

EVOLUTION OF ABANDONED UNDERGROUND HARDROCK MINE CLOSURES BY THE TEXAS ABANDONED MINE LAND RECLAMATION PROGRAM¹

by
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Abstract. The Texas Abandoned Mine Land (AML) Reclamation program began investigating, designing and implementing hard rock abandoned underground mine closures, after a young boy fell to his death in an abandoned mine opening in 1982. This paper discusses the evolution of abandoned hard rock mine closures in west Texas, by the Texas AML program in response to the development of abandoned underground mine resource information. Case histories are presented of the Texas AML program's efforts in west Texas including: mine history summaries; site characterization, environmental assessment; design and construction planning considerations, and construction cost information.

Additional Key Words: abandoned underground mines, bats, cinnabar, category 2 species, bat gates.

Introduction

The Texas Abandoned Mine Land (AML) Reclamation Program was established by the Railroad Commission of Texas (RCT) in 1982 after being approved and authorized by the federal Office of Surface Mining Reclamation and Enforcement (OSM), according to the Surface Mining Control and Reclamation Act of 1977 (SMCRA). In 1982, the Texas AML program began investigating and closing abandoned underground mine openings in the abandoned Terlingua Cinnabar Mining District after the death of a 14 year old, resulting from a fall into one of the abandoned openings.

Since 1983, the Texas AML program has closed 201 abandoned mine openings in Brewster, Culberson, and El Paso counties in west Texas. Awareness and understanding of the natural resources associated with abandoned mines and how these resources are affected by reclamation efforts has increased over the past several years. The objective of this presentation, is to chronicle the development of the awareness of abandoned underground mine resources as affected by the Texas AML program and the subsequent reactions

by the Texas AML program. As a result of this increased understanding, mine closures have evolved from simple earthen backfills to vandal resistant angle iron bat gates, and closure designs and construction plans have evolved to protect cultural resources and rare and sensitive flora and fauna.

Terlingua and Study Butte.

The Terlingua and Study Butte cinnabar mines are located in the Big Bend region of southwest Texas (Figure 1). The immediate area is characterized by rugged desert mountains and flora and fauna typical of the Chihuahuan desert.

The Terlingua quicksilver district produced over 11,385,000 lbs. (150,000 flasks) of quicksilver from 1899 - 1944 (Yates and Thompson, 1959). The mines operated at Terlingua and Study Butte were among the most productive of the mines in the district. The Chisos and Rainbow mines which were located in Terlingua, consisted of over 23 miles of tunnels with shafts sunk to deeper than 800 feet. The Study Butte mine was the third largest producer of quicksilver in the Terlingua District. Ore was extracted from several working levels that were up to 300 feet deep.

A 14 year old boy fell to his death in one of the openings of the Chisos Mine, near the Terlingua Ghost Town, in May 1982. The fall was estimated at 285 feet (RCT 1983). As a result of this incident, and increasing tourist activity in the area, the RCT's AML reclamation program began investigating the abandoned mines and preparing closure plans.

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maternity roosts, even though most of the mine openings had some form of closure in place that was not conducive to bat ingress and egress.

Park natural resource specialists surveyed the mine area for the presence of threatened, endangered or sensitive plant species. Two cactus species were found that were classified as category 2 species by USF&WS. Category 2 species are considered rare, but more information is needed to determine their status or taxonomic validity. A cholla cactus (*Opuntia imbricata* var. *argentina*) was found growing through two chain link fence mat closures. Another category 2 species - a Cory cactus (*Coryphantha duncanii*) was found in the vicinity of a mine opening.

The Mariscal Mine is listed on the National Register of Historic Places (NPS, 1993). The mine workings, retort facilities, mine buildings and roads were considered to be part of the historic fabric of the site.

In August 1993, the NPS prepared an environmental assessment of the mine closure plans. The eight portals were to be closed using an angle-

iron bat gate design (Figure 3) that was more vandal-resistant than the round bar designs used on the Christmas Mountains project. Shafts were to be closed using reinforced metal grating (Figure 4). Two shafts, thought to have value for bat ingress and egress into the mine, were to be fitted with bat gate cupolas; which are bat gates constructed in a box configuration and fitted over a hole cut in the metal grating (Figure 5). A construction window from November to April was imposed to limit disturbance to the maternity colony.

Sensitive plant species were to be avoided, and those that could not be avoided were to be removed and transplanted. Construction activities were not allowed to disturb historic resources and bat gates were recessed into some of the mine openings to preserve the character of the workings.

