LAKE VALLEY MINE SAFEGUARD PROJECTS
LAKE VALLEY, SIERRA COUNTY, NEW MEXICO

Submitted by:
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Mining and Minerals Division
Energy, Minerals and Natural Resources Department
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March 2015

Phase I Construction:
December 2004 to August 2005
St. Cloud Mining Company, Winston, NM
Final Cost: $410,927.33

Phase II Construction:
September 2007 to June 2008
St. Cloud Mining Company, Winston, NM
Final Cost: $711,182.35

Phase III Construction:
July 2008 to November 2008
Runyan Construction, Silver City, NM
Final Cost: $99,329.12

Phase IV Construction:
August 2010 to January 2011
Pioneer Industries Inc., Albuquerque, NM
Final Cost: $433,840.05

Lake Valley Maintenance Project:
January 2012 to March 2012
Runyan Construction, Silver City, NM
Final Cost: $11,945.00

Total Construction Cost: $1,667,223.85

Archaeological Consultant: Dos Rios Consultants, Silver City, NM

Bat Consultant: Dr. J. Scott Altenbach, University of New Mexico (ret.)

Geotechnical Consultant: Kleinfelder, Albuquerque, NM

Toroid Tire Plug Consultant: N.L. Tribe & Associates, Kelowna, British Columbia

Geosynthetically Confined Soil® Consultant:
Bob Barrett, Co-Founder of Geosynthetically Confined Soil® Wall Technology

Engineering Design, Contract Management and Contract Administration
for Professional Services and Construction: New Mexico Abandoned Mine Land Program

Project Partner: Bureau of Land Management

History and Background

One of the first landmarks a traveler sees approaching the ghost town of Lake Valley from the south along State Highway 27 is Monument Peak. From some angles, part of its crown of rocks resembles a giant lizard resting on the mountain. As our traveler nears the town, she will first notice a looming stockpile of black crushed manganese ore from 1950s mining. Then, as she turns off the highway onto the maintained dirt road leading to the town, she will first see scattered buildings and ruins and then a large adobe schoolhouse on a small rise.

Hills and mountains cradle the town site on nearly all sides. Only through a gap between two hills to the southeast does the view open onto the flat Chihuahuan Desert grasslands and basin-and-range country of southwestern New Mexico. Hillsboro, the nearest town and perhaps our traveler's next destination, is situated 17 winding miles further north across low craggy mountains.

For a town deserted for several decades, some of the buildings are in remarkably good shape, especially the two-room schoolhouse, which the Bureau of Land Management (BLM) has restored and maintains as a small museum, displaying a collection of local historical and mining artifacts and a fully furnished 1930s classroom. The BLM has stabilized several other buildings in the town site, including a one-room chapel. In a town that once housed as many as a couple thousand people, today only one couple lives, volunteering with BLM to manage the museum and keep watch on the area. On Wednesdays through Sundays, the Lake Valley Historic Townsite[1] is a key stop for tourists travelling the BLM Lake Valley Back Country Byway,[2] some of whom linger for an hour or two to visit the museum and ghost town and take photographs.

Over a low range of hills immediately north and northwest of the town, the landscape reveals the reason for the town's former existence – the remnants of several decades of silver and manganese mining dating to the territorial and early statehood days of New Mexico.[3] The adventurous traveler or local who ventures into the primary mined area over the barbed wire fence (or past the locked gate with signs warning them that the land beyond is private and that abandoned mines are death traps) will encounter a scene of seeming devastation. Rough, tan and black mine waste piles cover the valley floor one right after the other and then continue spottily up nearby hillsides. In the desert silence, crumbling adobe walls, partially collapsed dry laid stone and wood frame buildings, leaning timber headframes and loadouts all speak of a vibrant, noisy past. On a hill slope opposite the large manganese ore stockpile lie the ruins of a rock crusher built over the remnants of an earlier mine mill. Seemingly randomly interspersed among the structures and waste piles are numerous shafts, adits, and stope openings, all of which were until recently wide open under the often cloudless skies.

At the schoolhouse museum, our traveler will learn that silver was discovered in Lake Valley in 1878 when the area was roamed by Apache bands, but that the history of mining there did not truly spring to life until 1881 on the heels of an intensely publicized and well-promoted speculative mining venture. Its promoters, George Roberts and J. Whitaker Wright, are considered by many as two of the most suave, unscrupulous individuals in the West and perhaps in the country in the 1880s. Wright made a fortune by promoting silver mining companies in Lake Valley and Leadville, Colorado, although none of the companies made money for their shareholders. Even today, some debate the veracity of their report of the discovery at Lake Valley of an underground room named the Bridal Chamber filled with native silver that could be melted off the walls with candles. Nonetheless, we do know that this report led to a frenzy of hastily marked claims, as hurriedly built rough-and-tumble frontier mining camp, extensive and continuous prospecting and mining for twelve years, and the construction of a railroad spur. Most of this activity came abruptly to an end in 1893, as it did at almost all silver mines, mills, and smelters in the western United States, when Congress demonetized silver leading to a precipitous fall in its price.

After lying nearly dormant for another decade, a second, quieter period of mining began in the early 1900s and extended fitfully to 1955. Although some silver was produced, mostly as byproducts, this later period of mining focused on the production of flux materials and manganese. As is true of so much mining history, mining activity in Lake Valley was largely driven by distant events: initially national monetary policies and the accompanying fluctuations in silver prices and later the demands for the strategic mineral manganese during two major world wars and the beginnings of the Cold War.

DESIGN CHALLENGES AND RECLAMATION TECHNIQUES

The New Mexico Abandoned Mine Land (AML) Program identified three key considerations governing the safeguarding approaches to be used at Lake Valley – first, the importance of the site in New Mexican mining history and its eligibility for listing on the National Register of Historic Places; secondly, the presence of significant bat habitat in the underground mine workings; and thirdly, the presence of facilities to encourage tourism at the site, including the adjacent Back Country Byway focusing on historic mining, the existence of an indoor and outdoor mining museum in the nearby partially restored and stabilized ghost town, and the possibility that the Bureau of Land Management may one day purchase privately owned land in the mining district as an expansion of that museum.

These factors led the AML Program to safeguard the abandoned mine openings in ways that, while protecting bat habitat, would both honor the history of local mining and be appropriate for an outdoor historical mining museum, particularly those features on BLM land and those closest to the ghost town. As part of this program, visible structural closures would incorporate aesthetic features and, in many instances, afford visitors a chance to look into underground mine workings. Construction activities would avoid damaging existing mining structures and remains, including timber headframes, loadouts, mill and house foundations, shacks, and extensive trash scatters. In a few instances, construction contractors would be required to brace timber headframes and loadouts at shafts and mine declines to minimize the risk of collapse during and after construction.

