Final Groundwater Restoration Plan for the Chino, Cobre, and Tyrone Mine Facilities

New Mexico Office of Natural Resources Trustee
4910-A Alameda Boulevard NE
Albuquerque, NM 87113
505-243-8087
www.onrt.state.nm.us

January 4, 2012

2. Overview of the Sites

This chapter overviews the mine facilities, water resources, and mining history and summarizes remedial actions for the three Sites: Chino, Tyrone, and Cobre mines.

2.1 Mine Facilities and Water Resources

The Sites, located in southwestern New Mexico, are open-pit and underground copper and iron mining, beneficiation, and processing facilities owned and operated by FMI (Figure 2.1).

2.1.1 Chino Mine

The Chino Mine is located approximately 12 miles east of Silver City in Grant County, New Mexico. The site includes the following mine areas and associated facilities (Daniel B. Stephens & Associates, 1999; Golder Associates, 2008) (Figure 2.2):

- North Mine Area
  - Santa Rita Pit and associated stockpiles
  - West of pit area (West, South, and Upper South Stockpile areas; Ivanhoe Concentrator and Former Precipitation Plant; Groundhog Mine Area; Bull Frog Tailing Area)
  - Lampbright Stockpile Area
  - Solvent Extraction/Electrowinning (SX/EW) Plant and mine water/stormwater/process water reservoirs (e.g., Reservoirs 3A, 5, and 8)
- Middle Whitewater Creek Area
- South Mine Area
  - Hurley Smelter
  - Lake One
  - Axiflo Lake
  - Old Tailings Impoundment Area (Impoundments 1, 2, B, C, 6W, 4, and 6E)
  - Tailings Impoundment 7 Area
  - Lower Whitewater Creek Area (south of Tailings Impoundment 7 along creek).

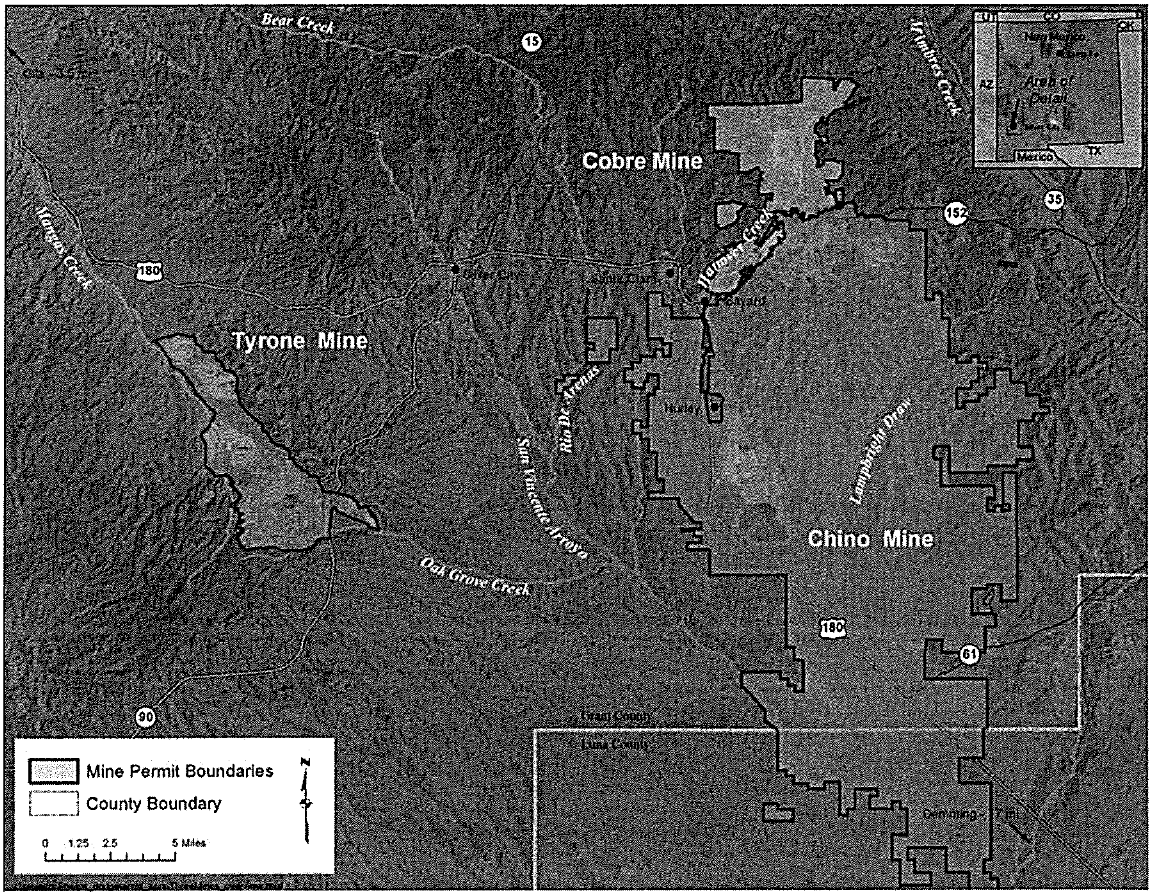

Figure 2.1. Overview of the Chino, Tyrone, and Cobre mines.

