LOW IMPACT STORMWATER PROJECT
MADRID, SANTA FE COUNTY, NEW MEXICO

Submitted by:
Fernando Martinez, Division Director
New Mexico Abandoned Mine Land Program
Mining and Minerals Division
Energy, Minerals and Natural Resources Department
1220 South Saint Francis Drive
Santa Fe, New Mexico 87505
(505) 476-3400

April 2017

Total Construction Cost: $1,264,255.93
June 2012 through June 2016

Community Planning and Outreach (2010 - 2011):
Dekker Perich Sabatini, Albuquerque, N.M.
Subcontractor: Karpoff & Associates, Albuquerque, N.M.

Geotechnical Consultant:
Kleinfelder, Inc., Albuquerque, N.M.

Stormwater Consultant:
URS Corporation, Albuquerque, N.M.

Design and Construction (2012 - 2016):
Rangeland Hands Inc., Santa Fe, N.M.
Subcontractors:
Riverbend Engineering, Albuquerque, N.M.
Zeedyk Ecological Consulting, LLC, Santa Fe, N.M.
Resource Management Services, LLC, Bernalillo, N.M.
Watershed Artisans, Inc., Santa Fe, N.M.
The RainCatcher, Santa Fe, N.M.
AUI Inc., Albuquerque, N.M.

Cultural Resources Monitoring:
Marron and Associates, Albuquerque, N.M.
Office of Archaeological Studies, Santa Fe, N.M

Project Partners:
Madrid Cultural Projects
Madrid Landowners Association, Inc.
Madrid Merchant Association
Madrid Village Water Co-op
Madrid Volunteer Fire District
County of Santa Fe
New Mexico Department of Transportation

Project Development and Contract Management and Administration:
New Mexico Abandoned Mine Land Program, Santa Fe, N.M.

Cover Photo. *Central Madrid in May 2016, looking north. Note the unreclaimed gob piles on its east slope at the middle right of the photo and on the valley floor in the upper right background. The Old Coal Town Museum buildings are in the right foreground and the Mine Shaft Tavern's roof is visible through the juniper tree in the lower left.*

HISTORY AND BACKGROUND

In 1954, the mine operator in the small coal mining community of Madrid, New Mexico, 27 miles southwest of Santa Fe, shipped its last load of coal to its final customer, Los Alamos National Laboratory. The coal had been under exclusive contract during and after World War II, providing the fuel for the Manhattan Project and other nuclear defense activities. With only a handful of residents staying on, most of the industrial, commercial, and residential structures and buildings in the town were left uninhabited and unmaintained, weathering in the wind, sun, and rain.

This state of affairs was a profound change from the community's heyday of mining, from the mid-1890s through the 1930s, when it was a company town providing both bituminous coal to power railroad locomotives and anthracite used to fuel smelters in El Paso and elsewhere. Its proud history includes its status as the oldest producing coal mine west of the Mississippi; production of both bituminous and anthracite coal from the same bedding planes; the first lighted baseball field west of the Mississippi, home of the Madrid Miners, a Double-A Minor League team; and brightly lit Christmas displays that are said to have been Walt Disney's inspiration for Disneyland.

Coal mining in the area had started as early as 1835, when small amounts were produced to fuel hardrock and gold mines at the nearby communities of Cerrillos and Dolores and a smelter at San Pedro. After the railroad reached New Mexico in 1880, increased demand for coal opened the Cerrillos Coal Field to industrial mass production in the 1890s. Soon thereafter, in 1896, the Colorado Fuel and Iron, part of the Rockefeller conglomerate, bought out the local coal company operating in Madrid. In 1906, ownership again changed hands to the locally owned Albuquerque and Cerrillos Coal Company with production peaking in 1928 at 87,148 tons of anthracite and 97,562 tons of bituminous coal, with 725 miners employed in the mines. In 1947, after serving as mine manager for many years, Oscar Huber assumed sole ownership of the mines and town.