In the project area, AML staff identified 297 hazardous mine openings scattered over approximately two square miles, with the vast majority of those within a half square mile. In the extensive underground workings (many of which are interconnected), UNM bat biologist Dr. Scott Altenbach found highly significant bat maternity and hibernation use by Townsend's big-eared bats (*Corynorhinus townsendii*), a species of concern, and several mouse-eared bat species (*Myotis*). 69 bat compatible closures would be required to preserve and protect their habitat. Provision for continued access by bats and other wildlife to a shallow lake in the underground mine workings, fed by surface runoff captured by a shaft and one of the few year-round water sources available in the area, was also important.

In addition to cultural resources and bat habitat considerations, surface rock conditions at Lake Valley presented a significant design challenge. Geotechnical investigations confirmed that much of the near-surface material at the mine sites, up to depths of forty to fifty feet, is caliche or calicrete. This material is a calcium carbonate cemented soil or rock found in dry climates, with variable and relatively low strength. This meant that most of mine portals where bat compatible structures were needed had to be stabilized to prevent continued or future collapse.

The underground mine workings are generally within a hundred feet of the surface, with some underground stopes and passageways reaching to within a few feet of the surface. Over the years, several of the shallower stopes had collapsed, leaving large depressions at the surface. The largest still intact shallow underground stope is so big that, during underground bat habitat surveys, mining lamps were barely able to illuminate the far walls and back. To minimize the risk of collapse of this stope, construction equipment was required to avoid an area close to an acre in size.

<u>Design Responses</u>

These design challenges led AML Program engineers to use both tried-and-true technologies for mine closure – backfilling; blasting; polyurethane foam (PUF) plugs, some with corrugated steel riser pipes for bat access or airflow to underground bat habitat; high-tensile strength steel mesh covers; and steel bat gates and cupolas – as well as to try new techniques.

<u>Toroid Tire Plugs</u>: Several of the large declined stope openings presented the greatest design challenges. Not only was the rock at these openings fractured and weak, with signs of partial collapse, but bats also needed to be able to continue to fly into and out of these openings. In particular, the Feature 4 Carolina stope opening presented significant difficulties. Its steeply declining entry was filled with a forest of intact ponderosa pine timber support posts that could not be removed for reasons of safety and historic preservation. In addition an immediately adjacent small open stope had served as a blacksmith shop in the 1880s and was slated for preservation. Designers considered several standard closure measures, including a PUF plug with

bat access, concrete masonry walls, and fencing, but rejected all options due to high costs, unacceptably high degrees of construction hazard exposure, or failure to truly mitigate the hazard.

Deciding that it needed to look at a new approach, the AML Program contacted N. Tribe and Associates Ltd., consulting mining engineers from British Columbia. AML engineers were aware that Norm and John Tribe had conceived of, developed and extensively field tested a technique called toroid tire plugging. This closure method uses large spent tires from off-the-road earthmoving equipment to form plugs at mine openings. Tightly placed either in stacks or vertically to fill mine openings, the tires form plugs flexible enough to adapt to movement of the near-surface rock around the closure as it continues to weather, settle, and fracture. Over each tire installation are placed, from the bottom up: an initial layer of fill to create a planar platform, a mat of spent highway truck tires cabled together on the fill platform, a geogrid, a geotextile, and a final layer of fill to finish grade. Together the three reinforcing elements – tire mat, geogrid, and geotextile – bridge voids in the fill that may develop above the tire plug as some of the initial fill leaks through small gaps between the tires in the plug, help to spread and equalize loads on the tire plug, and minimize movement of fines through the entire installation.[4] Although the tires will slowly oxidize over time, their longevity can be expected to be several hundred years when protected from ultraviolet light.

One common way of providing passage for bats at adits, declines, and stopes is to use corrugated steel pipes (CSPs), especially where the portal needs stabilizing. Although the Tribes had not used toroid tire plugs with pipes through them to accommodate bats, they felt that it was feasible to do so. Knowing that unexpected problems might arise during construction of this untested configuration, AML Program engineers decided to proceed, reasonably sure that any such problems could be solved. They were right on both counts.

To close the 16-foot high by 20-foot wide Feature 4 Carolina stope opening, four adjacent stacks of six- to ten-foot diameter tires were placed at its brow, with a 72-inch diameter CSP between two of the stacks. When the tire stack at the culvert was continued on top of the pipe, it created a point load on the CSP, denting its top. To solve this problem, the tires above the culvert were removed, the culvert reshaped to round, a PUF cap placed over the culvert to spread loads over its full width at the plug location, and tires stacked above the cap to the back of the stope opening. See the attached drawing and photograph. The nearby stope with the historical blacksmith shop had unstable rock conditions and, to prevent human entry, the opening was covered with a dark colored high-tensile strength mesh that allows viewing into the opening.

Another sixteen mine openings, ranging from other large stope openings to small adits and a small shaft that required only a single large tire as a plug, were also successfully closed using toroid tire plugs. The AML Program has gone on to use toroid tire plugs at other project sites.

<u>Polyurethane Foam Plugs:</u> Several other mine openings required innovative closures, two using PUF plugs in novel ways and another two using Geosynthetically Confined Soil® technology.

PUF has a history of successful use in abandoned mine safeguarding dating back to the 1980s. Where plugs have been placed against timber cribbing, however, the timbers tend to retain moisture and can eventually rot away, leading to plug failure. A 5½-foot square, 94-foot deep shaft (only known by its feature number, #047-034S) required a bat compatible closure with a riser pipe inside a PUF plug to stabilize the near surface caliche. But the shaft had over fourteen feet of timber cribbing some distance below the surface, below which competent bedrock was visible. To avoid placing PUF against the timbering, a small PUF plug was constructed in bedrock just below the bottom of the cribbing. This plug was designed to be sufficiently strong to support eight-feet of lightweight scoria fill placed between the 48-inch diameter CSP riser pipe and shaft walls and any portions of the cribbing that could not be safely removed during construction. The caliche above the scoria fill was then excavated to form a crater within which a large PUF plug shaped like an inverted cone was placed to support the entire weight of the scoria fill below it and the bat closure above it. This is the first and only installation of such a double PUF plug at a shaft known to the N.M. AML Program. See the attached drawing.

