

National Abandoned Mine Land
Reclamation Award Nomination

Nominated Project:
Lone Star – Mariposa Abandoned Mine Land
Reclamation Project

Location of Project:
Brewster County, Texas; approximately 225 miles southeast of El Paso,
Texas

Submitted by:
William H. Reimer, Engineering Technician
Mark J. Rhodes, AML Program Manager
Railroad Commission of Texas
Surface Mining and Reclamation Division
1701 N. Congress Ave.
Austin, Texas 78711
(512) 463-7313

Dan Trout
Office of Surface Mining Reclamation and Enforcement
5100 East Skelly, Suite 470
Tulsa, Oklahoma 74135
(918) 581-6430

Project Start: 1997
Project Completion: 2000
Project Costs: \$575,892

Organization Responsible for Reclamation:
Railroad Commission of Texas

Construction Contractors:
Johnston Products of Dallas
Runyan Construction

Submitted: March 2002

Project Background

The Lone Star – Mariposa Abandoned Mine Land (AML) Project was a multiphase effort to close dangerous abandoned underground mine openings in the historic Terlingua cinnabar (mercury) mining district west of Terlingua in Brewster County, Texas (Figure 1, Project Location Map). The project covered an area approximately a mile wide and three miles long with eleven different surface and mineral owners. It closed 163 mine openings at eight abandoned cinnabar mines. The eight mines include: the Mariposa, Lone Star, Margaret D, Monte Cristo and Croesus, Duncan, Rio Grande, and Tarrant mines.

The mines were completed in three phases, from 1997 to 2000 at a total cost of \$575,892.

- Phase 1, completed in 1997 at a cost of \$185,371, concentrated on steel grate and bat gate closures at the Mariposa Mine.
- Phase 2, completed in 1999 at a cost of \$148,985, focused on steel grate and bat gate closures at the Lone Star Mine.
- Phase 3, completed in 2000 at a cost of \$241,536, focused on the remaining shallower mine openings at the Mariposa Mine, many of which were suitable for backfilling.

Mine History

The **Mariposa** mine (Photo 1, Mariposa Mine showing adits at the base of California Hill) was the largest and deepest mine complex in this project and is located approximately 5 miles west of Terlingua, Texas. Approximately, 140 openings consisting of pits, trenches, adits and shafts have been identified at this site. The productive ground, a rectangular area roughly 3,500 feet long and 1,000 feet wide, centers about California Hill where Cinnabar was first discovered in the Terlingua area in 1884. Production was primarily between 1895 and 1911. Production of mercury was revitalized during World War I and between 1933 and 1945. The mine produced 20,000 to 30,000 flasks of mercury weighing 76 pounds each, making it the second largest producer of mercury in the Terlingua cinnabar mining district. The mine has approximately 23 miles of underground tunnel workings beneath California Hill. The principle subsurface workings consist of approximately three miles of drifts, stopes and crosscuts under California Hill that explore a vertical range of about 300 feet, much of the ore however was removed from pits, trenches and shafts northeast and west of the hill. Two of the shafts are 300 feet or more deep.

The **Lone Star** mine is located approximately 7 miles west of Terlingua, Texas and 1.5 miles west of the Mariposa Mine. Most of the portals are located on Tres Cuevas Mountain, which rises abruptly about 800 feet above the desert floor. At least 28 openings, consisting of adits, shafts, and trenches have been identified at this site. The mine was active during the 1910's, 1940's, 1954 to 1958, and early 70's. More than 1,000 flasks of mercury were produced from the mine. The workings consist of extensive trenching, several shafts and adits with drifts.

The other mines addressed by this project (**Margaret D** lode, **Monte Cristo** and **Croesus** claims, **Duncan** Group, **Rio Grande Quicksilver** mine, and **Tarrant** mine) are all within a mile of the Lone Star and Mariposa mines. Most of them were active from the early 1930's to the mid 1940's except for **Margaret D**, which was mined before 1905, during the early history of the mining district. The **Tarrant** and **Margaret D** mines were the largest producers of these other mines whose production was probably between a few hundred to a few thousand flasks combined. They all consist of many trenches, pits, shafts and underground stopes although their workings vary in size.

