DRAFT ENVIRONMENTAL IMPACT STATEMENT

AUGUST 1996

Little Rock Mine Project

Lead Agency

U.S.D.I. Bureau of Land Management
Las Cruces District Office
Mimbres Resource Area

Cooperating Agency

U.S.D.A. Forest Service
Silver City Ranger District
Gila National Forest

BLM-NM-PL-96-003-1793

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Las Cruces District Office
1800 Marquess St.
Las Cruces, New Mexico 88005

IN REPLY REFER TO:
1793 (NM 91644)

August 1996

Dear Reviewer:

Enclosed for public review and comment is the Draft Environmental Impact Statement (DEIS) for the Phelps Dodge Little Rock Mine Project. The project is being proposed by Phelps Dodge Mining Company. Your review and comments are needed at this time to ensure that your concerns have been considered in the planning process.

The DEIS analyzes the impacts of the re-establishment of the Little Rock Mine, based on the Plan of Operations submitted to the Bureau of Land Management (BLM). The Little Rock Mine is an open-pit copper mine located approximately seven miles south of Silver City, New Mexico. Several alternatives, which consist of the No Action Alternative; an open pit mine, haul road and stream diversion; and two additional haul road alternatives, a partial backfill alternative and two additional stream diversion alternatives are examined. The DEIS addresses those issues and concerns which were raised during the public scoping period. The Plan of Operations and Technical Reports are available for review at the BLM offices in Las Cruces and Santa Fe, New Mexico.

Public comments concerning the adequacy and accuracy of the DEIS must be postmarked no later than October 15, 1996, and must be submitted in writing to:

Little Rock Mine Project Team Coordinator
BLM Las Cruces District
1800 Marquess Street
Las Cruces, NM 88005

Use this address when requesting further information on materials referenced in the DEIS.

A public hearing to accept verbal and written comments has been scheduled on the following date, time, and place:

DATE	TIME	CITY	LOCATION
September 25, 1996	7:00 p.m.	Silver City, New Mexico	Grant County Courtroom, 2nd Floor 201 North Cooper Street

Depending on the number of people who wish to make a statement, a time limit may be imposed on oral comments. Oral comments should be accompanied by a written text or written synopsis of the presentation. Both written and oral comments received during the public comment period will be fully considered and evaluated for preparation of the final Environmental Impact Statement.

If you would like additional information, please contact Juan Padilla, EIS Team Coordinator at (505) 525-4376.

Sincerely,

Jim C. McCormick Jr.
FOR
Stephanie Hargrove
Area Manager
Mimbres Resource Area

LITTLE ROCK MINE PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Draft (X) Final ( )

The United States Department of the Interior, Bureau of Land Management

1. Type of Action: Administrative (X) Legislative ( )

2. Abstract: Phelps Dodge Mining Company (PDMC) has proposed to re-establish the Little Rock Mine, an open-pit copper mine located approximately seven miles south of Silver City, New Mexico. The proposed action includes the construction, operation, and reclamation of the proposed mine pit, including the diversion of stream water in California Gulch, and the creation of a pit lake after mining operations have ceased. PDMC estimates that approximately 100 million tons of leachable ore could be removed from the proposed pit. Up to 160,000 tons of ore per day would be mined and processed at existing, permitted sites at PDMC's Tyrone Mine facility over a two- to four-year period.

   The proposed project will also require the construction of a haul road that will allow transportation of ore from the Little Rock Mine site to the processing facilities located at Tyrone. Overburden or other inert, non-mineralized materials will be stockpiled for potential use in reclamation. Project construction will employ the existing workforce at Tyrone.

   The Draft Environmental Impact Statement analyzes the potential environmental effects of the proposed Little Rock Mine Project and addresses issues identified throughout the public scoping process and agency involvement. Key issues identified include potential effects to surface and ground water quantity and quality; reclamation potential of the proposed mine pit; and to a lesser extent, impacts related to biological, socioeconomic, visual, cultural, air, noise, and land use resources.