After the demise of coal mining in 1954, Joe Huber, son of Oscar and owner of the town site and associated mineral rights, attempted for a couple of decades to sell the entire town site as an industrial center. When the few potential deals fell through, he decided in 1975 to sell the remaining 150 standing buildings at bargain prices to those willing to renovate the derelict miner's shacks and other structures.

Within six weeks the entire town was sold or rented, primarily drawing people interested in exploring and establishing alternatives to life in mainstream America. With remarkable vigor and perseverance, the new counterculture settlers refurbished many buildings as residences and shops, rebuilding the town over the subsequent decades.[1]

Today the town boasts over 40 shops, restaurants and galleries and a privately-owned coal mining museum in former mining company buildings, with an antique steam locomotive, antique cars and trucks and old mining equipment. Tourists from around the United States and the world

[1] Hovey, Kathryn, Anarchy and Community in the New American West: Madrid, New Mexico, 1970-2000, University of New Mexico Press, Albuquerque, 2005.

visit the town and enjoy its shops, galleries, weekend festivals and revived lighted Christmas displays.

PROJECT DEVELOPMENT AND COORDINATION WITH THE COMMUNITY

Starting in the early 1980s, the New Mexico Abandoned Mine Land Program worked extensively in Madrid closing numerous dangerous mine portals and shafts; removing hazardous structures, including a large timber coal breaker and loadout that was close to collapse, and safeguarding others; and reclaiming two gob piles that were delivering significant amounts of storm runoff and sediment that repeatedly clogged the town's rudimentary drainage infrastructure.

In 2010 and 2011, the Program undertook a coordinated series of community open houses, presentations, design workshops, and one-on-one meetings with residents, business and land owners, local civic organizations (including Madrid Landowners Association, Madrid Cultural Projects, and Madrid Merchant Association), County of Santa Fe, New Mexico Department of Transportation (NMDOT), State Historic Preservation Office, and other stakeholders for their input on what the Program could fund to address coal mining related problems. Brochures and posters were developed for community information and a project website[2] set up to inform the community of developments and progress on both the planning and later construction projects.

Coordination in an unincorporated community can be challenging in that there is no central organization, such as a town council, which can be consulted for community input and decision-making. Generally, however, the reception to the planning effort in Madrid by residents, landowners, and civic organizations was positive. About 15 to 20 people from a town of a little over 200 would usually show up at the several community open houses held in the town volunteer Firehouse and at field design workshops.

The primary finding of the planning and outreach effort, managed by Dekker Perich Sabatini (DPS), an architecture design and planning firm in Albuquerque, was that the fundable issue most important to the community was improvement of the resident's quality of life as it related to improvements to stormwater drainage. That effort would focus on the east slope in the community at and below bare, high-sediment-producing gob piles. During intense storms, these piles produce significant runoff that floods homes, businesses, and roads and carries a surplus of sediment that builds up at houses and businesses and clogs roadways, driveways, drainage structures, and State Road 14.

Public comment also indicated a high level of interest in maximizing stormwater harvesting opportunities for beneficial reuse, or low impact development, as an integral part of stormwater improvements. This interest arises from the residents' direct experience with living in an extremely water-limited environment where annual precipitation averages twelve inches per year and many residents haul in potable water.

However, and somewhat paradoxically, it was also important to many residents that Madrid's historic landscape retain its industrial character, particularly the highly visible gob piles in and

[2] The project website for the Madrid Mining Landscape Study and Low Impact Stormwater Project, including planning documents and announcements, is at: http://www.emnrd.state.nm.us/MMD/AML/MML/index.html.

above the town. These remnants of an industrial past both connect the townspeople to local history and define the town as a unique place.

In the 1970s, much of the town site and mining areas had been placed on the National Register of Historic Places. As such, it was also critical from a regulatory standpoint that development of the desired community improvements retain the industrial nature of the landscape. This meant that the AML Program had to find means of stabilizing erosion on the gob piles while minimally altering their appearance.