A FONSI was issued in May 1994 (NPS 1994). The RCT awarded a construction contract for the closures in December 1994 and completed the closures by May 1995. Average completed portal closure costs were \$7,000 each. Average completed shaft grate closures were \$10,800 each, and per bat gate cupola closures averaged \$9,500.

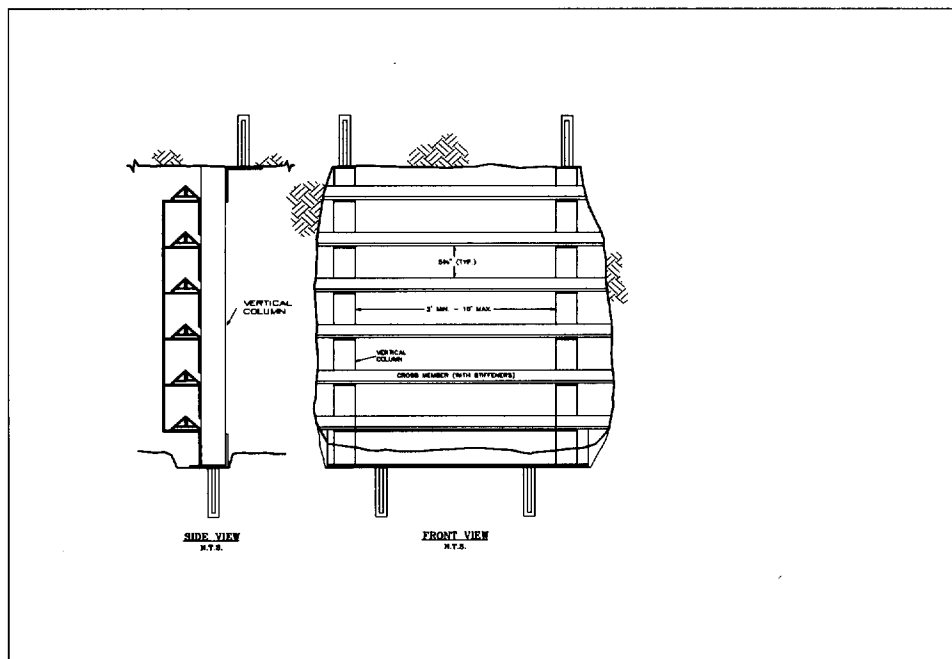


Figure 3. Angle Iron Bat Gate Closure Design

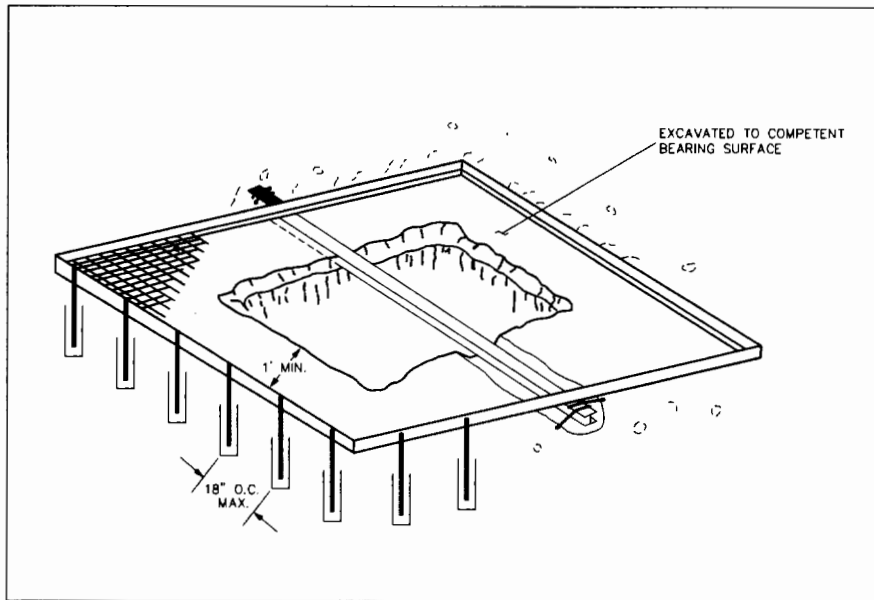


Figure 4. Metal Grating Closure Design

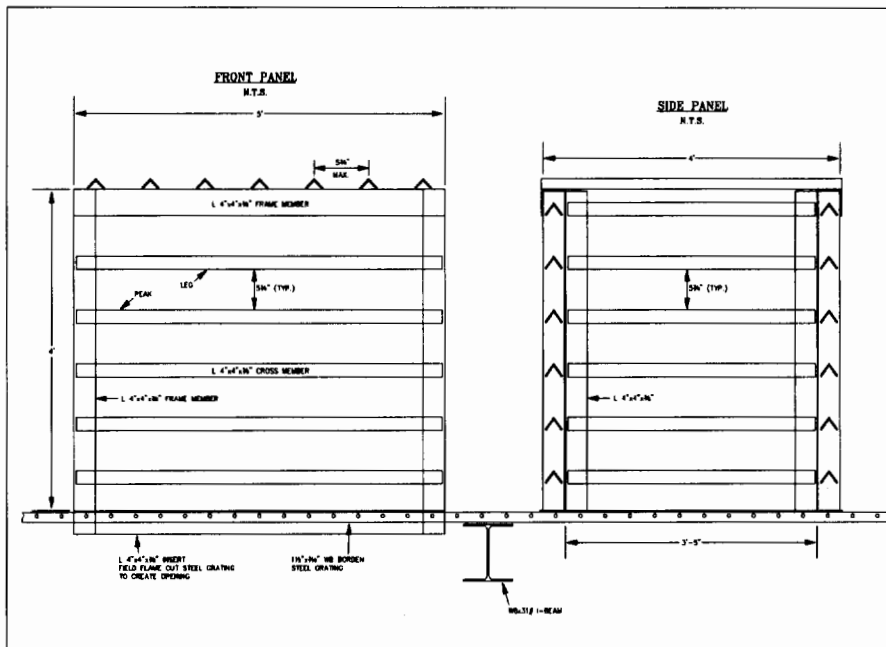


Figure 5. Bat Gate Cupola Closure Design

Guadalupe Mountains National Park

The Texas and Calumet copper mines operated from the 1890s until 1934 (NPS 1996), within, what is now the Guadalupe Mountains National Park (Figure 1). In October 1995, the NPS requested AML reclamation assistance from the RCT, in accordance with the cooperative agreement between the NPS and the RCT, to close dangerous mine openings in Guadalupe Mountains National Park.

The Texas and Calumet mines were located in Dog Canyon, at an elevation ranging from 6,300 to 7,200 feet msl. The canyon was extremely steep, with slopes ranging from 30 to 75%. The Guadalupe Mountains rise dramatically and abruptly above the adjacent desert floor. The pinyon pine (*Pinus edulis*) juniper (*Juniperus* spp.) and ponderosa pine (*Pinus ponderosa*) communities are the predominate vegetation type in Dog Canyon.

The NPS conducted a preliminary investigation of the abandoned mine workings prior to requesting AML assistance from the RCT. Similar to the investigation at Big Bend National Park, the investigation team consisted of a NPS geologist and cultural resource specialists and consulting bat and mine closure specialists. The investigation team found 4 portals and 