3. Comments have been requested from the individuals, groups, and agencies shown on the distribution list in Chapter 5.

4. For further information contact:

   Juan Padilla, Team Coordinator
   Bureau of Land Management
   Mimbres Resource Area
   1800 Marquess
   Las Cruces, New Mexico 88005
   Telephone: (505) 525-4376

5. Date Draft Filed with Environmental Protection Agency August 15, 1996.

6. Comments on the Draft EIS must be postmarked no later than October 15, 1996.

RECOMMENDED:

Stephanie Hargrove
Area Manager
Mimbres Resource Area

APPROVED:

Linda S. C. Rundell
District Manager
Las Cruces District

BLM-NM-PL-96-003-1793

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SUMMARY

SUMMARY

The Little Rock Mine Project is located approximately seven miles south of Silver City in southwestern New Mexico. The proposed mine site occupies an existing, non-operational mine west of the Phelps Dodge Mining Company (PDMC) operations at Tyrone (Figure 1-1 on page 1-3). According to estimates in the Little Rock Mine Project Plan of Operations, up to 160,000 tons of material per day would be removed from the pit over a two- to four-year period. PDMC estimates that approximately 100 million tons of leachable ore and 60 million tons of waste could be removed from the pit and processed at existing, permitted sites at PDMC's Tyrone Mine facility. The proposed project would also require the construction of a haul road that will enable PDMC to transport ore from the Little Rock Mine pit to the existing Tyrone operations for processing.

PDMC submitted the Plan of Operations to the Bureau of Land Management (BLM) Mimbres Resource Area in October 1993 for the proposed re-establishment, operation, and reclamation of the Little Rock Mine Project. The proposed project area includes lands administered by the Las Cruces District of the BLM; Silver City Ranger District of the Gila National Forest; and private, patented lands owned by PDMC and MM Holdings of San Jose, California.

The BLM is serving as the lead federal agency for the preparation of an environmental impact statement (EIS) in accordance with the National Environmental Policy Act (NEPA) of 1969. The Forest Service is a cooperating federal agency. Other agencies participating in the development of the EIS include:

- U.S. Fish and Wildlife Service (USFWS) - vegetation, wildlife, and threatened and endangered (T&E) species
- State Historic Preservation Office (SHPO) - cultural and historic elements
- New Mexico Environment Department (NMED) - water and environmental quality
- State of New Mexico Department of Game and Fish - threatened and endangered species and wildlife
- New Mexico Energy, Minerals and Resources Department, Mining and Minerals Division (MMD) - New Mexico Mining Act
- U.S. Army Corps of Engineers - stream diversions and haul road

This EIS describes the proposed Little Rock Mine Project, project alternatives, and potential environmental consequences of implementing the proposed action, project alternatives, or the no-action alternative. Resources considered in the analysis include cultural, visual, land use, biological, surface water, ground water, geology, soils, socioeconomics, air quality, and noise. The baseline information included in this report was derived from primary and secondary sources including comprehensive management plans; aerial photos; field inventories; recent investigation and sampling programs; personal interviews; as well as comments and suggestions from individuals, agencies, and special interest groups.

DESCRIPTION OF MINING OPERATION

The project would be a conventional open-pit mining operation with a production rate of as high as 160,000 tons of material per day for a period of between two and four years. No processing or waste disposal facilities are planned for the project area. All material mined would be transported to the existing Tyrone Mine facilities via a haul road to be constructed from the Tyrone Mine to the project site. Overburden or other inert, non-mineralized materials would be stockpiled for use in reclamation. All leachable ore will be processed at existing permitted processing sites at the Tyrone Mine. Solid wastes generated at the Little Rock Mine would be transported to and disposed of at existing permitted facilities at the Tyrone Mine.

Minimal associated facilities specific to future mining of this site would be required and would consist of a dewatering system, a water pipeline and fill station to provide water for dust suppression, a 46kV power distribution system, and temporary operating and maintenance facilities. These facilities would be removed upon completion of mining.

A map of the proposed mine site is shown in Figure 2-1 (on page 2-3). The mining limits used to determine the maximum extent of the mine pit were based on copper prices in excess of the current price. The actual mining limits may be reduced from this area based on economic parameters and the future price of copper.

