

Gibson Mine:

A historic restoration by the Friars

by Pejman Eshraghi and Michael C. Ford

The story of the Gibson Mine dates back to the late 1800s. Located 112 km (70 miles) east of Phoenix, AZ, in what became known as Bellevue, AZ, the Gibson Mine briefly thrived, famous for its high-grade copper ore exceeding 20 percent by some accounts.

Fast forward a century, and the story is one of an abandoned mine beset with environmental problems caused by historical and wildcat mining practices and decades of neglect. The site eventually came to the attention of state environmental regulators, who threatened enforcement action against the only current or historical owner it could locate – the unwitting (and unlucky) Franciscan Friars of Saint Barbara (Friars). The Friars' journey presents a unique approach to abandoned mine reclamation involving public-private partnerships, creative financing, innovative technologies and a long-term commitment to land restoration.

History

Throughout the early 1900s, the Gibson Mine brought much fame and fortune to its first owners, Sam Gibson and Tim Henderson. In its heyday, from 1906 to 1912, 3.17 kt (7 million lbs) of copper and 56.7 kg (2,000 oz) of silver were produced at the mine at a current market value of \$19 million.

Comprised of more than 809 ha (230 acres) of patented claims, the mine sits above a drainage divide in the Pinal Mountains, with the northern portion of the site in the Pinto Creek watershed, draining into the Salt River, and the southern portion in the Mineral Creek watershed, draining into the Gila River.

The mine includes seven veins, with at least two mined extensively over the years. Mining operations included underground mining with above ground crushing, grinding and concentrating. At its peak, the town boasted a post office, boarding house, stagecoach with daily trips to Globe and 350 residents. The underground mine ceased formal operations due to a significant drop in copper prices during the Great Depression. Most of the facilities, tailings and low-grade ore generated from the early operations were simply left on site.

Between the 1960s and the early 1990s, small scale, sporadic operations continued. Lessees and sub-lessees conducted both heap and in situ leaching operations. The heap leaching solutions circulated through a small asphalt-lined heap and a series of single-lined ponds. Copper-laden



solutions were eventually sent to launder tanks, from which plated copper was removed for off-site processing. In situ leaching operations were also conducted, targeting the collapsed underground workings with dilute sulfuric acid circulated through several small surface injection pads. The copper-bearing solutions were collected by gravity flow from several adits from the old underground operations and piped to a series of small, concrete storage tanks, where copper cementation occurred, and the barren

Before (above) and after photos of the heap leach facility at the Gibson Mine.

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Excavation operations at the heap leach pad at the historic Gibson Mine.

solution was pumped back into the system for reuse.

Following a series of large storms in the early 1990s, a neighbor downstream from the mine noticed a turquoise liquid running through his property and contacted the Arizona Department of Environmental Quality (ADEQ). ADEQ's investigation quickly confirmed that the leach solution ponds at the site had been overwhelmed by the volume of rain, and had overflowed into Pinto Creek. The problems did not stop there, however. The investigation also revealed that the in situ operations had been abandoned, leaving acidic, copper-bearing solution to discharge freely from the adits. The operators of the site had not obtained any of the environmental permits necessary to conduct such operations; and acid rock drainage, formed by oxidation of metal sulfide minerals, was discharging from more than 91 kt (100,000 st) of waste rock and tailings left on the site, without runoff controls. The site was strewn with industrial garbage, including dozens of junked vehicles, and was pockmarked with uncovered shafts and adits left over from the historical underground workings. More than 100 years after its celebrated opening, the Gibson Mine was now a poster-child for shoddy mining practices as well as the dangers to the environment and public safety of abandoned mining operations. Water quality testing soon confirmed that the site was also a major source of water quality impairment to Pinto Creek.