The project's bat biologist, Dr. Scott Altenbach, also recommended that the Bella #3 Mine (Feature #052-089S) be closed with a bat compatible closure. The shaft, 5 foot by 9 foot by 63-foot deep, however was lined with timber cribbing almost to its base, some of it partially collapsed. In addition, the State Historic Preservation Office had designated that the headframe remain intact. AML engineers were unable to devise a constructible, affordable and permanent closure that would allow for bat passage through the shaft while preserving the headframe. In further consultation with Dr. Altenbach, he was willing that the shaft be closed since there were several other bat compatible closures nearby. However the drift at the base of the shaft could not be blocked, being important for bat movement in the underground workings. But backfilling the shaft would completely block the drift. Instead, construction crews were sent underground to build formwork for a 23-foot thick PUF plug at the base of the shaft. PUF could be placed against bedrock on at least three sides of the shaft while leaving the fourth side along the drift open for bat passage. The shaft volume above the PUF plug was filled with lightweight scoria with a two-foot thick compacted clay cap at the surface to minimize water infiltration. See the attached drawing and photograph for details. Before working underground, the contractor prepared a safety plan, including establishment of alternate emergency escape routes.

Geosynthetically Confined Soil®: Geosynthetically Confined Soil® (GCS) technology is not known to have been used previously for mine closures, but proved to be a good closure method for the Streiby Shaft (Feature #048-035S), a 4 foot by 5 foot by 56-foot deep shaft that required a bat compatible closure. However, the shaft was nearly completely lined with timber cribbing, the upper ten to fifteen feet of which was significantly disintegrated and partially collapsed. Deeper cribbing was in much better condition. A deep PUF plug was not feasible at this site and depth to bedrock was unknown, but at least twenty feet below the surface. The AML Program requested design assistance from Bob Barrett, a geotechnical engineer who helped to develop GCS technology. With his help, the Program decided that the best solution was to excavate a 16-foot deep crater in the calicrete around the timber cribbing; remove the exposed, disintegrating, and collapsed cribbing; and place a relatively thin polyurethane foam plug to support the initial fill layers of a GCS plug.

GCS uses eight-inch layers of compacted granular fill sandwiched between geotextile sheets, creating an easily and quickly constructed, high-strength, low-cost supporting structure.[5] At this location, this approach was significantly less costly than placing a concrete plug or full PUF plug. AML engineers designed a CSP riser pipe through the hybrid PUF/GCS plug and a bat compatible structure at the surface that minimizes precipitation wetting of the timbers below the GCS plug. In a desert environment in a largely dry mine, protecting timbers from precipitation will significantly extend their life. See the attached drawing and photographs.

The N.M. Program also used GCS to repair a small subsidence crater above one of the toroid tire plugs in Lake Valley where the soil fill was leaking past the tire plug installation.

The Federal Highway Administration has demonstrated bearing capacities exceeding 20 tons per square foot with GCS technology and is promoting its use for bridge abutments (under the designation “geosynthetic reinforced soil”). The Program has since used GCS technology to construct low-cost retaining walls at shaft closure sites on another project.

<u>Other Notable Closures</u>: A two-compartment shaft measuring about 8-foot by 11-foot in the town site (Feature #088-86) still had the original belt-driven pumps that were used to supply water to the town mounted on wooden beams over the opening. The AML Program safeguarded the opening with a PUF plug with concrete slab cap (to protect the shallowly placed PUF), while preserving the pumps and appurtenant piping close to their original locations as a historical display. (Original shaft depth is unknown because of collapsed timber cribbing.) Tourists can visit this site on a recently built trail that accesses this and other nearby mining features near the town site.

In a small follow-up maintenance project, a small bat cupola was installed over the entry to a corrugated steel pipe with recessed bat gate in an adit. The culvert portal is within a large depression resulting from collapse of a shallow stope, where tumbleweeds would collect every spring, completely blocking the culvert in front of the bat gate. The upper third of the cupola is above the general seasonal level of the tumbleweeds in the depression and provides bats year-round access through the culvert into the mine workings.

<u>Revegetation</u>: Several mining access roads were closed to limit vehicular access to bat compatible closures, thereby reducing the potential for vandalism. Closed roads and all land disturbed by construction activities were extreme roughened and successfully seeded with native grasses, forbs, and shrubs. In arid and semi-arid climates,[6] extreme surface roughening significantly improves seeding success by de-compacting soils and forming numerous depressions that capture precipitation and windblown organic matter and protect young sprouts from drying winds.[7]

Coordination with the Community and BLM

In a public meeting in Hillsboro prior to construction, local citizens expressed support for the mitigation and elimination of hazardous mine openings at Lake Valley. Attendees knew of incidents of human visitation to the mine site and sometimes into the mine workings.

As the AML Program's key partner on the project, BLM staff also expressed strong support for safeguarding of the mine openings on both BLM and private land. Some staff supported the idea of extending a trail onto BLM land deeper within the mining district where several bat cupolas were to be located. AML Program and BLM staff also raised the idea of purchasing privately owned land for inclusion into a Lake Valley outdoor mining museum. To date neither trail development to the BLM-owned mining area nor property purchases have moved forward, but the AML Program's safeguarding work, done aesthetically and in a manner appropriate for public visitation, would allow those proposals to move forward.

Summary

AML engineers designed a total of 98 structural closures, 69 of which were bat compatible. (The Program continues to monitor bat habitat and changes in bat populations in the mine workings through both internal and external surveys.) Each structural closure was custom-designed for its particular setting. Another 199 openings, usually smaller workings with little or no bat habitat potential, were backfilled using mine waste rock or other nearby borrow material.[8]

Working with the local community, private landowners, and BLM, the AML Program rose to the social and technical challenges to safeguarding this historic mining site. Features were closed in ways that conserve as much of the historical value of the structures and mine openings as possible, while allowing safe visitation by travelers and preserving significant bat habitat in the mine workings. The Program was able to achieve this at an average cost of only $5,600 per mine opening, despite the significant number of structural closures required and the technical difficulties that several of them presented. One reason for the relatively low cost of structural closures is the use of toroid tire plugs, since spent tires were able to be procured for little more than the cost of hauling.

The NM AML program used innovative technology throughout this project in a way that exceeds the spirit and intent of the Surface Mining Control and Reclamation Act (SMCRA) by eliminating the significant hazards at this abandoned mine site while preserving wildlife habitat and historical mining structures. The public is more aware of SMCRA through public meetings and published work on this project, including an archaeological report several hundred pages long, the placement of maps resulting from the project as displays in the schoolhouse mining museum, and a local newspaper article in the Truth or Consequences Herald (see the article attached below).