Building on the findings of DPS' Madrid Mining Landscape Study, the Program, in a contract with URS Engineering, conducted a stormwater study in 2010 and 2011, including surveys of residents and businesses to identify where frequent flooding was occurring, analyses to locate primary stormflow paths and sub-basins in the community, and quantification of stormflows. The Program also contracted with Kleinfelder, Inc. for a geotechnical study to locate possible near-surface mining voids that the Program needed to be aware of in planning for drainage improvements. Fortunately, no mining voids within the area of interest were located that could impact potential surface drainage improvements.

Laying this ground work of community involvement and initial studies proved to be essential in the next phases of work – design and construction.

DESIGN AND CONSTRUCTION

In June 2012, the Program entered a design-construct contract with Rangeland Hands, Inc. (Rangeland) to develop, analyze, and build context-sensitive low impact stormwater alternatives. Rangeland and their subcontractors evaluated methods for erosion and sediment control and stormwater harvesting on and near the gob piles as well as alternatives for improving the stormwater infrastructure that caries flows from the gob piles through the town to the primary arroyo bisecting the community. Low impact stormwater options included methods to slow and infiltrate stormwater on and near the gob piles, bioswales, areas of permeable roadway pavers, and newly constructed storm channels. The Program and Rangeland conducted additional public meetings and design workshops for further community input on the more detailed alternatives being developed.

Before any of these alternatives could be implemented, a slow-moving cold front stalled over Colorado in September 2013, leading to extreme flooding that made national news. Fingers of that storm reached southward into New Mexico, one of which hovered over Madrid for several days. During heavy rains on the evening of September 15, saturated mine wastes in one of the east-slope gob piles suddenly broke loose, washing water-laden debris into a couple of the Old Coal Town Museum buildings, up against the old stream locomotive, and onto State Road 14.[3]

[3] A video of the September 15, 2013 flood in Madrid can be found at: https://www.youtube.com/watch?v=eJekh6sIPIY, a TV news report at: https://www.youtube.com/watch?v=bfUp1ZzKwmY, and a newspaper report at: https://www.abqjournal.com/264437/madrid-suffers-from-flooding.html.

Within two weeks, NMDOT mobilized to clear a clogged culvert and drop inlet along State Road 14 near the area of the blowout and, in early October, Rangeland began construction of immediate measures to protect public health, safety, and property. Measures included installing temporary protective Jersey barriers below the blown-out gob pile and above the Museum, installing other Jersey barriers at the head of a gob pile being deeply eroded by drainage off a nearby driveway, grading and installation of base course at driveways eroded by runoff from the gob piles, and rock lining of roadside ditches along portions of the driveways most impacted.

Because the Abandoned Mine Land Program had received State Historic Preservation Office clearances for this area in previous work and given the Program's need for an accelerated response, the Office concurred with the initial and subsequent construction phases following review of a proposed cultural resources monitoring plan prepared by Marron and Associates.

The Program and Rangeland then planned and executed more permanent measures. In June 2014, Rangeland remobilized equipment and crews to the site to construct rock channels on the hillside to divert stormwater around or to carry it safely across the gob piles above the Museum; to backfill an adit that had reopened in the area; and to further stabilize the gob piles with additional compost and mulch applications and planting and seeding of native species. Additionally, Rangeland constructed two types of innovative low rock barriers on the larger of two gob piles, one called "media lunas" (half-moons) and the other rock mulch rundowns,[4] both of which slow and infiltrate precipitation to aid in vegetation establishment and growth while armoring the surface against erosion.

The low rock barriers and rock channels were designed in place and installed by experienced operators and crews. Steeper rock channels were constructed as step-pool structures, which dissipate a portion of the water's kinetic energy at each drop. Additional rock ditches and rolling dips with rock-lined outlets were constructed along the adjacent driveway for erosion control and stormwater conveyance. Over eight hundred one-gallon sized native seedlings were planted to stabilize the channels and gob piles.[5]

During construction of improvements to drainage and gob stabilization on the hillslope, archaeologists monitored all activities. While constructing a rock channel to direct flows to an existing upper drop inlet, a rock structure dating back to the mining era was uncovered, so construction was temporarily halted in the immediate area, and the site excavated and recorded.