ADEQ initially focused its attention on the operators at the site. Unfortunately, they were small scale and underfunded and quickly disappeared. ADEQ then turned to the site owners, and they were able to find one responsive partial owner of the site – the Friars. The Friars had been gifted a portion of the property in 1969 from a well-meaning church-goer who envisioned great things for the Gibson. The Friars accepted the gift sight unseen, and never set foot on the site until after ADEQ's

investigation. What they saw shocked them as they realized their gift would turn out to be a huge liability.

Rather than attempt to avoid the potential liability for the Gibson's conditions, the Friars decided to engage the regulators head-on to develop a solution for the site's problems. However, the Friars had a big problem of their own - lack of money. As a religious order dedicated to serving the poor, each Friar takes a vow of poverty. The organization is completely dependent on donations and the meager wages its Friars earn serving the poor. ADEQ could not have found a property owner more ill-equipped to deal with the Gibson's legacy.

With guidance from their environmental attorney and consultants, the authors and the Friars formed a series of public-private partnerships and presented their proposal for reclamation to ADEQ. The agency approved the Friar's plan, which was estimated to cost more than \$5 million, and paved the way by providing significant regulatory and financial assistance to remediate the site. ADEQ's water quality improvement matching grants were an integral part of the plan that also included contractor discounts, in-kind donations, collaboration with the University of Arizona, and the generosity of two nearby mining companies (BHP Copper Inc.'s Pinto Valley Operations and KGHM's Carlotta Copper), enabling the small, nonprofit religious order to move forward and realize its vision of reclamation.

Initial reclamation

The first phase of reclamation began in 2006, with more than 91 kt (100,000 st) of heap leach materials and old vat leach tailings excavated and transported to Pinto Valley for copper recovery, saving an estimated \$3 million when compared to conventional transport and disposal at a landfill. Liners were removed from the four process solution ponds and impacted soils beneath two of the ponds were excavated down to bedrock and recontoured, while clean soils beneath and surrounding the other ponds were re-contoured. A second ADEQ grant provided for the design and installation of an anaerobic permeable reactive drain to mitigate the acid rock drainage on the Mineral Creek side and promote biological reduction of sulfate to sulfides.

Subsequent sampling of the Gibson Tributary and Pinto Creek indicated that these initial reclamation efforts reduced the Gibson's contribution of dissolved copper by approximately 50 percent. While the removal of materials significantly reduced the concentration

of dissolved copper and other metals, it was evident that unreclaimed areas of the Gibson Mine continued to produce acid rock drainage during storm events.

Site restoration

Thanks to the Friars’ award of a third ADEQ matching grant in 2011, the final phase of reclamation began with a goal of restoring the Gibson property to premining conditions and further reducing dissolved copper in storm water leaving the property. This phase of the work included site contouring, storm water management and control, and the application of a soil and vegetative cover.

The site was divided into disturbed and undisturbed areas. Clean storm water generated on undisturbed land was diverted to bypass the mined areas and discharged downstream. Storm water generated on previously disturbed lands, encompassing all previous mine operations, was channeled to newly constructed impoundments to retain the impacted water on site. Previously disturbed areas were then covered with more than 23,000 m³ (30,000 cu yds) of clean soil and a vegetative cover was established.

With future impacted surface water discharge eliminated, subsequent sampling of the Gibson Mine Tributary and Pinto Creek indicated contribution of copper to Pinto Creek has been reduced by more than 75 percent. Moreover, water quality on both sides of the site is expected to continue to improve with time as the historically impacted stream channels are flushed out and the vegetative cover further establishes itself.

With the \$2.2 million reclamation of the Gibson Mine now complete, the story of this once thriving, turn-of-the-century copper mine offers an uncommon approach to reclamation and restoration involving numerous public and



private partnerships, creative financing solutions, innovative technologies, and an owner, the Franciscan Friars of Saint Barbara, fulfilling a unique determination to restore the land to its premining condition and ensure a productive postmining land use for this historic site. ■

Before (above) and after photos of the reclaimed raffinate pond, heap leach pad and waste rock tailings at the Gibson Mine.