Project Statistics

297 hazardous mine openings safeguarded:

- 98 structural closures:
  - 69 bat compatible closures:
    - 9 bat cupolas
    - 15 horizontal bat gates at shafts
    - 14 vertical bat gates in adits and culverts
    - 21 mesh and grated airflow closures
    - 10 other structural closures for bat habitat preservation
  - 29 other structural closures for historic preservation, etc.
- 199 openings backfilled

19.2 tons of weathering steel used in bat compatible closures

585 cubic yards of polyurethane foam installed

6,116 square feet of high tensile-strength steel mesh, with 89 rock anchors, installed

17 mine openings closed with toroid tire plugs using:

- 140 large earthmoving tires to form the plugs, and
- 629 truck tires for the tire mats

Two Geosynthetically Confined Soil® installations

14.5 acres of land disturbed by construction activities (including half a mile of obliterated old mining access roads) extreme roughened and seeded

Completed in five phases of construction over seven years

Notes:

1. Information on the Lake Valley Historic Townsite can be found at: en.wikipedia.org/wiki/Lake_Valley,_Sierra_County,_New_Mexico and http://www.blm.gov/nm/st/en/prog/recreation/las_cruces/lake_valley_townsite.html.

2. For information on the Lake Valley Back Country Byway, visit: www.newmexico.org/lake-valley-trail/ and www.blm.gov/nm/st/en/prog/recreation/las_cruces/lake_valley_byway.html.

3. Satellite and bird's eye views of the project site can be viewed by typing in the coordinates of the approximate center of work, 32°43'26" N 107°34'18" W, in Google Earth (the town site

is located about 0.4 miles southeast of these coordinates) or by searching for Lake Valley, Sierra County, New Mexico in Google Maps or Bing Maps. In close views of the project area, the rippled ground surface left by extreme surface roughening, some of the bat closures, and standing headframes are visible. Links to numerous photographs and images of the Lake Valley town site are also available in Google Earth and Flickr and from internet search engines.

4. More information on toroid tire plugs, including installation photographs, is found at: members.shaw.ca/nta/nltribe/, https://circle.ubc.ca/bitstream/id/23684/1999%20-%20Tribe,%20Tribe%20-%20A%20Successful%20Method%20of%20Reclaiming.pdf, www.emnrd.state.nm.us/MMD/OFD/documents/2008StCloudLakeValleyII.pdf, and www.emnrd.state.nm.us/MMD/AML/documents/Fig_13_048-021_049-000_Stopes_Tire_Plugs.pdf.

5. Information on Geosynthetically Confined Soil® is available at: www.gcswall.com/, www.fhwa.dot.gov/multimedia/research/infrastructure/bridges/grs/index.cfm, and www.fhwa.dot.gov/publications/research/infrastructure/structures/11027/11027.pdf.

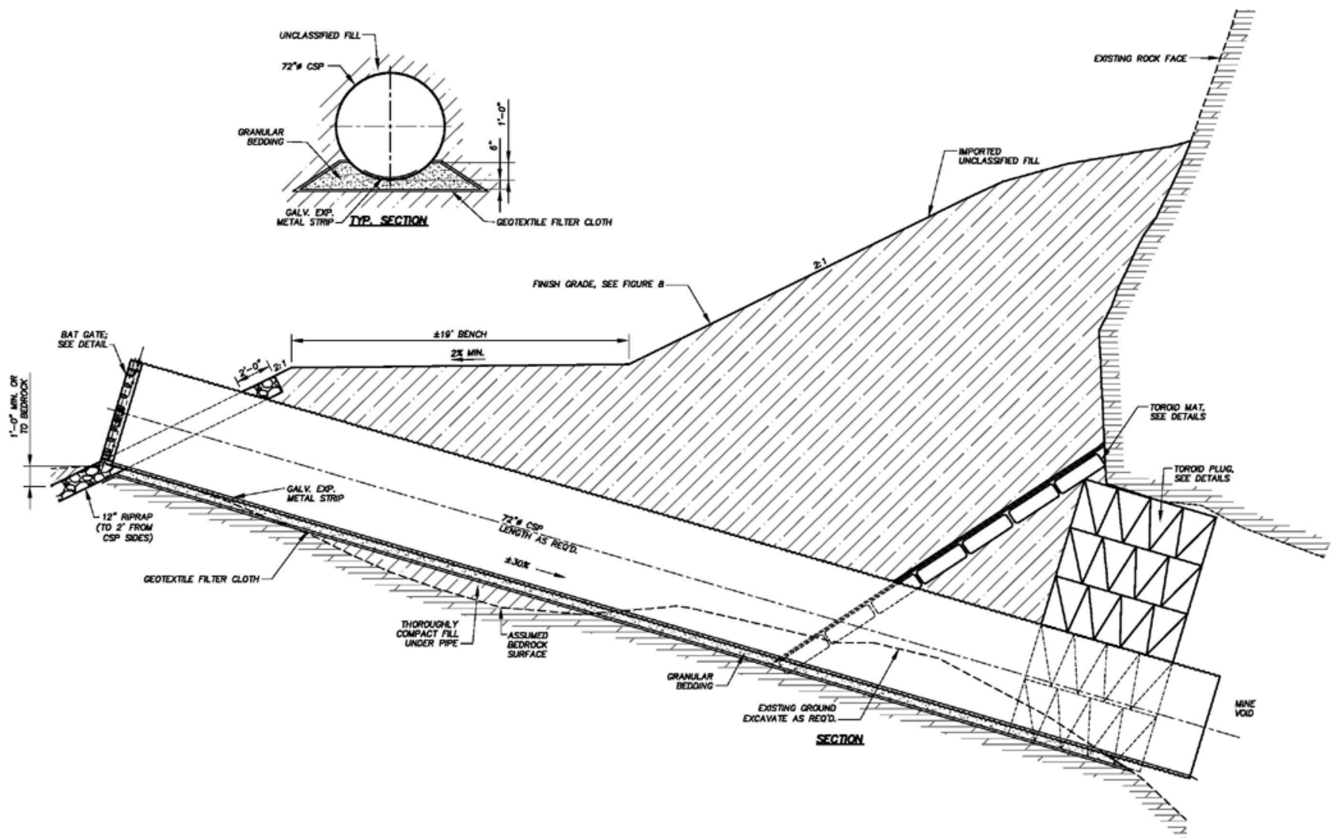
6. The nearest long-term weather station in Hillsboro, N.M. reports 12.40 inches mean annual precipitation, with a low of 3.35 inches in 1956 and a high of 20.33 inches in 1941. Additional climatic information for the Hillsboro weather station is available at: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm4009.

