Section 319
NONPOINT SOURCE PROGRAM SUCCESS STORY
New Mexico

Mine Reclamation Improves Willow Creek Water Quality

Waterbody Improved

Willow Creek was buried by waste materials from the Pecos/Tererro Mine at the confluence of Willow Creek and the Pecos River. In the early 1990s, the New Mexico Environment Department (NMED) found elevated turbidity, conductivity, sedimentation, and metals (including cadmium and zinc) in the creek. These findings led NMED to add Willow Creek to the state's Clean Water Act (CWA) section 303(d) list of impaired waters for turbidity, conductivity, and stream bottom deposits (now called sedimentation) in 1998. Cadmium and zinc were added as additional causes of impairment in 2002. Around the year 2000, stakeholders began restoring mined areas, and water quality improved. As a result, New Mexico removed Willow Creek from its list of impaired waters for turbidity in 2004 and for cadmium and zinc in 2012.

Problem

The 5.26-mile-long Willow Creek is a tributary to the Upper Pecos River in north-central New Mexico (Figure 1). The creek's watershed is largely managed by the Santa Fe National Forest (92 percent), but it also includes some private land (8 percent) and a mine site owned by the New Mexico Department of Game and Fish. The watershed is 98 percent forested and 2 percent grassland.

In the early 1900s, waste rock generated from operations at the Pecos/Terrero mine and mill was deposited into Willow Creek and its floodplain. The fill forced the creek from its original channel and caused it to flow over waste rock deposits along the southern edge of the floodplain. The mine and mill waste rock was also used for decades as construction and maintenance material for local roads and in the nearby state fish hatchery and campground. Initial environmental impact investigations indicated that runoff and leachate from these waste materials had contaminated ground water, surface water, soil, and sediment downstream.

After a large fish kill occurred during the spring of 1991, NMED conducted a water quality survey and found metals in seeps and surface water discharges around the mine. As a result, NMED placed Willow Creek on the state's CWA section 303(d) list of impaired waters in 1998 for turbidity, conductivity, and stream bottom deposits, and in 2002 for cadmium and zinc.

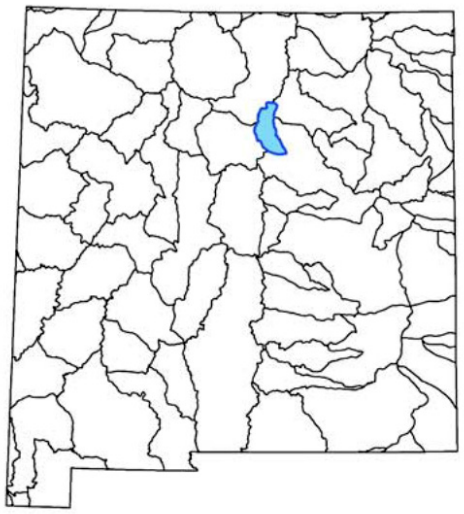

Figure 1. Willow Creek is in New Mexico's Upper Pecos River watershed (blue).

Project Highlights

Restoration efforts date back to 1950, when the New Mexico State Game Commission purchased all properties related to the mine and mill. In 1985 NMED (at that time known as the New Mexico Environmental Improvement Division) conducted a comprehensive investigation of the area in conjunction with Cyprus-Amax Minerals Company staff. An Administrative Order on Consent was issued in 1992; it required the responsible party, Cyprus-Amax, to reclaim the mine site (including

Willow Creek and surrounding areas). The reclamation work, conducted from 1999 through 2003, included closure of the mine shaft, excavation and consolidation of all mine waste, revegetation of disturbed areas, and geomorphic restoration of the Willow Creek floodplain, wetlands, and riparian habitat. The geomorphic restoration, implemented using Rosgen natural design methods, was completed in 2000. It included removing nearly 65,000 cubic yards of waste rock from the floodplain and reconstructing 900 feet of the creek (Figure 2).

Figure 2. Project partners removed waste rock from the floodplain and restored the natural channel along Willow Creek, seen here in July 2008.

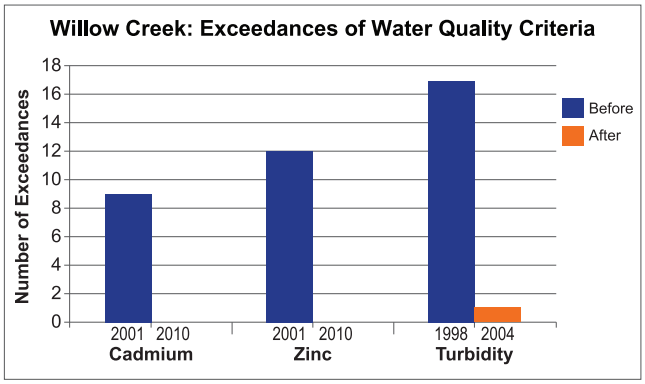

Figure 3. The number of exceedances of the water quality criteria for metals and turbidity decreased following the restoration of Willow Creek.

Results

The mine reclamation project improved water quality. Turbidity data collected in 2004 showed that only one of eight samples exceeded 10 nephelometric turbidity units, allowing NMED to remove turbidity as a cause of impairment on the state's 2004 CWA section 303(d) list (Figure 3).

Water quality data collected in 2010 showed that Willow Creek met the state water quality standards for dissolved cadmium and zinc. All 50 water quality samples taken throughout the year showed that cadmium and zinc were below detection limits, with the exception of one zinc sample of 40 micrograms per liter (µg/L), which although detectable, was still below the zinc water quality criterion. The criteria for metals are dependent on hardness and can vary over time; however, between 2001 and 2010 the mean cadmium concentration dropped from 7.75 µg/L to 0 µg/L (all samples below detection) and the zinc concentration dropped from 4.65 µg/L to 0.3 µg/L. Therefore, NMED removed cadmium and zinc from the 2012 CWA section 303(d) list as sources of impairments to Willow Creek (NM-2214.A _ 030). The 5.26-mile-long creek remains listed as impaired for sediment/siltation and specific conductance.

Partners and Funding

Cyprus-Amax Minerals Company, the primary responsible party, conducted the reclamation work. (Cyprus-Amax was later purchased by Phelps Dodge.) Additional responsible parties included the New Mexico Department of Transportation and the New Mexico Department of Game and Fish because they had used contaminated materials on state roads and on Lisboa Springs Fish Hatchery property, respectively. Two NMED bureaus were involved: The Ground Water Quality Bureau provided oversight of reclamation and monitoring, and the Surface Water Quality Bureau conducted surface water quality monitoring. CWA section 319-funded staff assisted in designing the reconstructed channel. In addition, the consulting firm Daniel B. Stevens & Associates conducted water quality monitoring.

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