By mid-September the work to stabilize the hillslope above the Museum was complete and attention shifted to improving stormwater conveyance from the hillslope to the arroyo. A dilapidated mining-era drop inlet collected stormflows from the hillside and gob piles and carried

---

[4] Information on and drawings and photos of media lunas and rock mulch rundowns are found at: http://www.watershedartisans.com/Erosion_Control_Field_Guide.pdf. See Figure 16 below for a photo of a media luna installed in the project.

[5] For newspaper and television reports on the low-impact stormwater project, see: https://www.abqjournal.com/460838/preventing-another-flood-in-historic-madrid.html, http://www.koat.com/article/flooding-leads-to-face-lift-in-old-nm-mining-town/5059005, and http://www.grantcountybeat.com/news/non-local-news-releases/17552-significant-restoration-work-completed-in-madrid-since-september-2013-floods.

them underneath a couple of the Museum buildings and the Mine Shaft Tavern in a derelict four-foot square concrete box culvert to a more recently constructed NMDOT drop inlet in front of the Tavern. Examination of the box culvert indicated that it was severely clogged with mining debris. The box culvert also often completely clogged just above it necked down to a 24-inch diameter pipe in front of the Tavern.

Beginning in February 2015 (a time of year negotiated with nearby shop and restaurant owners to minimize business impacts), Rangeland and its subcontractor, AUI Inc. sliplined the box culvert with a continuous, 36-inch diameter, smooth barrel steel pipe; removed the section of 24-inch pipe in front of the Tavern and replaced it with a 36-inch diameter pipe connected to the NMDOT drop inlet; reconstructed the upper drop inlet (using the existing drop inlet as the outside formwork for new concrete structure); and replaced the temporary Jersey barriers with architecturally appropriate precast concrete stormwater barriers. The sliplining pipe through the Museum area and under the Tavern was grouted in place for structural stability. Two new cleanout manholes were installed, one halfway along the pipe between two buildings and the other in front of the Tavern. The work was completed In April, in time to clear the site for the CrawDaddy Blues Fest in May.

The contract with Rangeland included any needed maintenance on their work within the four-year contract period. In 2016 the AML Program determined that the dry stack rock wall built at the top of the larger gob pile to divert storm drainage around it needed to be raised. Sediment buildup from a small unreclaimed gob pile above it threatened to overtop the wall. This work was completed in May and has been the only maintenance work needed to date.

SUMMARY

Although significantly more work needs to be done to protect the residents of Madrid from the adverse effects of stormwater and sediment runoff from historical gob piles, the AML Program made significant strides in this project to quickly mitigate the potential for further stormwater and erosional debris damage in one of the most densely built-up areas of the town. The projects also developed preliminary plans for possible further protective work and built trust for the Program with community members and civic organizations. Through careful and comprehensive planning and public outreach efforts, the pitfalls inherent in working in an unincorporated and highly individualistic community and with multiple landowners were largely avoided and a significant project completed.

The Program and its contractors installed innovative, effective, and locally sustainable stormwater infrastructure and erosion control measures that rehabilitated degraded land, minimized visual impacts to the historic landscape such that the work is barely noticeable, and exceeded the spirit and intent of the Surface Mining Control and Reclamation Act. The Program also used comprehensive community outreach efforts and contracts that brought in experienced community planners, designers, and a construction contractor and subcontractors who could develop, plan, and construct these measures professionally and, when needed, quickly. Other AML programs may be able to make use of these approaches.

In addition, public outreach and community design workshops throughout development and implementation of the project and newspaper and television exposure of the AML Program's response to the flood of September 2013 have increased public awareness of SMCRA.