4 vertical openings in need of closure. Two bat species (Townsend's big-eared bat and cave myotis) were observed using the adits as intermediate and warm season roosts. The bat and mine closure specialist felt that the adits could potentially function as winter hibernacula. Angle iron bat gates were recommended for the adits with a construction window from April to October to avoid disturbing bats that could potentially hibernate in the adits.

All but one of the proposed closures were located within a designated wilderness area. The vegetation communities were considered fragile and not tolerant of construction disturbances. Motorized vehicles were not allowed within the wilderness area. Therefore, equipment and materials mobilization were accomplished via helicopter and all other travel was by foot.

The Texas and Calumet mines are deemed eligible for inclusion on the National Register of Historic Places (NPS 1996), therefore construction disturbances could not alter the historic fabric.

Excavations were only allowed in the presence of an NPS cultural resource specialist.

In January 1996, the NPS completed its environmental assessment (NPS 1996) and issued a FONSI in April, 1996. The RCT awarded a contract for the construction of 4 angle-iron bat gates and the backfilling of 6 vertical openings. The work was initiated on September 16, 1996 and was completed October 7, 1996. All equipment and materials were mobilized and demobilized via helicopter. Bat gate closures averaged about \$9,000 each.

Lone Star-Mariposa

The Lone Star and Mariposa cinnabar mines operated intermittently from the late 1800s to 1945. Over 2,277,000 lbs. (30,000 flasks) of mercury were produced, making it the second largest producer in the Terlingua Cinnabar Mining District.