Surface water resources

The Chino Mine is east of the Continental Divide in the Mimbres watershed. The Mimbres River is a closed-basin desert stream and a well-defined river channel that terminates approximately 10 miles east of Deming, New Mexico (NMWRRI, 2000). Major drainages at the Chino Mine include Whitewater Creek, Hanover Creek, and Lampbright Draw. Hanover Creek is an ephemeral stream that originates northeast of the Chino Mine and joins Whitewater Creek near the Ivanhoe Concentrator. Whitewater Creek is an ephemeral stream that runs from the North Mine Area to the South Mine Area. Whitewater Creek flows into the San Vicente Arroyo south of the mine. Lampbright Draw is an ephemeral stream draining the eastern portions of the North Mine Area that flows south and eventually joins the San Vicente Arroyo (M3 Engineering & Technology, 2001).

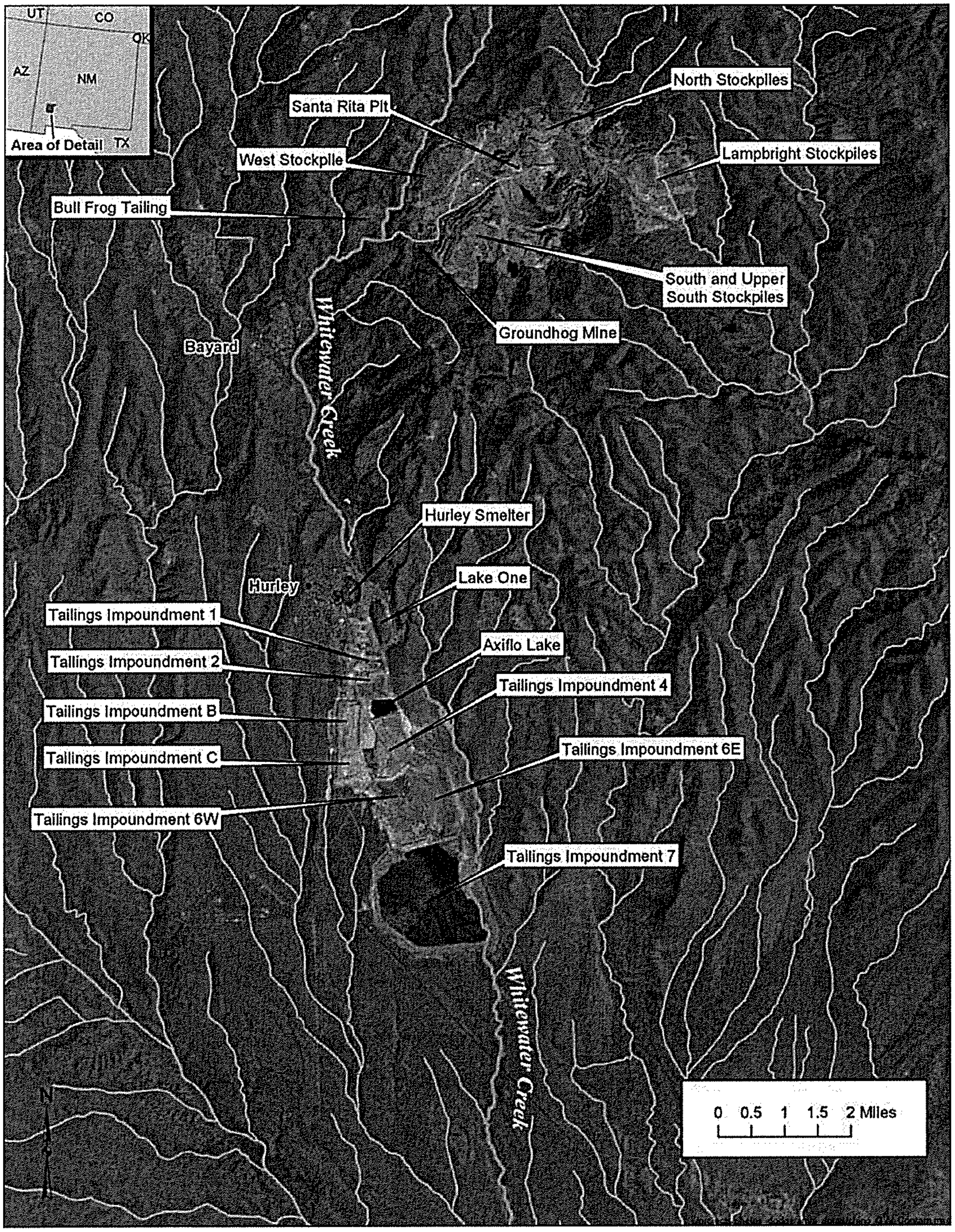

Figure 2.2. Hydrologic features and mine facilities at the Chino Mine.

Geology and groundwater resources

The major aquifers at the Chino Mine include the Gila Conglomerate, igneous and sedimentary rock units, and Quaternary alluvium.

The geology and hydrogeology of the Chino Mine vary widely in the three major geographic areas of the site: the North Mine Area, the Middle Whitewater Creek Area, and the South Mine Area. The ability of rocks to contain and transmit groundwater is a function of the geology of rock (rock type), the amount of open pore spaces or fractures/faults in the rock, the amount of water that infiltrates from the surface, and the groundwater gradient.