- The **Margaret D** lode is the longest, most continuous cinnabar lode in the Terlingua mining district, extending nearly 7,000 feet with shafts 30 feet to an estimated 100 feet deep.
- The workings of the **Monte Cristo** and **Croesus** claims comprise two small stopes extending from the surface down about 40 feet and a shallow shaft. One stope is more than 100 feet long.
- **Duncan** Group Development work consists of about 150 feet of tunnels, 900 feet of trenches, and several shafts less than 20 feet deep.
- The **Rio Grande Quicksilver** mine site consists short drifts that are connected with the surface through stopes at the 25 feet level. One shaft is reported to be 100 feet deep.
- The **Tarrant** mine consists of extensive underground workings from the No. 1 and the No. 3 shafts. The No.1 shaft is 130 feet deep and has more than 2,400 feet of drifts at the bottom. The No.3 shaft goes down nearly 250 feet and has more than 1,100 feet of drifts at the bottom.

Vegetation and Wildlife Impact

The Lone Star – Mariposa AML project site is located in the Trans-Pecos ecological region and are adjacent to areas of native vegetation described as creosotebush–lechugilla shrub (McMahon, Frye, and Brown, 1984). Distribution of the predominate vegetation of creosotebush–lechugilla shrub is on the lower slopes and intermountain valleys of the Trans-Pecos with commonly associated plants such as mesquite, yucca, lotebush, ocotillo, catclaw, whitebrush, ceniza, pricklypear, tasajillo, chino grama, black grama, and tarbush.

The following State and Federal agencies were consulted about the effects of the project on environmental and cultural resources:

- U.S. Fish and Wildlife Service (USFWS)
- Texas Parks and Wildlife Department (TPWD)
- Texas Historical Commission (THC)

The USFWS and TPWD expressed concern about bat habitat that may be present within the abandoned workings and possible presence of Lloyd's Mariposa cactus *Neolloydia mariposensis*, a threatened species. There were no properties listed or eligible for listing on the National Register of Historic Places within the project or affected area according to THC correspondence.

Surveys by the abandoned mine land (AML) staff showed that the major portion of the underground workings of the Mariposa mine were interconnected by twenty-four openings. Survey crews observed bats near six of these openings and at least two roosts deeper within the mine workings. AML staff determined that the other eighteen openings provided access to mine workings with enough complexity to provide bat habitat (winzes to multiple levels and stopes). This information was presented to TPWD and Bat Conservation International (BCI) bat specialists. After discussing closure plans, it was determined that the closure plans adequately addressed the bat resources and more extensive mine and bat surveys were not necessary.

The AML staff conducted sensitive plant surveys at the mine sites. Lloyd's Mariposa cactus, a threatened species, was observed in the area of the Mariposa mine. The disturbed area around the mine workings (trenches, shafts, adits, and ore dumps) is extensive. The cactus' distribution was limited to vegetated areas on rocky limestone soils, undisturbed by mining activities. None were identified in the immediate vicinity of any gate or grate closures.

The location of Lloyd's Mariposa cactus was flagged during the construction to avoid disturbing suitable habitat and any impact to this species. Contractors avoided habitat suitable for the Lloyd's Mariposa cactus as an additional precaution. Fill material stockpiles and equipment storage were limited to previously disturbed areas. No undisturbed fill was used during this project. Backfilling was done with waste rock left from the mining process.

Historical structures such as hand stacked rock walls, wooden headframes, tipples, and timbers were identified prior to construction in areas to be impacted by mine closure activity. It was determined that the proposed mine closure plan would have no significant effect. Mine closures were designed and planned to avoid impact to the historic fabric of the mine.

Historic mine structures were required by the bid document to remain intact and undisturbed and were therefore protected during construction. Any of these items found near a closure were addressed with special conditions in the bid document. Ground disturbing actions were limited to areas previously disturbed by mining to minimize disturbance of artifacts. Mine spoil was used for backfill operations. New road construction was not allowed.

AML Problems

The Lone Star - Mariposa mine sites are approximately 10 miles northwest of Big Bend National park, 5.5 miles west of Big Bend Ranch State Park and 7.5 miles north of the

Rio Grande River. The public regularly visits the site and explores the mine structures and workings. A racecourse for an annual mountain bike race traversed the mine area. All of these mines site are in close proximity (1.25 miles) to State Highway 170 and readily accessible by improved dirt roads. Several mines share access with the Chili Appreciation Society International (CASI) site that draws several thousand people to their annual chili cook-off.

These mine openings had health and safety hazards typically associated with abandoned hard rock mines such as:

- deep abandoned shafts with deteriorating head frames or collars;
- cave-ins caused by deteriorating rock conditions;
- unstable mine roof collapses;
- unsafe structures or ladders providing access into shafts and winzes;
- complex underground workings that could lead to disorientation;
- frequent use by poisonous reptiles.