PROJECT STATISTICS

One reopened adit backfilled
670 feet of architectural precast stormwater barriers installed
1.0 acres of steep hillside gob stabilized with compost incorporation, seeding, planting, mulching, and installation of rock media lunas and rock mulch rundowns
975 feet of new rock channels constructed to divert stormwater around two gob piles, 75 feet of which were hand-built; steeper channels were constructed as step-pool structures
1,700 feet of driveway improved to handle stormwater and control erosion with compacted base course and strategically placed rock roadside ditches and rolling dips
862 one-gallon native seedlings planted and irrigated for one growing season from temporary water tanks via drip system, for hillslope and channel stabilization

445 feet of 36-inch diameter steel sliplining pipe installed, all but 50 feet of which was sliplined and grouted inside an existing box culvert
One concrete drop inlet reconstructed
Two new cleanout manholes and one smaller pipe inlet installed
Hydraulic improvements at one existing drop inlet

NOTE: Satellite and bird's eye views of the project site can be viewed by typing the coordinates of the approximate center of work, 35°24'18" N 106°09'08" W, in Google Earth or by searching for Madrid, New Mexico in Google Maps and in Earth view looking at the area about 170 feet southeast of the Mine Shaft Tavern toward the south end of town and on the hillside above the adjacent Old Coal Town Museum.

PHOTOGRAPHS

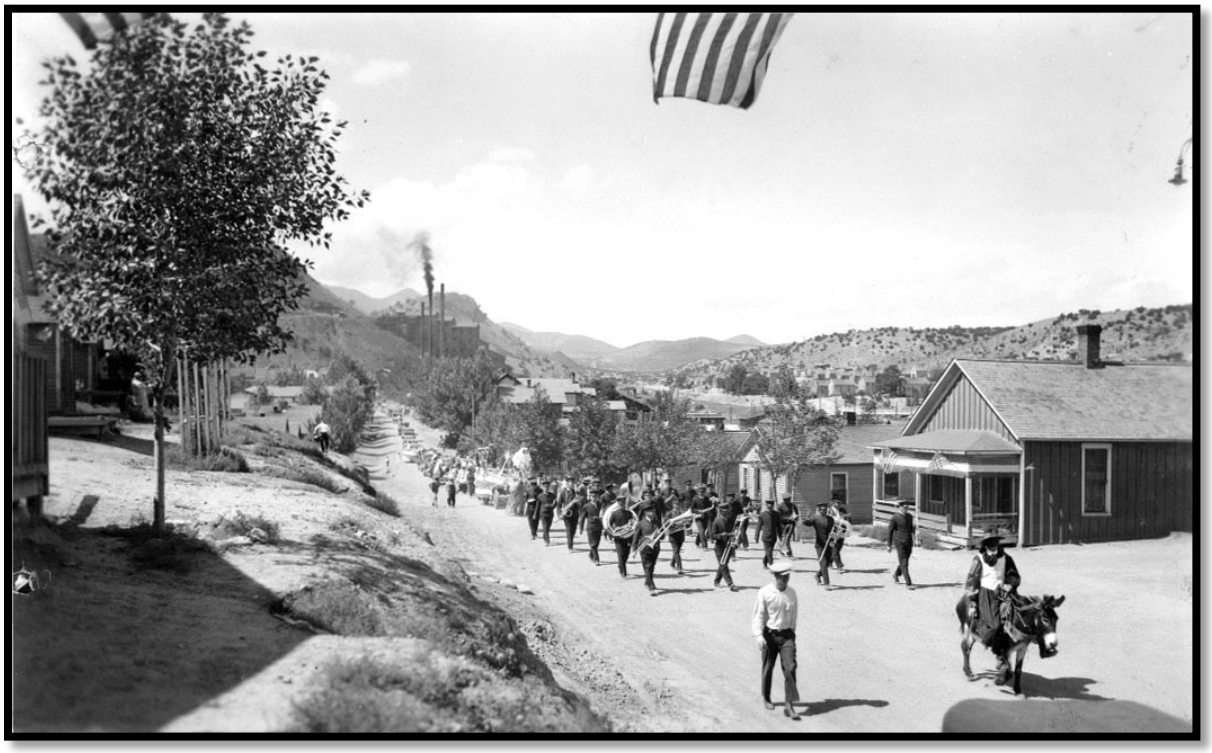

Figure 1*. Fourth of July parade in Madrid with power plant and breaker in background, ca. 1930*

