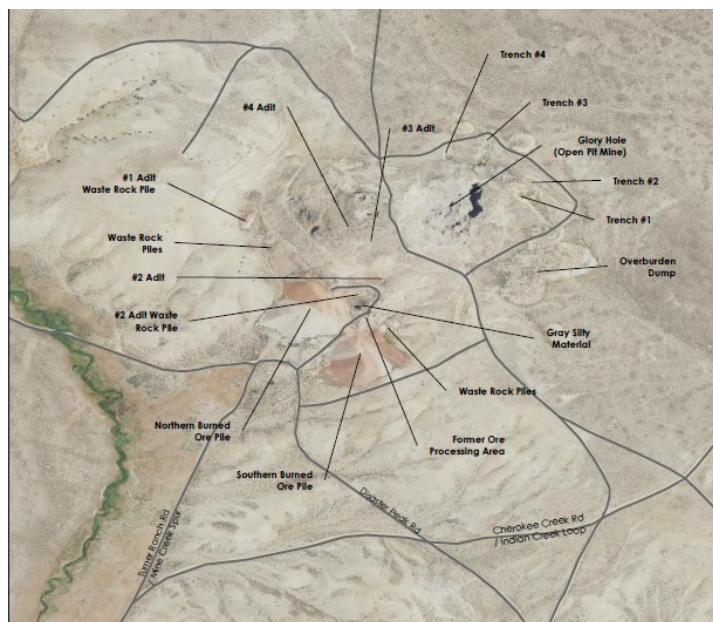


Figure 2: Site layout and key features at Opalite Mine (EPA 2020).

The Environmental Protection Agency (EPA) and Oregon Department of Environmental Quality (ODEQ) performed several investigations on the site between 2000-2016, including preliminary assessments, site investigations, a macroinvertebrate study of

McDermitt Creek, and a removal assessment. These surveys indicated heavy metal contamination in the ore processing area, waste rock piles, the glory hole, and burned ore piles. In EPA's 2016 removal assessment, exceedances were recorded for Hg, arsenic (As), and antimony (Sb). In the ore processing area, Hg was up to 5,360 mg/kg at 8 ft below ground surface (bgs) and 4,580 mg/kg at 3 ft bgs, exceeding industrial soil removal management level (RML) of 140 mg/kg by more than an order of magnitude. Arsenic was found as high as 670 mg/kg at 3 ft bgs, exceeding industrial soil RML of 300 mg/kg and industrial soil regional screening level (RSL) of 3 mg/kg. The glory hole also exceeded industrial soil RMLs for As and Hg. The waste rock piles had Hg up to 1,290 mg/kg, As up to 4,667 mg/kg, and Sb up to 2,123 mg/kg (above industrial soil RML of 1,400 mg/kg). The northern and southern burned ore piles presented the largest site features and a potential source of contamination; As, Hg and Sb concentrations were above EPA RSLs and/or RMLs, but lower than other site sources.

In addition to the waste rock and burned ore, a pile of gray silty material was found at the site (in the ore processing area adjacent to the main road) containing up to 2,700 mg/kg Hg and 62.5 mg/kg As. This mine waste appeared to be ash or soot from the rotary furnace. Because the ash was a powder-like material at the surface that could easily be eroded, dispersed or inhaled by any public visitors, this was addressed in EPA's 2020 TCRA. In the TCRA, the EPA stabilized and capped a total ~170 yd³ of this ash from two piles. The TCRA also involved building/reinforcing access restrictions: a lower bypass road was constructed as a detour, adits were collapsed to prevent human access, and three gates and additional warning signs installed across the site.