7. Information on extreme surface roughening is found in The Practical Guide to Reclamation in Utah, Utah Division of Oil, Gas and Mining, n.d., on pages 106 ff. at: https://fs.ogm.utah.gov/pub/MINES/Coal_Related/RecMan/Reclamation_Manual.pdf .

8. More information on the AML Lake Valley projects, including construction drawings and photographs, can be found on the N.M. Abandoned Mine Land Program's website at:

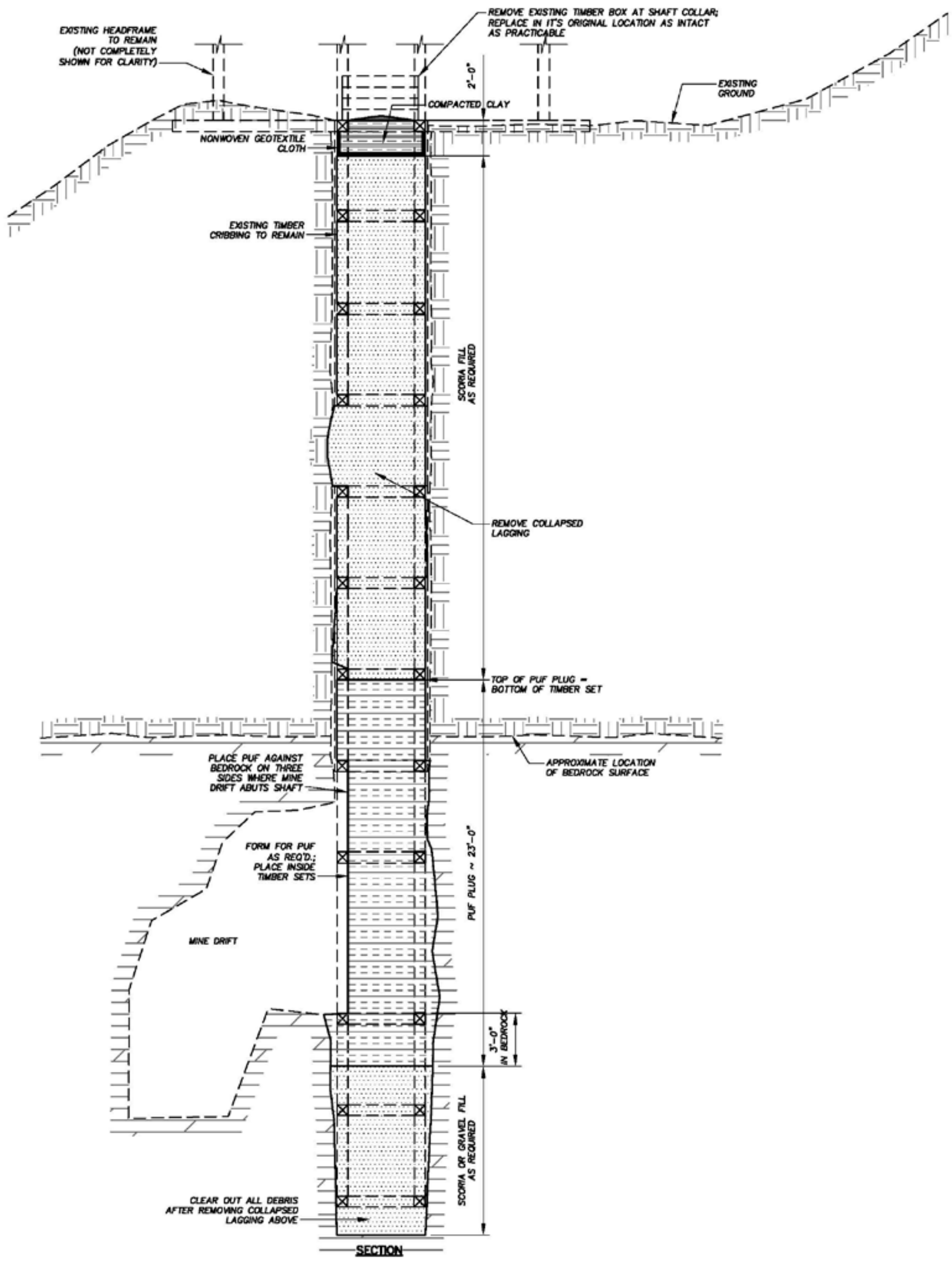
Phase I:	www.emnrd.state.nm.us/MMD/AML/AML-LakeValleyPhaseI.html
Phase II:	www.emnrd.state.nm.us/MMD/AML/AML-LakeValleyPhaseII.html
Phase III:	www.emnrd.state.nm.us/MMD/AML/AML-LakeValleyPhaseIII.html
Phase IV:	www.emnrd.state.nm.us/MMD/AML/AML-LakeValleyPhaseIV.html
Maintenance:	www.emnrd.state.nm.us/MMD/AML/AML-LakeValley.html

DRAWINGS AND PHOTOGRAPHS:

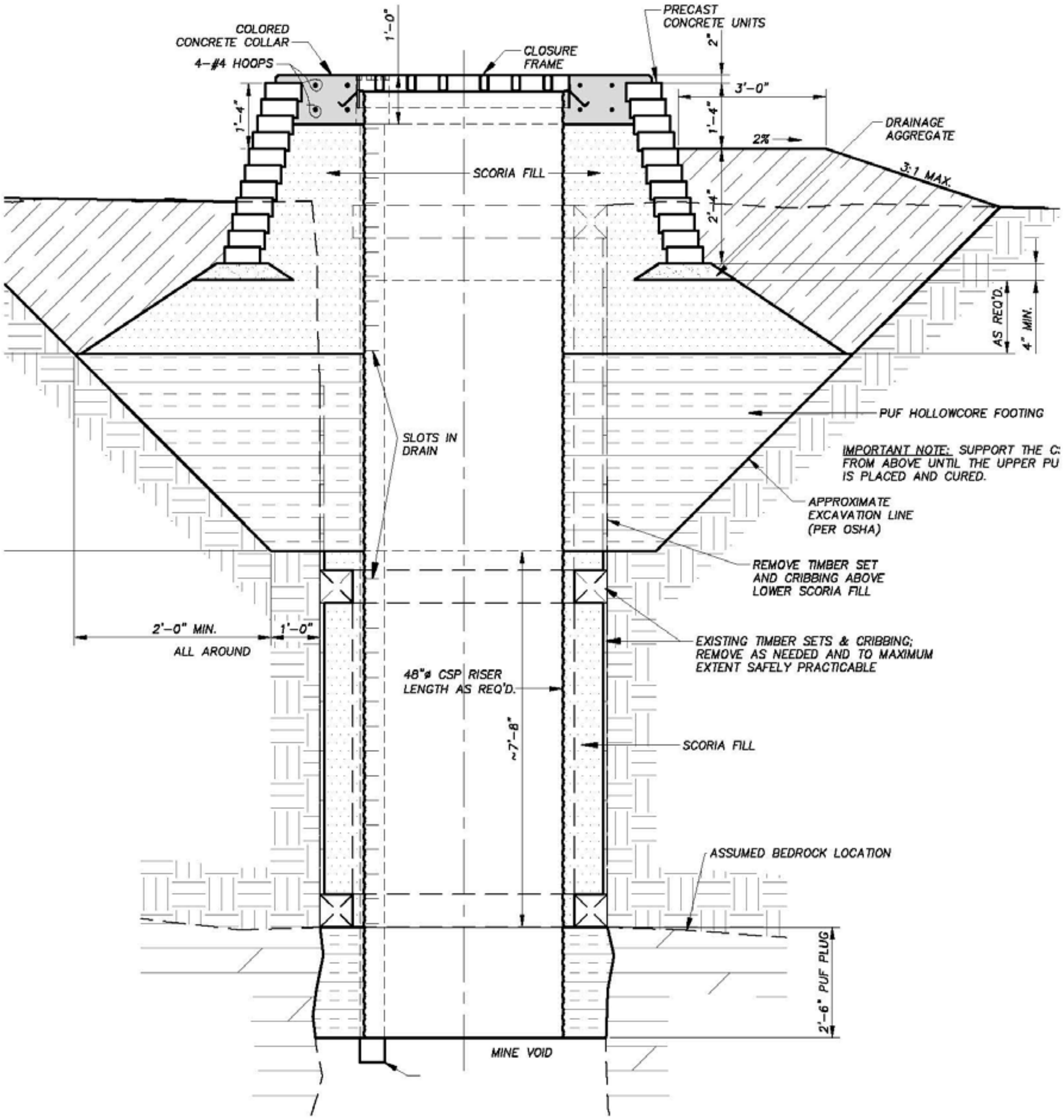


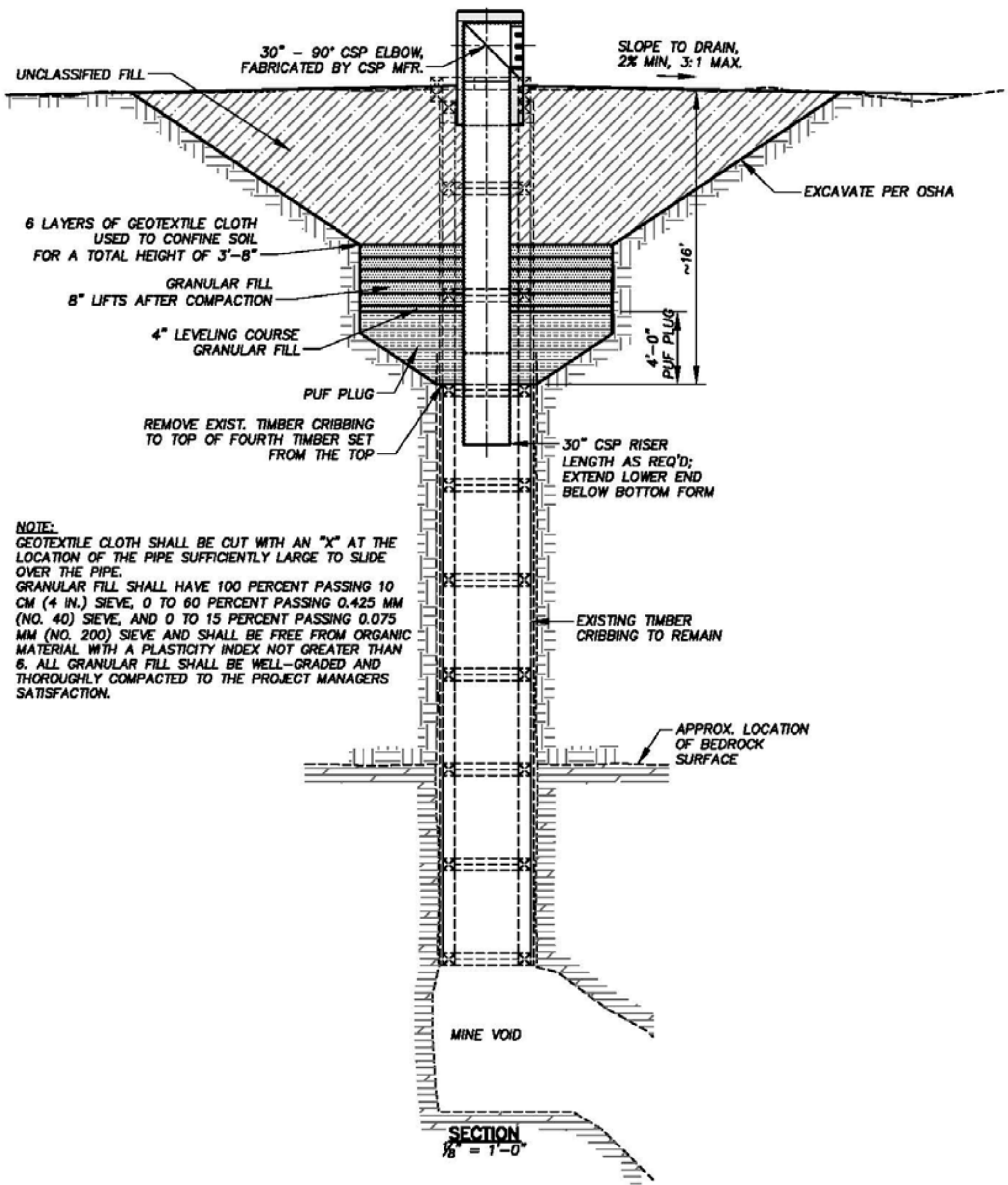
Carolina Lode Feature 4 stope opening: Design drawing for toroid tire plug with 72-inch diameter CSP and bat gate

Bella #3 Shaft: Design drawing for deep PUF plug with lightweight scoria fill



Feature #047-034S: Design drawing for double PUF plug for horizontal bat gate with CSP riser





Streiby Shaft: Design drawing for CSP riser with hybrid PUF/GCS plug and bat gate

Lake Valley "e"

Lake Valley phase 1 "e"

Reclaiming Abandoned Mines at Lake Valley

By Carlos A. Padilla
HERALD Editor

Despite the peaceful name, Lake Valley was a tough silver mining boomtown between 1880-1893, and had several hundred people and many mining town businesses designed to entice the money from the miners. It is claimed there were three churches, hotels, two newspapers, 12 saloons and a number of stores.