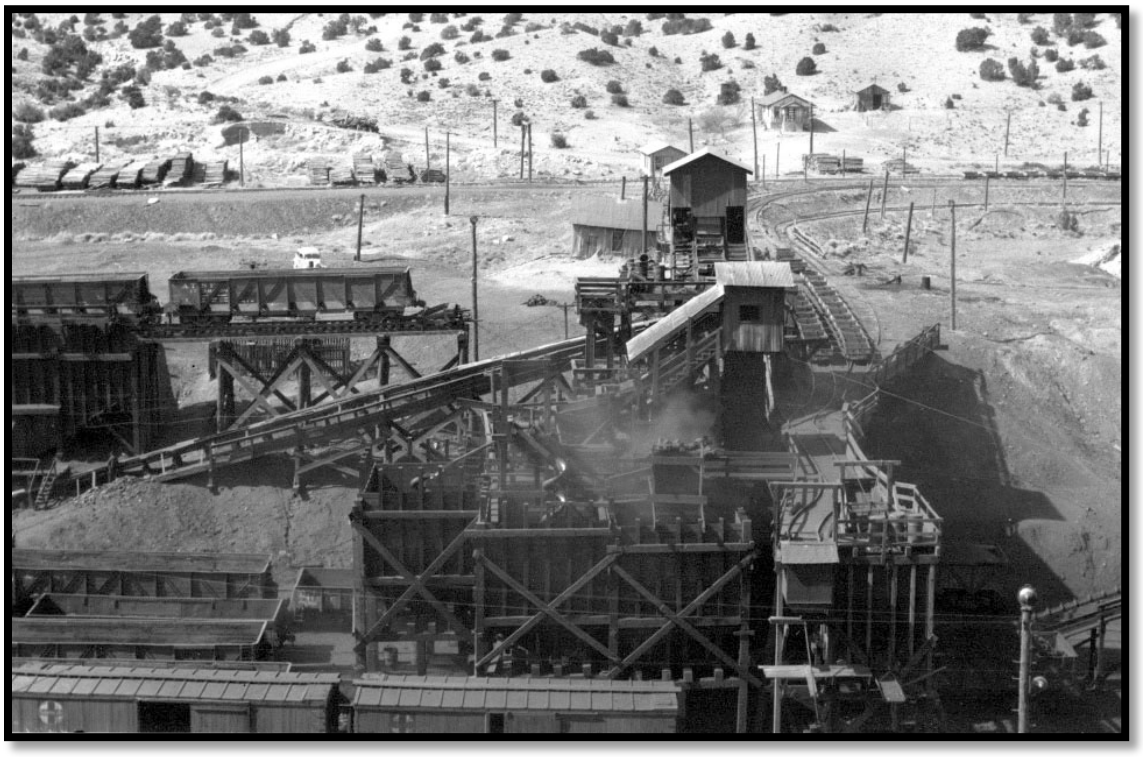

Figure 2. *Jones Tipple for bituminous coal in Madrid, ca. 1930*

Figure 3. *Community design workshop, December 2012*

Figure 4. *Deeply eroded gob pile above Museum and Icehouse Road. Precast barriers were placed along the driveway above the gob pile to divert runoff to the upper drop inlet.*

Figure 5. *Coal debris damage to historical Museum building below eroded gob pile*

Figure 6. *Arrows indicate the newly blown-out gob pile above the Museum, September 2013.*

Figure 7. *Debris flow from gob blowout across driveway and onto Museum property, September 2013*