Despite the 2020 removal action, environmental hazards from Opalite Mine remain today. The majority of waste including the waste rock and burned ore piles remain unstable and uncapped. The metal contamination may be impacting downgradient surface water, sediment and fish, as found in ODEQ's 2003-2004 Site Investigation (SI). This SI identified contaminants of potential concern (COPCs) to human health and contaminants of potential ecological concern (CPECs) to ecological receptors like fish. Concentrations of As in Mine Creek, McDermitt Creek and Hot Creek exceeded DEQ Level II Ecological Screening Level Values (SLVs) for sediment, but not for surface water. Sediment in McDermitt Creek had the most metals with exceedances: As, cadmium (Cd), nickel (Ni) and selenium (Se). ODEQ had also conducted a macroinvertebrate study in 2004 to assess potential biological impacts from Opalite Mine. While the River Invertebrate Prediction and Classification System (RIVPACS) did not find biotic impairment due to loss of taxa, the temperature, sediment and metals diagnostic stressor tools indicated noticeable shift in community structure that implicated degraded biotic integrity. This suggested that decreasing toxic metal runoff and improving stream habitat would benefit the benthic communities of Mine, Hot, and McDermitt Creeks.

Site Opportunity

Opalite Mine is a Good Samaritan pilot site candidate because significant hazards from existing mine waste warrants more extensive clean up action in addition to EPA's 2020 TCRA. This site may also be of interest for reprocessing waste rock and burned ore. The McDermitt Caldera has been raised to attention recently as possibly one of the largest lithium (Li) reserves in the world (Yirka, 2023). This makes Opalite Mine a location of interest for new mining as well. Any future geological surveys would bring more detailed characterization of the possible critical minerals present at the mine.

A Good Samaritan project for Opalite Mine could bring other interested organizations to the table. For example, the Western River Conservancy owns some land on the banks of McDermitt Creek due to conservation interest putting landbanks in between rivers under stable ownership. This organization may be interested in supporting creek restoration of Mine Creek, McDermitt Creek, or Hot Creek. The Fort McDermitt Paiute and Shoshone Tribe may also be interested in Opalite Mine because part of their reservation land surrounds McDermitt, Nevada, spanning between Oregon and Nevada. While it is not specifically known whether Opalite Mine tailings were used as fill material, it is known that McDermitt and Cordero Mine material had been used to construct high school tracks in McDermitt, exposing residents to heavy metals.

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Wrightson Mines, Arizona

Overview

The Wrightson Mines include seven underground former copper (Cu), lead (Pb), silver (Ag), zinc (Zn), and gold (Au) mines in the Wrightson Mining District of Santa Cruz County in the Coronado National Forest, Arizona. The mines are divided into northern (Little Joker Mine, Philadelphia Mine, Saint Louis Mine) and southern (North Ultimo Mine, South Ultimo Mine, Double Header Mine, Armada Mine) mines approximately 0.5 miles from each other. All mines occur along the National Forest System Road (NFSR) 72 and require four-wheel drive to access (Figure 1). The Wrightson Mines consist of multiple waste rock piles, tailings, shafts and adits that pose an active concern for human health and the ecosystems from heavy metal leaching into the surrounding environment. There may be potential for reprocessing waste, including for metal recovery of Cu, Pb, and Zn. As a Good Samaritan pilot site, the Wrightson Mines could demonstrate the value of using reprocessing to help with restoration.

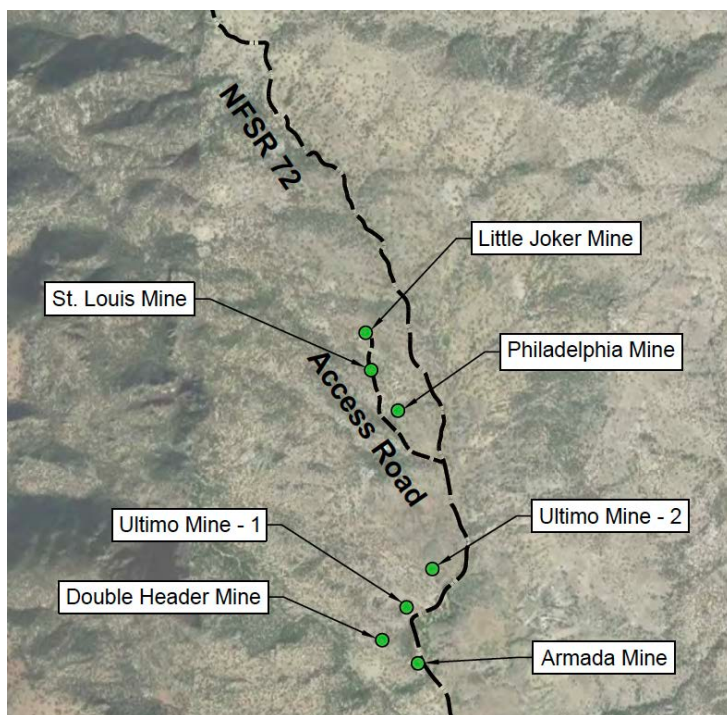


Figure 1: Locations of the Wrightson Mines in Coronado National Forest (ECM, 2023).