In 2005, visitors to Lake Valley will find a picturesque ghost town nestled amid the eastern foothills of the Gila National Forest's Black Range. In 1895, a fire destroyed many of the businesses, leaving few buildings intact at Lake Valley, a number of which are privately owned.

But the scene was much different 125 years ago, according to St. Cloud Mining Co. President Pat Freeman. "Silver was discovered in Lake Valley in 1879," says Freeman, adding that the silver mining rush was strong in the area in the 1880s and '90s.

"There was a resurgence in mining manganese during the Korean War in the '50s," Freeman says, describing the more recent mining activity to take place at Lake Valley.

The Lake Valley area is one of the more historically significant mining districts in New Mexico.

When the end arrived for the mining of manganese at Lake Valley—now managed by the Bureau of Land Management (BLM)—the federal government became involved in the latest chapter of America's abandoned mine lands (AML).

Freeman reveals how this involvement has led to mining companies like St. Cloud transcending their historical roles and stereotypes as entities that purely remove resources from deep within the earth to be utilized by humans in a useful—albeit man-made—manner; and into one of entities that are establishing habitats for wildlife and reclaiming abandoned mining sites.

BAT GRATE - Lloyd Moiola of the state Mining and Mineral Division, stands on top of a bat grate cap, during a tour Thursday, July 21, of the mine reclamation project in Lake Valley, in association with St. Cloud Mining Company of Sierra County. HERALD photos/CARLOS PADILLA

Lloyd Moiola, an archaeologist and reclamation specialist with the state's Mining & Minerals Division-Abandoned Mines Bureau, accompanied Freeman Thursday, July 21 to offer insight into the state's role in the reclamation.

MINING LAW

The Surface Mining Law was enacted to ensure that lands mined for coal would be restored to original conditions as part of the mining process, as well as the restoration of non-reclaimed coal mined lands that were abandoned before 1970.

After nearly 30 years of AML reclamation funded under the Surface Mining Law, thousands of dangerous health and safety problems related to abandoned mines throughout the country have been eliminated.

There seems to be little public awareness that this reclamation is taking place throughout the country. When highly-visible scars dot the landscape, people naturally recognize the legacy of past mining. After abandoned mine problems are eliminated and reclamation is complete, however, it becomes nearly impossible for any observer to see that health and safety problems once existed on the site.

Ironically, the better the reclamation, the less apparent it is. Thus, the best reclamation is virtually invisible. Invisibility is the goal, and a difficult one to attain due to New Mexico's varied ecosystems, which range from high, steeply sloping mountainous areas to semi-arid plains and arid desert. Vegetative communities and wildlife are equally diverse across the state. Average annual rainfall ranges from a high of approximately 20 inches to a low of about six inches, depending on elevation.

Historically, much of the state's Mining & Minerals Division's (MMD) reclamation work has involved abandoned coal mines. As MMD continues to reclaim its high priority coal hazards in its inventory, it plans to direct much of its resources on equally hazardous abandoned non-coal mine sites, such as Lake Valley, according to Moiola.

POSITIVE IMPACT

AML's managing work plan identifies three topics or principles. The goal of these principles is to evaluate the quality of on-the-ground reclamation work and to generate ideas for improving operations, if possible.

The first principle dictates that on-the-ground reclamation is to be achieved in a timely and cost-effective manner. This principle focuses on overall reclamation success and specifically how efforts have enhanced wildlife by providing food and water sources as well as cover and habitat. The objective of this principle is to determine if projects are reclaimed in a manner which minimizes the amount of maintenance required, promotes landscape stability, provides established vegetation and cover for enhancement of wildlife diversity, and provides durable and effective safeguards or closures that abate hazards to humans and wildlife, while preserving existing or providing new habitat.

In addition to its reputation for sound engineering and environmental science, the state's AML program is known for promoting environmental reclamation and preservation on other fronts, such as public outreach to landowners, educating the public regarding hazards associated with abandoned mines, preservation of threatened or endangered species, protection of wildlife in general, and technical assistance to state and federal agencies.

The state's AML program continues to make a dedicated effort to identify and protect bat populations that use abandoned mines for habitat. New Mexico AML installs bat grates as necessary to provide access for bats while restricting public entry.

At Lake Valley, St. Cloud specialized crews build the gate structures to MMD specifications, Freeman reveals.

The dangerous open vertical shafts at Lake Valley and other AML sites are being covered with bat grates—or caps—and people who visit the site no longer have to worry they will fall into an open mineshaft, Moiola and Freeman point out.

Grated closures allow for ventilation of the mineshafts, vital to sustain this habitat for bats.

With public ownership and good rock-climbing opportunities in the area, the land around the mine site is used for both cattle grazing and recreation. The dangers at Lake Valley are becoming a part of its past, and the habitat in the mines now aids the survival of bat and owl species.

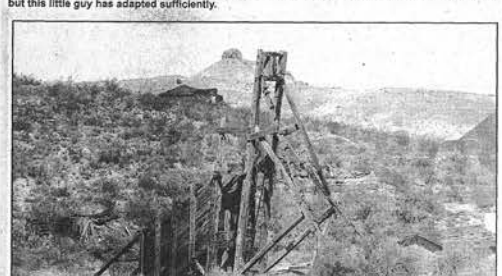
See MINES on Page 17

LLOYD MOIOLA (left) and Pat Freeman Thursday, July 21 explain that loads of silver were mined from the Lake Valley area some 125 years ago.

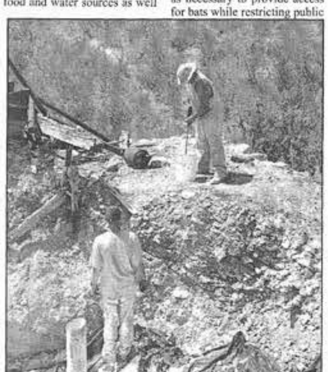
BUILT TO SPECIFICATIONS - Pat Freeman, president of St. Cloud Mining Company, stated that every protective structure was built to state specifications and a number of variations had to be taken into consideration for each location.