Figure 8. *Gob blowout debris build-up against steam locomotive at Museum, September 2013*

***Figure* 9.** *Clean-up of gob blowout debris in a Museum building, September 2013*

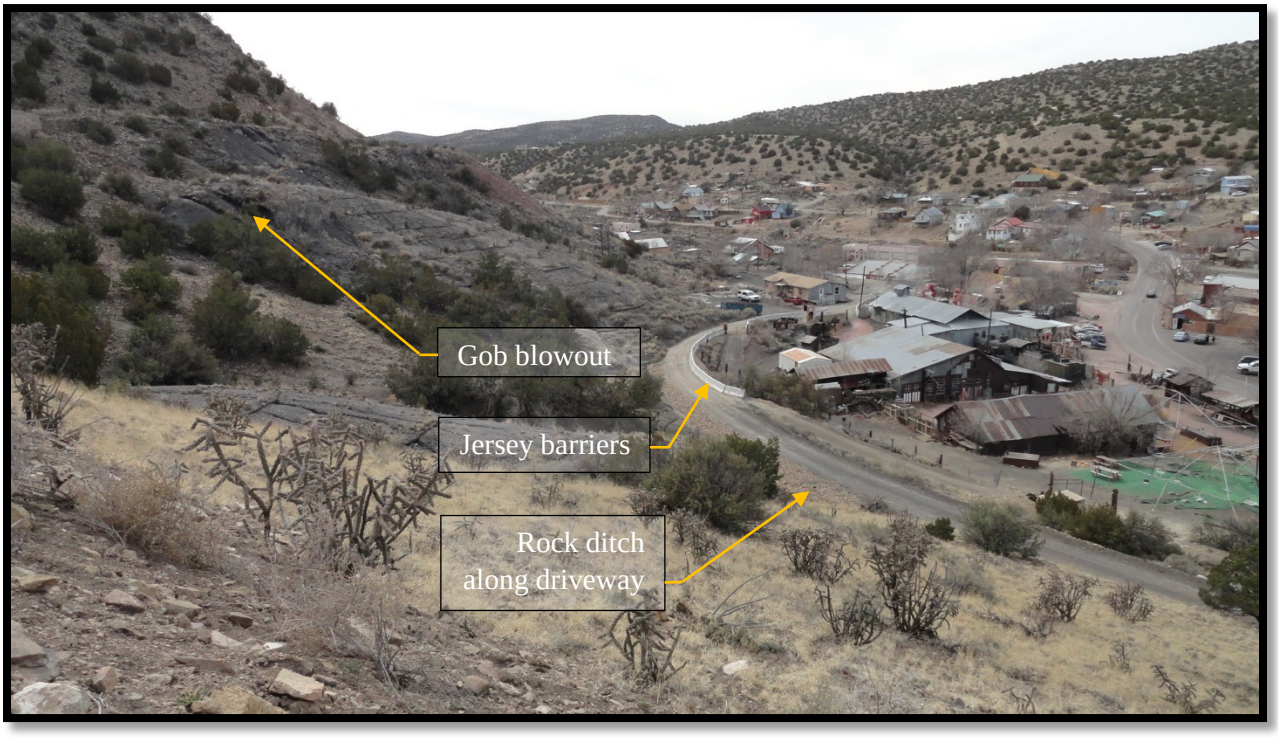

Figure 10. *Completed accelerated construction for temporary site protection with rock-lined ditch, base course on driveway, and temporary Jersey barriers above* the *Museum and State Road 14, October 2013*