The *North Mine Area* contains a complex array of igneous (plutonic and volcanic) and sedimentary rock units and numerous near-vertical, north-to-northeast trending faults (Golder Associates, 2008). The oldest rocks in the area are sedimentary rocks (generally sandstones, limestones, and shales) that were deposited during the Paleozoic (570 to 230 million years ago) and Cretaceous (140 to 65 million years ago) periods. The ore body is largely hosted in the Santa Rita Stock, a plutonic igneous rock that ranges from granodiorite to quartz monzonite in composition (similar to granite). The stock was intruded into the older sedimentary rocks. After the mineralization of the copper deposit, volcanic rocks, including rhyolite tuffs and basaltic-andesitic lava flows, blanketed the igneous intrusion south of what is now the Santa Rita Pit area (see Figure 2.2). The Santa Rita Stock was extensively fractured and cut by intrusive dikes, especially in the areas west of the pit. The composition of the dikes is similar to that of the stock.

The rocks in the North Mine Area generally have low primary porosity and hydraulic conductivity, although higher values can exist in the sedimentary units. Groundwater flow in the plutonic and volcanic units in the North Mine Area is predominantly through the abundant fractures.

The *Middle Whitewater Creek Area* is located geographically between the North and South Mine areas and extends from Gold Gulch in the north (near the Town of Bayard) to the Town of Hurley in the south (see Figure 2.2). The most important aquifer in the Middle Whitewater Creek Area is the alluvium along Whitewater Creek (Golder Associates, 2008). In the north end of the area, the underlying bedrock is principally igneous (quartz diorite sill), and south of Bayard the bedrock consists largely of volcanic tuffs. The thickest alluvium (> 100 feet) is located around Bayard. South of Bayard the alluvium varies from approximately 5 to 20 feet thick and from 500 to 3,000 feet wide.

The *South Mine Area* geology and hydrogeology are dominated by the Gila Conglomerate. Alluvium of varying thickness lines and underlies Whitewater Creek in this area. Volcanic rocks outcrop to the east of the tailings impoundments, and limestones outcrop on the western side of the impoundments. The Gila Conglomerate was formed essentially as an alluvial fan, filled streambeds and lakes, and is composed of gravel on the large end to clays on the small end (Golder Associates, 2008). The Gila Conglomerate in Grant County is divided into upper and lower units. The upper part of the upper unit has the highest porosity and ability to transmit water and is the most important aquifer in the area (Trauger, 1972). The Gila Conglomerate pinches out on the north end, near Lake One, and thickens to the south, where it is approximately 500-feet thick south of Tailings Impoundment 7 and up to 1,000-feet thick farther to the south (Figure 2.2).

2.1.2 Tyrone Mine

The Tyrone Mine is located approximately 10 miles southwest of Silver City, New Mexico, in southwest Grant County. The site includes the following mine areas and associated facilities (Daniel B. Stephens & Associates, 2004) (Figure 2.3):

- Mine/Stockpile Area
  - Main Pit, Gettysburg Pit, Copper Mountain Pit (and several smaller pit areas)
  - SX/EW Plant
  - Pregnant Leach Solution (PLS) Collection Impoundments
  - Mill and Concentrator Facilities
  - Former Precipitation Plant Area and Acid Unloading Area
  - Leach Stockpiles (Nos. 1, 1A, 1B, 2, 2A, 3, East Main, Gettysburg Out Pit, and Gettysburg In Pit stockpiles)
  - Waste Stockpiles (Nos. 1C, 1D, 3B, a portion of the 2B, Savanna, and Upper Main stockpiles)
- Oak Grove Wash/Brick Kiln Gulch Area
  - No. 1 Leach Stockpile
  - Burro Mountain Tailings Impoundment
- Mangas Valley
  - Nos. 1, 1A, 1X, 2, 3X, and 3 Tailings Impoundments.