REINFORCED ENTRANCE - This mine entrance is located adjacent to the Bridal Chamber—so named due to the 2.5-million ounce silver crystal excavated from the ground in the 1800s.

OWL SANCTUARY - Prior to reclamation, this mine shaft did not display evidence of owl occupation, but this little guy has adapted sufficiently.

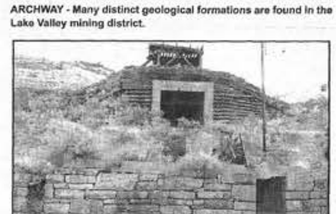


MUCK CHUTE - Few of these structures remain standing in the Lake Valley area.



PUF PACK - St. Cloud crews dispense polyurethane foam into some of the mine shafts to plug them up.

ARCHWAY - Many distinct geological formations are found in the Lake Valley mining district.



PAST MEETS FUTURE - Crews work alongside abandoned structures more than a century old in an effort to ensure Lake Valley's future as a tourist destination.

Oxen team leaving Lake Valley, ca. 1882 (Rio Grande Historical Collections, Neg. RG-149/12)

A partially timber cribbed shaft prior to closure

Cluster of six horizontal bat closures

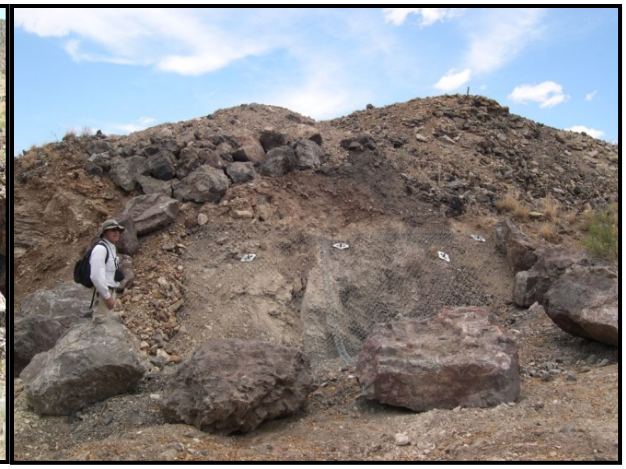
Carolina Feature 4 Stope before, during, and after construction. The small stope with blacksmith shop in the center of the top and bottom photos was later covered with a dark, almost invisible mesh to prevent entry. A barbed-wire fence protects the considerably reduced highwall.

Shaft prior to closure

Completed bat cupola at the same shaft

Drift at the base of the Bella #3 Shaft at the location of the deep PUF plug prior to closure. The large PUF plug was placed behind the timber shaft supports to the left with lightweight scoria fill above the plug.


Carolina F. 120 Stopes prior to tire plug closures


Steel mesh closure of stope opening

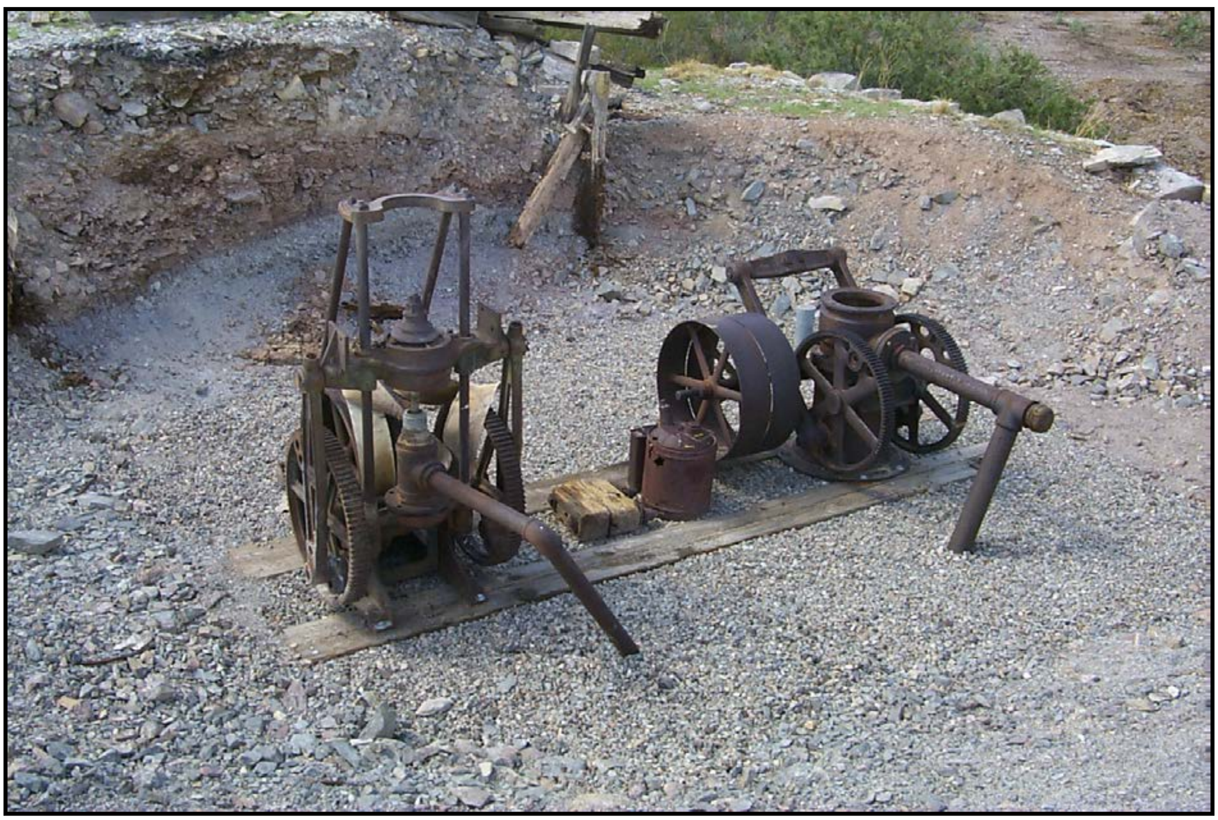

Horizontal bat compatible closure with a riser pipe inside a PUF plug


Placing concrete at a bat cupola foundation


Interior view of the F. 4 Carolina toroid tire plug, with PUF cap over the 72-inch CSP

Construction of airflow closure with CSP riser and hybrid PUF/GSC plug at the Streiby Shaft. Note the extreme surface roughening around the closure prior to seeding.


Toroid tire plugs at a shaft and declined open stope during construction prior to completion



Preserved historical pumps and piping at Shaft #088-086. The shaft is plugged with a polyurethane foam plug and concrete cap covered with gravel.