The Mariposa Mine is located approximately 1.25 miles north of Highway 170 (Figure 1) and is readily accessible from the location of the Terlingua World Chili Championships, an annual event that hosts thousands of participants. More than 100 abandoned mine openings connect over 3 miles of drifts, winzes, and crosscuts, through a vertical range of about 300 feet.

The Lone Star Mine is located approximately 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. Approximately 15 abandoned shafts and portals have been located. Most of the shafts are 40 feet or less in depth and adits are seldom more than 300 feet in length.

The Lone Star and Mariposa Mines were investigated by Texas AML staff as part of a west Texas inventory. Surveys were conducted to characterize mines, collect mine closure design information and environmental resource information. The reclamation effort is divided into three phases. The first phase includes gate and grate closures at the Mariposa Mine. The second phase will include gate and grate closures at the Lone Star Mine. The third phase will include shallower mine openings at the Mariposa Mine that were suitable for backfilling.

State and federal agencies were consulted about the effects of the Phase I project on environmental resources. The THC determined that the Phase I project would not adversely affect significant cultural resources. TPWD and the USF&WS expressed concern about bat habitat that may be present within the abandoned workings and possible presence of Lloyd's Mariposa Cactus (*Neolloydia mariposensis*), a category 2 species.

More extensive surveys by the AML staff showed that the major portion of the underground workings were interconnected by 24 openings. Survey crews observed bats near six of these openings and determined that the other 18 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 BCI bat specialists. After discussing closure plans, it was determined that extensive mine and bat surveys were not necessary. Portals used or thought to be used by bats were to be gated. Shaft openings thought to be used by bats were to be grated with a gate installed in a corrugated metal pipe (CMP) that would then be inserted into the grate (Figure 6). Other shaft openings needed for ventilation would either be grated or have cable netting installed over them.

AML staff conducted a survey of the Mariposa mine area to determine the presence of Lloyd's Mariposa cactus. The cactus' distribution

was limited to areas on rocky limestone soils, undisturbed by mining activities, and none were located in the immediate vicinity of any gate or grate closures.

An environmental assessment was prepared, based on plans developed with TPWD and BCI. A FONSI was issued by OSM in June 1996. The project was bid and a contract executed in December 1996. The project is currently in progress. Average gate closure bid costs are \$3,580. The CMP/grate closures were bid at an average of \$5,500.

Summary

The manner in which each of the preceding projects was designed and completed indicates the evolutionary nature of the approach used in closing underground hardrock mine openings. In the early stages of this program, abandoned mines were identified and treated as a hazard to human health and safety in need of immediate attention. At that time, reviewing state and federal agencies seemed to be in agreement with the RCT assessment of the hazard and limited their comments to the more critical environmental resources, such as endangered species and sites included on the National Register of Historic Places. AML reclamation programs closed hazardous openings as quickly, permanently, and economically as possible.

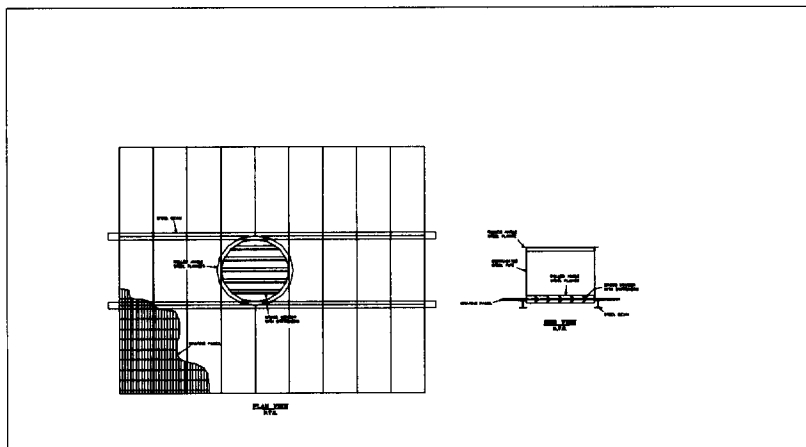


Figure 6. Corrugated Metal Pipe Closure Design

Over time, the various state and federal reviewing agencies developed better resource inventory data, especially concerning biological resources. Availability and access to this information has resulted in greater input into abandoned mine land plans and designs

The abandoned mine land reclamation community has responded by creating innovative mine closures and designing and planning abandoned underground mine closures that minimize impacts on natural and cultural resources. In some instances, the closures have actually enhanced the affected resources. As a result of this increased understanding of our natural resources, abandoned underground mines are not simply labeled as hazards to human health and safety, but are considered in many cases to be a valuable habitat and cultural resource.

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