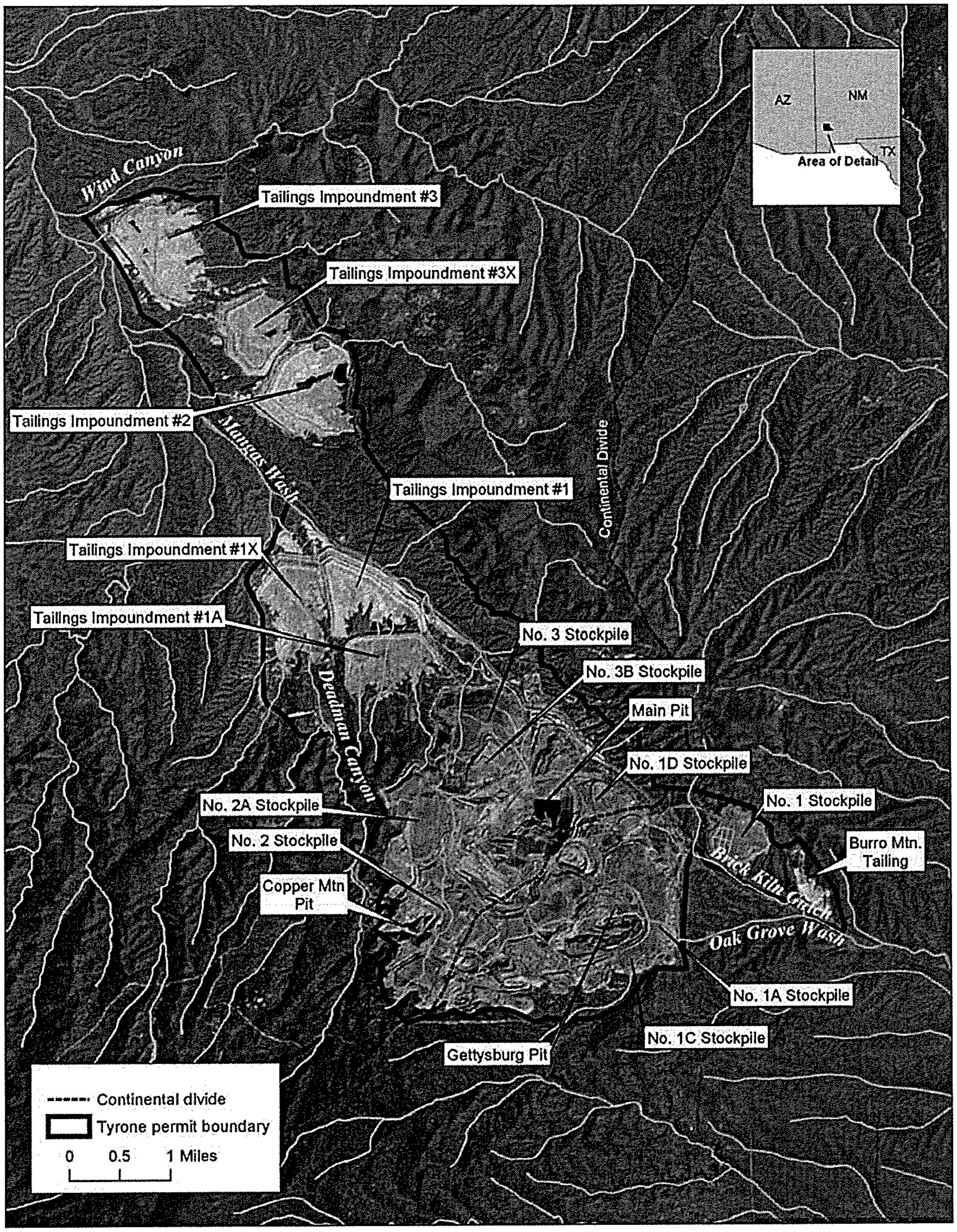

Figure 2.3. Hydrologic features and mine facilities at the Tyrone Mine.

Surface water resources

The open pit straddles the Continental Divide (Figure 2.3). Before open-pit mining, the pit area drained toward the northwest into Mangas Creek, an ephemeral stream that flows north into the Gila River, and toward the southwest into Brick Kiln Gulch and Oak Grove Wash, which flow into the Mimbres River. Because open-pit mining and associated dewatering operations have altered the hydrologic regime, some groundwater that would have flowed into the Gila and Mimbres basins is now captured by pit dewatering operations (M3 Engineering & Technology, 2001).

Geology and groundwater resources

The most important hydrogeologic units at the Tyrone Mine are the Gila Conglomerate, alluvium along the creeks and washes, and the igneous rocks in and around the open pit and stockpiles. The copper ore body is contained in a granite-like igneous rock and is bounded by several major faults on the western, eastern, and southern sides (Daniel B. Stephens & Associates, 1999). This igneous rock (quartz monzonite) is located under and around the open pit and stockpiles, along the eastern flanks of Deadman Canyon, and near the 1A leach stockpile in Oak Grove Wash.

As noted for the Chino Mine, the Gila Conglomerate is a sedimentary rock with a range of porosities and is derived from the physical weathering of local mountains. The most permeable portion of the Gila Conglomerate, the upper Gila, is located under the northern end of the No. 3 leach stockpile in uppermost Mangas Wash just downgradient of the stockpile, and downgradient of the No. 1 and 1A stockpiles in Oak Grove Wash (see Figure 2.3).

The younger alluvial material is the most porous material on the site and was deposited directly on the Gila Conglomerate. Alluvium lines Deadman Canyon, Oak Grove Wash/Brick Kiln Gulch, small tributaries of the upper Mangas Wash under and downgradient of the No. 3 leach stockpile, and Mangas Wash under and downgradient of all the tailings impoundments (see Figure 2.3 for locations). Groundwater is present in the alluvium but is not necessarily continuous in underlying, lower-permeability, igneous rocks or the Gila Conglomerate (i.e., the upper portions of the regional aquifers are not saturated with groundwater). Shallow groundwater that is not directly connected to underlying regional groundwater is called "perched." Perched water in the Tyrone Mine area may feed groundwater to deeper regional groundwater (Daniel B. Stephens & Associates, 1997c, 2004).