Mine History

Ore deposits for the Wrightson Mines were discovered as early as the 1870s, but production did not begin until the 1900s. The ore deposits occur in quartz fissure veins, and the country rock is highly altered older andesite (Drewes, 1979). The veins contain mainly copper minerals like chalcocite containing silver, with some veins containing

argentiferous galena (Schrader & Hill, 1915). Claims to the Wrightson mines were owned by Anaconda-Arizona Mining Company, which began operating in the Wrightson District in 1905. Ore bodies had been worked on intermittently through 1949, and the last recorded production was in 1958. Volume of production was generally small: approximately 300 tons of ore averaging 5% Pb, 3% Cu, 30 oz Ag/ton and minor gold (Stanton, 1975). The Wrightson Mines produced mainly Cu and Ag; reports indicated that processing methods at the time were inefficient and left metals in the waste material.

Environmental Investigations and Current Conditions

A 2023 Preliminary Assessment and Site Inspection (PA/SI) found all seven mines were releasing heavy metals into the surrounding environment at concentrations that pose a risk to human health and ecological receptors. In soil samples, antimony (Sb), arsenic (As), and Pb were above Arizona Non-Residential Soil Remediation Levels. The main risk is for metal leaching into surface water and groundwater, and for acid mine drainage at five of the mines. To fully understand the extent and risks of metal migration into waterbodies, further characterization of nearby surface water and groundwater is needed. However, the human health and ecological risk factors highlight the need to remediate the Wrightson Mines. The area is used for recreational access by hikers, but some evidence has been found of camping on the waste piles (Maldonado, 2024). A site-specific biological assessment has not yet been conducted, but this region of the Wrightson is known to host 12 endangered species and two critical habitats (ECM, 2023). The endangered species include the jaguar and ocelot (along with their critical habitats), the Mexican Spotted Owl, the Chiricahua Leopard Frog, the Northern Mexican Gartersnake, and the Monarch Butterfly. In addition, 16 migratory bird species were identified to potentially be migrating near the site.

The waste rock and tailing piles (Figure 2) at all seven mines could be considered for reprocessing, particularly for Cu, Pb, and Zn. The 2023 PA/SI reported elevated concentrations of Cu (up to 21,900 mg/kg), Pb (up to 107,000 mg/kg), and Zn (up to 8,000 mg/kg) across the sites. Additionally, As (up to 1,870 mg/kg), Ba (up to 3,230 mg/kg), Sb (up to 1,550 mg/kg), Ag (up to 403 mg/kg), Cd (up to 75.3 mg/kg), Hg (up to 50.5 mg/kg) exceeded Environmental Protection Agency (EPA) Ecological Soil Screening Levels (Eco-SSLs). Further sampling would need to be conducted to identify the volume of material and distribution of minerals and metals, including critical minerals.



Figure 2a: Photograph of waste rock pile at Walker Mine (left), Double Header Mine (middle), and mill tailings at St. Louis Mine (right) (ECM, 2023).

Site Opportunity

The US Forest Service (USFS) is the lead agency working on remediation for the Wrightson Mines. The USFS has been investigating the Wrightson Mines due to the concern for human health and ecological receptor exposure to heavy metals on the sites. Following the 2023 PA/SI, the USFS is planning an Engineering Evaluation and Cost Analysis (EE/CA) for completion in fall 2024, which would bring additional insights for reprocessing and restoration. These sites are in a prime opportunity window for the Good Samaritan pilot program due to the immediate need, but cleanup action has not yet been formally planned and likely not be funded until FY2026 (Maldonado 2024). The USFS is discussing consolidating waste piles from each of the mines for removal, which would be ideal for reprocessing the waste. This approach would allow restoration and closure of multiple mines.

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