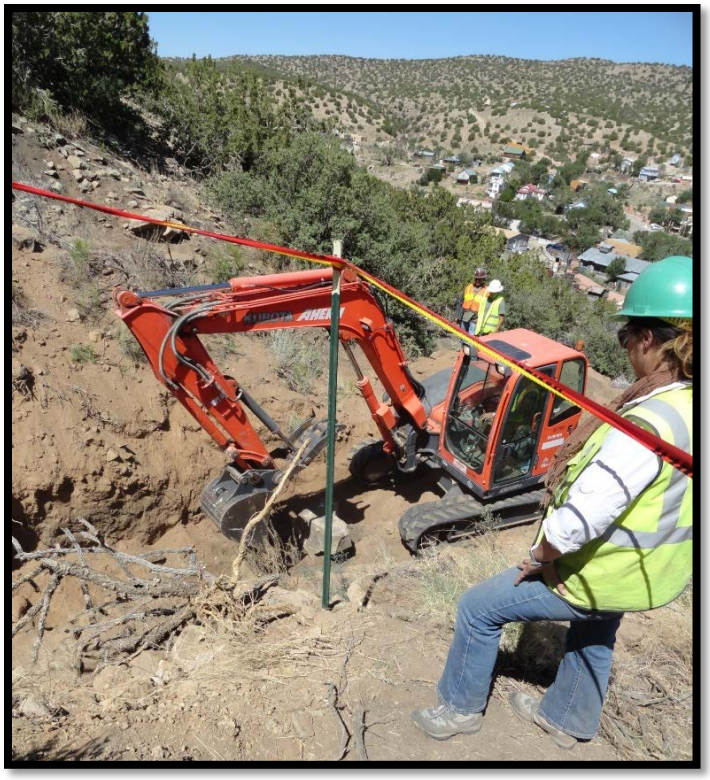

Figure 11. *Backfilling the Cranky Charlie Coal Mine adit, June 2014*

Figure 12. *Working in tight quarters to construct a rock bypass channel, July 2014*

Figure 13. *Hand-built step-pool rock channel at edge of larger gob pile, July 2014*

Figure 14. *Constructing a machine-built, step-pool rock bypass channel around blown-out gob pile, July 2014*

Figure 15. *The completed step-pool rock bypass channel in August 2016. Note planted and seeded vegetation in and around the channel. The large light colored rock was covered with smaller tan rock to better blend channels into the surroundings.*

Figure 16. *Newly constructed rock media luna on the larger gob pile to collect sheet flow, slow and infiltrate it, and direct it toward a rock mulch rundown below.*

Figure 17. *Archaeological excavation underway during construction, July 2014*

Figure 18. *Precast architectural blocks for stormwater control, replacing temporary Jersey barriers, September 2014*

Figure 19. *Newly planted native seedlings for slope stabilization, October 2014*

Figure 20. *Rock diversion channel on left and smaller reclaimed gob pile on right one year after construction, August 2015*

Figure 21. *Raising of the dry stack rock wall to divert hillslope stormflows around the top of the larger reclaimed gob pile, May 2016*

Figure 22. *The derelict upper drop inlet below the gob piles and above the Museum before construction*

Figure 23. *Storm box culvert below the upper drop inlet, clogged with coal mine waste debris before permanent reconstruction through sliplining*

+

Figure 24. *Box culvert after jet flushing, February 2015. Note exposed tree roots on floor.*

Figure 25. *Sliplining 36-inch diameter steel pipe into the box culvert at the upper drop inlet, February 2015*

Figure 26. *Casting new clean-out manhole immediately outside of the Mine Shaft Tavern (later capped with concrete slab with manhole ring and cover), March 2015*

Figure 27. *Newly cast grout infill to improve hydraulics in the lower NMDOT drop inlet in front of Mine Shaft Tavern, March 2015. Stormwater flows from right to left in this photo.*

Figure 28. *Grouting sliplined pipe into place, March 2015. Note fresh grout rising around the steel pipe and its location underneath the Mine Shaft Tavern.*

Figure 29. *Reconstructed upper drop inlet, April 2015. Note the mulched rock diversion ditch behind the drop inlet in upper left of photo.*

Figure 30*. View of the larger reclaimed gob pile in August 2016, which was initially reshaped and reclaimed in 1999 and additionally stabilized in 2014*