Igneous rocks on the western side of the site have been upthrown hundreds of feet along the Sprouse-Copeland Fault, a regional, nearly vertical, north-trending fault in the upper/middle portion of Oak Grove Wash, and moved directly against the Gila Conglomerate (Daniel B. Stephens & Associates, 1999). The regional Mangas Fault runs in a northwesterly direction on the eastern side of the Mangas Wash and Brick Kiln Gulch. The Gila Conglomerate is thickest on the northeastern side of the Mangas Fault and is only a few feet thick on the southwestern side. Faulting can increase the porosity of adjacent rocks due to the increased fracturing associated with the fault. The large differences in groundwater levels across faults at the Tyrone Mine suggest that they inhibit groundwater flow between different rock types across the faults (Daniel B. Stephens & Associates, 1997c).

2.1.3 Cobre Mine

The Cobre Mine is located approximately 3 miles north of Hanover, New Mexico, in Grant County. The site includes the following main mine facilities (Shepherd Miller, 1999; M3 Engineering & Technology, 2001; Telesto Solutions, 2005) (Figure 2.4):

- Continental Pit
- Continental underground mine and workings
- West, East, South, Buckhorn, and Union Hill Waste Rock Disposal Facilities (WRDFs)
- Low-grade and high-grade ore stockpiles
- Main tailings impoundment
- Magnetite tailings impoundment.

Surface water resources

The site drains into Hanover Creek and the Mimbres River watershed. Hanover Creek headwaters are in the Pinos Altos Range to the north of the site. The creek is perennial only for a short distance adjacent to the Towns of Hanover and Fierro, possibly due to contributions from local septic system outfalls, and downstream of Fierro Spring (Shepherd Miller, 1999; M3 Engineering & Technology, 2001). Hanover Creek flows into Whitewater Creek, which flows southward to the Chino Mine. Ephemeral drainages on the mine site include Grape Gulch, Poison Spring Drainage, and Buckhorn Gulch. These drainages usually flow only after summer thunderstorms (M3 Engineering & Technology, 2001). Perennial springs and seeps exist on the site, including Fierro Spring; seeps in Grape Gulch, Gap Canyon, and Poison Spring, which are located upstream of the mine; and Buckhorn Gulch Spring and seeps along Hanover Creek, which are downstream of mining activity.

Geology and groundwater resources

Even though the Cobre Mine is the smallest of the three sites, it has the most complex geology. More than 30 types of igneous rock exist at the site, including sills, dikes, stocks and plugs, older sedimentary rocks, younger volcanic rocks, and more recent alluvium (M3 Engineering & Technology, 2001). The alluvium is limited to an approximately 0.75-mile stretch of Hanover