Closure Types

A variety of closure designs have been used by the AML section of the Railroad Commission of Texas (RCT). Bat accessible closures were selected for mine workings where bat use or bat habitat potential have been observed. Bat gates were installed in portals used or thought to be used by bats. Shaft openings thought to be used by bats were grated with a bat gate cupola. The bat gates made with angle steel were based on designs developed by Roy Powers, a mine closure consultant to the U.S. Park Service. His designs were based on several years of experience in cave and mine closure. Other shaft openings needed for ventilation were closed with either a steel grate or cable net.

“Bat-friendly” closures installed in this project include the following types and numbers.

- **Angle Iron Bat Gate** Showing Removable Bar in Unlocked Position: (Photo 2) closed 12 adits;
- **Corrugated Metal Pipe (CMP) with Angle Iron Bat Gate** attached to one end: closed 4 adits;
- **CMP Bat Cupola and Steel Grate** with Angle Iron Cross Members: (Photo 3) closed 5 shafts;
- **Angle Iron Bat Cupola and Steel Grate**: (Photo 4, Cover Photo) closed 3 shafts;
- **Steel Grate**: closed 47 deeper shafts;
- **Cable Net**: closed 14 openings.

Shallow mines with no connection to other openings or mine workings (winzes, stopes, or drifts), generally exhibited little or no evidence of bat use. These mine openings were closed using the following methods.

- **Backfills**: closed 67 shallow shafts;
- **Rock and Mortar Walls**: closed 9 shallow adits;
- **Concrete Caps**: closed 2 small openings.

Design Efficiencies and Innovations

The implemented gate and grate designs were intended to minimize the closure's effects on bat use and mine air flow characteristics and maximize resistance to vandals. "Bat-friendly" closures limit the affect on the flow and circulation of air within mines.

Two new designs were incorporated into this project.

- CMP Bat Cupola with Angle Iron Cross Members (Photo 3)
- Recessed Steel Grate in Shaft Opening (Photo 5)

Sections of corrugated metal pipe (5 feet tall and 6 feet diameter) were used for bat cupolas. They were placed into a hole excised in steel grating after being fitted with rolled angle flanges and an angle steel closure. Flanges were made of 3" x 3" x 3/8" rolled angle steel. Two sections of flanges were placed back-to-back and welded around the bottom of the CMP. One section was welded around the top of the CMP to protect the bats from the sharp metal edge. Steel beams were placed 6 feet apart, on center, and centered over the shaft opening to support the CMP cupola and grating panels. The closure was made of angle steel cross members spaced 5-3/4" apart. The cross members were made from 4" x 4" x 3/8" angle steel with 1-1/2" x 1-1/2" x 1/4" angle steel stiffeners. The angle steel closure was placed in the bottom of the CMP to minimize vandals' access to the shaft opening. The five feet height was implemented to eliminate most predators' interference with the bats using the cupola mine entrance.

Steel Grates were recessed into smaller shaft openings where no beams were required (less than eight feet span) to support the grating and solid rock existed near the collar of the opening. Steel dowels one inch in diameter were epoxy grouted into the rock in a level plane a minimum of eighteen inches on center around the inside of the shaft opening. Angle steel (2-1/2" x 2-1/2" x 3/8") framework was installed around the entire perimeter with the inside corner of the angle welded to the steel dowels. Steel grating was cut to fit the inside of the shaft and welded on top of the angle steel framework. Any gaps along the edges more than four inches were covered with flat steel. This method minimized the impact on the area around the shaft. It is also less visible and preserves the historical impression of the mine.

Closure Effectiveness

Bat roosts have been observed in an adit at the Mariposa mine and an adit at the Lone Star Mine before and after the bat gates were installed. The mine openings were surveyed during a period of likely active ingress and egress.

No closure repair or maintenance has been necessary since the project began in 1997. There were provisions in the bid document to minimize erosion problems. Berms were built to divert storm water runoff away from shaft closures. The project site is monitored for vandalism because of its high visitation.

Benefits to Landowner and Community

This project has drastically limited the liability for the area landowners by eliminating dangerous openings. These mines are part of the rich mining history in an area that relies on tourism. It has increased public safety for tourists and the local populace from the hazards associated with abandoned mine workings while preserving the mine's historic structures and cultural features.

BIBLIOGRAPHY

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