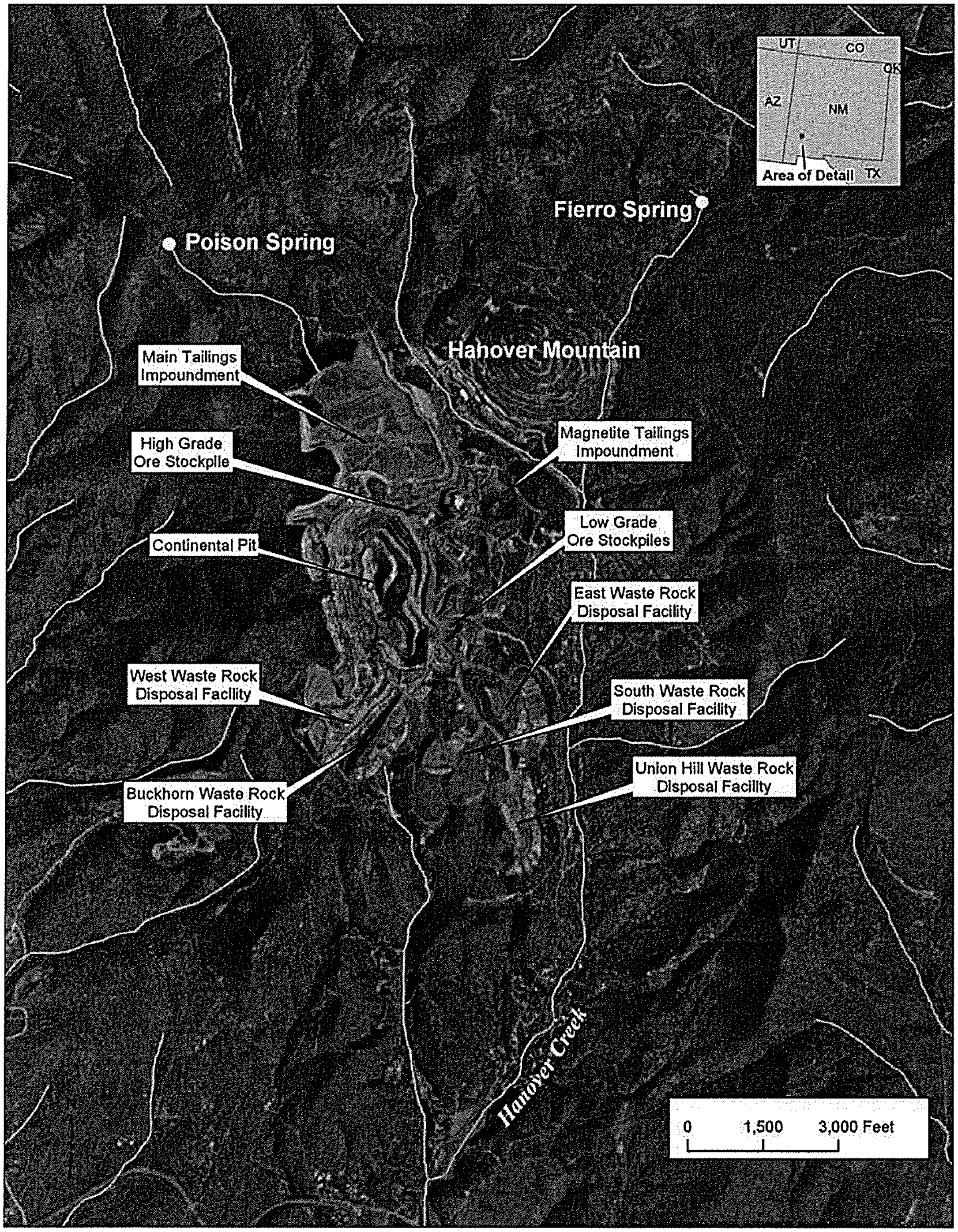

Figure 2.4. Hydrologic features and mine facilities at the Cobre Mine.

Creek downstream of Fierro Spring (Figure 2.4). Shallow perched groundwater exists in alluvium, terrace gravels, and weathered rock in Grape Gulch, Poison Spring, and upper Buckhorn Gulch and generally flows to the south or southeast. Two of the main springs in the area, Fierro and Poison springs, discharge perched groundwater (M3 Engineering & Technology, 2001).

Regional groundwater exists in the upper bedrock units (Colorado Formation and Beartooth Quartzite) and in the lower bedrock unit (older Paleozoic sedimentary rocks and the Hanover-Fierro intrusive stock) (Shepherd Miller, 1999; M3 Engineering & Technology, 2001). Groundwater in the upper bedrock unit flows to the south and southwest from the Pinos Altos Range and does not appear to be affected by mining-related groundwater dewatering. Groundwater in the lower bedrock unit on the site generally flows radially toward the underground workings (M3 Engineering & Technology, 2001) north of the Barringer Fault, where most of the upper bedrock unit has been eroded. On the southern side of the fault, groundwater flows to the south, and both the upper and lower bedrock units exist (Shepherd Miller, 1999).

2.2 Overview of Site Histories

The following sections provide an overview of the site histories for the Chino, Tyrone, and Cobre mines.

2.2.1 Chino Mine

Open-pit mining at Chino began in 1910. As of 1998, the Santa Rita Pit was approximately 1,500 feet deep, 1.8 miles in diameter, and covered more than 1,500 acres (M3 Engineering & Technology, 2001). The pit is actively dewatered by pumping groundwater wells to allow access to the ore. The pumping creates a cone of depression in the groundwater table, with the lowest groundwater elevations below the open pit. As a result, surrounding groundwater flows toward the pit (M3 Engineering & Technology, 2001). Mine dewatering water from the underground mine was historically discharged directly to Whitewater Creek (Golder Associates, 2008).

In 1911, a mill and concentrator were built near the current Hurley smelter site. The ore was extracted from the open pit and ground at the mill. In the flotation process, the ground ore is suspended in water and flotation chemicals (including a substance similar to pine sap), and air is bubbled through the mixture. The flotation chemicals attach to the copper sulfide minerals in the ground ore, air bubbles attach to the flotation chemicals, and the copper sulfide concentrate floats to the top of the flotation cells. The concentrate is skimmed from the top and sent to a smelter for sulfur removal. The material that does not float to the top (more than 99% of the ore) becomes waste, which is referred to as tailings. The Hurley smelter was completed in 1939. Lake One was created in 1910 by damming Whitewater Creek to store water for the mill (Integrated Analytical Laboratories, 2009). Waste from the smelter (slag) was deposited on the northwestern side of Lake One. In 1982, a new mill and concentrator (the Ivanhoe Concentrator) near the open pit replaced the original Hurley mill and concentrator. Tailings from the flotation operation have been deposited east of Hurley in piles and impoundments along and near the former Whitewater Creek drainage.

In 1936, leaching operations of low-grade ore stockpiles were initiated near the open pit. Copper was extracted from leach solutions at precipitation plants. In 1988, the SX/EW plant was constructed east of the open pit, and additional leaching activities began (M3 Engineering & Technology, 2001). In the leaching process a sulfuric acid solution (pH 1.7 to 2.5) is applied to the top of the stockpiles. This solution percolates through the piles to form a high-copper PLS, which is collected at the bottom of the stockpiles. The PLS is then transferred to uncovered solution ponds and pumped to the SX/EW plant. An organic solvent is added to the PLS (SX), and the copper-bearing organic solvent solution is stripped of copper in the EW process, where the copper is precipitated onto a 99.9% pure metallic copper cathode. The stripped but still acidic PLS, known as raffinate, is recycled for further stockpile leaching (Dresher, 2001).

In 1997, 99,900 tons of copper were produced by flotation, and an additional 69,100 tons of copper were produced by the SX/EW process. In 2001, production rates dropped to 18,300 tons of copper by flotation and 59,900 tons of copper by SX/EW (U.S. Securities and Exchange Commission, 2002). The copper mill and flotation operation were shut down temporarily in March 2001. In January 2002, the Chino Mine was temporarily closed (U.S. Securities and Exchange Commission, 2002) but has since reopened. Primary extraction of ore from the pit by flotation continues, and the tailings are deposited in the active Tailings Impoundment 7. Flotation concentrate is currently sent to a smelter in Arizona (Golder Associates, 2008). Leaching of stockpiles and operation of the SX/EW plant are also ongoing. FMI is required by NMED to continue actively dewatering the open pit to prevent formation of a contaminated pit lake.

Located within the permit boundary of the Chino Mine, the Groundhog Mine is a historical underground polymetallic (zinc, lead, copper, silver) mine (see Figure 2.2). Lead carbonate was first mined along the Groundhog Fault in the late 1860s. Controlling interest in the three claims that make up the mine was sold to ASARCO in 1928, and mining continued into the 1970s. In 1994, ASARCO sold the property to Phelps Dodge. As a condition of the sale, ASARCO moved the stockpiles from Bayard Canyon to the San Jose shaft area and covered them with a thin layer of soil. One uncovered stockpile (Groundhog No. 5) remains (M3 Engineering & Technology, 2001).

2.2.2 Tyrone Mine

In the late 1870s through the early 1900s, a number of companies mined turquoise, copper, and fluorspar in the Tyrone Mine area. Phelps Dodge consolidated the mining claims in the area by 1913 and developed a large-scale underground operation that shut down in 1921, with sporadic operations from 1921 to 1929 and from 1941 to 1950.

Open-pit copper mining began in 1967 when excavations were made to expose and mine the ore. By September 1969, 95 million tons of overburden had been removed from the Tyrone pit to allow the mining of copper ore to begin (SARB, 1999). In February 1999, the Tyrone open pit was approximately 1,400 feet deep and covered an area of about 1,400 acres. Parts of the pit have been partially or completely backfilled. The pit is actively dewatered, which induces groundwater flow toward the pit (M3 Engineering & Technology, 2001).

Initially, copper was recovered from the ore using flotation methods, with an initial mill and concentrator capacity in 1969 of 29,000 tons of ore per day. In 1972, the concentrator capacity was expanded to 50,000 tons per day (SARB, 1999). The copper concentrator operated from 1969 to 1992, and the concentrate was shipped offsite for smelting (M3 Engineering & Technology, 2001). The flotation process produced tailings as a by-product, which was then piped to one of six tailings impoundments in the Mangas Valley (SARB, 1999).

Stockpile leaching operations began in 1972 on the No. 1 stockpile, with copper extracted from the leach solution in a precipitation plant. Additional leaching operations began in 1984, with the opening of the SX/EW plant (SARB, 1999). In 2003, Discharge Permit 166 allowed the discharge of up to 35 million gallons per day of leach solution to the No. 2 leach stockpile and up to 49 million gallons per day of PLS to the SX/EW plant (NMED, 2003).

Since 1992, Tyrone has been solely a copper leach operation. From 1997 to 2001, annual production of copper through the SX/EW process at the Tyrone Mine ranged from 76,400 to 82,600 tons. An additional 2,600 tons of copper were produced by the precipitate process in 1997, but no precipitate copper has been produced since (U.S. Securities and Exchange Commission, 2002). In 2010, 202 million tons of ore were produced using SX/EW methods at an average ore grade of 0.28% (Freeport-McMoRan Copper & Gold, 2010).

2.2.3 Cobre Mine

The Cobre Mine has a long history of copper and iron ore production. Commercial copper production by underground methods at the site began in 1858, and approximately 1 million pounds of copper were produced over a three-year period (M3 Engineering & Technology, 2001). The Modoc and Republic mines, located near the present-day Continental Pit and owned by the United States Smelting, Refining, and Mining Company (USSR&M), produced iron ore (magnetite) from the early 1900s through 1974. Magnetite production peaked at 200,000 tons per year from 1916 to 1931. The magnetite tailings impoundment stored magnetite ore from 1967 to 1982. Underground mining of copper ore from a skarn deposit under what is now the Continental Pit began in 1947. The copper ore was extracted by USSR&M and processed using flotation methods at their Bullfrog Mill, located approximately 6 six miles south of the mine. Underground copper mining ended in 1971, shortly after open-pit extraction began at the Continental Pit in 1967.

The current phase of copper mining at the site began in 1964 with underground extraction and flotation operations at the Nos. 1 and 2 flotation mills (started in 1967 and 1973, respectively). The mine was closed from 1982 to 1993 due to low copper prices and went on standby in 1999 (Telesto Solutions, 2005). Although the mine has received approval to resume mining and expand operations (including excavation of Hanover Mountain, and expansion of the South WRDF and the Continental Pit), it has not yet resumed mining (as of 2011) (Telesto Solutions, 2005).

2.3 Summary of Remedial Actions

FMI has conducted a number of remedial actions at the Sites, as listed in Table 2.1. Table 2.1 includes remedial measures completed by late 2009/early 2010 and some planned future remedial actions. The general types of remedial actions include groundwater pumping to maintain open-pit capture zones; regrading, covering, and revegetating tailings impoundments; installing groundwater and seep capture systems; limited removals of waste rock piles; restoration of Oak Grove Wash; and improvements in PLS collection systems. These remedial measures generally do not eliminate currently injured groundwater but could limit the future expansion of injured groundwater.

Table 2.1. List of general remedial actions taken as of January 2010 at the Chino, Tyrone, and Cobre mines

Mine site	Area	Current or completed remedial actions	Potential effect on groundwater injury
Chino Mine	Open Pit	Groundwater pumping (in perpetuity, with future treatment); upgraded PLS collection with steel raffinate tank.	Limits future expansion of injured groundwater around pit
	North Mine Area	*Lampbright Area/Reservoir 8:* drained PLS from Reservoir 8 (formerly unlined), cleaned out sediment, made lined concrete collection system with concrete and high-density polyethylene pipes and liners and stainless steel tank for PLS; pumpback systems using converted monitoring wells; after PLS spill (booster tank) on north slope of Lampbright, cleaned contaminated sediment, power-washed outcrops, installed warning system to shut down booster; installed French drain and pump north of Lampbright; lengthened trench near Sump 3. *SX/EW Area:* upgraded PLS collection with steel raffinate tank. *West/South Stockpiles*: built dams in paleochannels on west side; upgraded dams with new pumps and backup pumps. *South Stockpile:* upgraded PLS collection system, installed French drains. *Lucky Bill:* Reclaimed waste rock pile.	Size of spill area is diminishing; could decrease concentrations in injured groundwater near Lampbright and prevent formation of injured groundwater mound in future
	Middle Whitewater Creek Area	None.	NA
	South Mine Area	*Lake One, Axiflow Lake, smelter, old tailings impoundments, Impoundment 7:* Lake One regraded; smelter reclamation completed; conducted cleanup of house yards in Hurley; reclaiming Impoundments B, C, and 6 West (3-foot cover, revegetation); pumping injured groundwater from south toe of Impoundment 7 to top of Impoundment 7. *South of Impoundment 7/Distributary Area:* no plans for reclamation.	Limits future expansion of injured groundwater near old tailings areas
Tyrone Mine	Open Pit	Groundwater pumping (in perpetuity, with future treatment).	Limits future expansion of injured groundwater around pit
	Deadman Canyon	Water from pumpback well at seep 5E sent to No. 2A stockpile; removed the *United States Natural Resources, Inc.* (*USNR) Stockpile* and put on 2B waste pile; capture of contaminated seeps.	Could improve groundwater quality under former USNR stockpile area; limits future expansion of plumes associated with stockpiles

Table 2.1. List of general remedial actions taken as of January 2010 at the Chino, Tyrone, and Cobre mines (cont.)

Mine site	Area	Current or completed remedial actions	Potential effect on groundwater injury
Tyrone Mine (cont.)	East Side/Oak Grove	Capped *7A and 1C waste piles:* regrading and covering slopes; installed pumpback capture systems for 7A, 7A west, and other piles and some alluvial groundwater; removed southeast side of *1C waste stockpile. Oak Grove Wash*: rebuilt to create free-flowing stream (now water of the United States under CWA); installed capture systems across wash, smaller systems along Brick Kiln. *1A/1B leach stockpiles*: covered, regraded, and revegetated No. 1 and pumpback systems; covered Burro Mountain; moved some material from 1A to 1B; surface PLS collection structures upgraded.	Lessened extent of PLS plume in Oak Grove Wash, but alluvial groundwater becomes recontaminated after rain events; could limit future extent of injured groundwater from stockpiles; improves quality of stream
	No. 3 Stockpile	Installed two pump-back lines (L and EL) across upper Mangas Wash and many pumping wells – pumps to PLS pond; hydrocarbon remediation – pumping free product on perched water table.	Limits future expansion of injured alluvial and regional groundwater
	Mangas Valley	Installed line of pumpback wells north of 1X tailings; capped Nos. 1, 2, 3X, 3 impoundments (capped tops and sides, side slopes 3:1, stormwater channels around impoundments). Extracting diesel fuel oil (leak in distribution pipeline at diesel tank farm) with skimmer pump – migrated to regional aquifer (poor well casings).	Limits future expansion of injured alluvial groundwater; limits increase in diesel fuel contaminant concentrations in groundwater
Cobre Mine	Continental open pit and underground workings	Closure of shafts and adits, including Hanover Empire Zinc area (only covered if less than threshold acid-generating values); collecting seeps and stormwater; reclaimed Pearson Barnes area (revegetation unsuccessful); reclaimed Slate, Bullfrog, Copper Flat, Kearny; removed hydrocarbon-contaminated soils on east side of pit.	Limits future expansion of injured regional groundwater
	Tailings impoundments	Removed reclaim pond on *main tailings impoundment* (send water to Chino); removing (selling) *magnetite tailings*; installed dust cover on main tailings area (only 6 inches thick).	Could decrease injured groundwater under tailings impoundment and in underground workings
	Waste rock facilities	Collecting seeps on south side of West waste rock facility, sending to Chino; covered much of West WRDF; collecting seeps on east side of East WRDF and Union Hill; upgraded seep collection systems in Poison Hill drainage (collects mine and natural seeps).	Reduces infiltration through piles, which could reduce future extent of injured groundwater

Sources: Daniel B. Stephens & Associates, 1997a, Table 2-2; Kurt Vollbrecht and Clint Marshall, NMED, personal communication, December 17, 2009 and January 20, 2010.