EXISTING ENVIRONMENTAL CONDITIONS

The site is characterized by mountainous, rolling terrain. The climate is mild with an annual average temperature of 55 degrees Fahrenheit with an annual precipitation of approximately 16 inches. Vegetation in the area is characterized by piñon-juniper, grassland, and occasional stands of ponderosa pine. Primary topographic features include three drainages that traverse through the area in a northerly direction—California Gulch, Deadman Canyon, and Whitewater Canyon. The proposed pit is surrounded by moderately undulating natural terrain that has been disturbed previously by mining operations located to the north and east.

The Little Rock copper deposit is located along the northeastern flank of the Big Burro Mountains. Extensive geologic characterization of the project area has identified three major geologic units. Precambrian-aged granite is crosscut by tertiary dikes of quartz monzonite porphyry. Younger deposits of sand and gravel are deposited above the older rocks in the northern part of the project area.

Vegetation types include semidesert grassland, interior chaparral, Madrean evergreen woodland, and Great Basin conifer woodland. The associated wildlife species constitute a mix of species that are characteristic of each vegetation type. Wildlife species identified near the mine area include at least 100 species of birds, deer, fox, coyote, black bear, lizards, small to medium-sized snakes, and several toads.

Cultural sites identified near the proposed mine project include historic archaeological sites (primarily related to mining) and prehistoric sites (artifact scatters and small habitations). Archaeological inventory data were collected by surveys conducted in 1993, 1995, and 1996.

Land uses in the proximity of the proposed project include a rural residence; trailer park; and dispersed recreation opportunities including hunting, hiking, wildlife viewing, and camping. Chapters 3 and 4 of the EIS provide a detailed inventory and impact assessment of all resources considered in this environmental study. Existing leach stockpiles are located adjacent to the proposed pit on BLM and Forest Service lands. The leach stockpiles are the remnants of previous mining operations at the site.

EXISTING SOCIAL AND ECONOMIC CONDITIONS

The proposed project area includes lands which are currently owned and managed by the BLM, Gila National Forest, PDMC, and MM Holding Company. There are three subsidiaries of PDMC operating at the Tyrone and proposed Little Rock mine sites—Phelps Dodge Tyrone, Inc. (Tyrone); Burro Chief Copper Company; and Pacific Western Land Company. Tyrone and Burro Chief Copper Company both employ personnel at the Tyrone mine site. The current workforce employed at Tyrone will be utilized to mine the proposed Little Rock mining area. There are no plans to add facilities or personnel from the existing locations at Tyrone.

ISSUE IDENTIFICATION

Prior to initiating the public scoping process for the Little Rock Mine Project, the BLM identified a range of issues that would require additional analysis in the EIS. In general, comments received from the public and agencies at the public meeting, and by written response during the scoping period, have reflected concerns for the same specific issues as well as some additional concerns.

The following potentially significant issues were identified by the BLM in the scoping letter of December 1994, and were included in many of the public and agency responses:

- quality and quantity of post-mining water generated by the open pit
- effect on surface water and riparian areas of the proposed haul road to the Little Rock site
- effect on surface water quality and riparian areas of the proposed diversion of California Gulch around the Little Rock site

Various other descriptions of these and related issues and concerns were offered by comments and questions, although in different words. For example, one comment that is related to the water quality/quantity issue included a concern for "pollution of the water table," and another mentioned "withdrawal of water from the Gila River."

Several comments were received regarding reclamation of the pit after mining operations are complete. These included:

- appearance of the pit after mining
- restoration and revegetation
- potential for backfilling of the pit
- post-mining land use

Other concerns included the following:

- cumulative effects to the environment
- other future mining activities
- impacts to the Silver City water supply
- impacts to wildlife from withdrawal of water
- disposal of existing wastes from former mining activity
- socioeconomic impacts of employment (hiring and termination)
- use of county roads and New Mexico Highway 90
- downstream erosion due to the diversion of California Gulch
- impacts of haul road on wildlife migration patterns, wildlife mortality, and erosion
- impacts of the existing leach stockpiles on underlying ground and surface water quality
- effects of pit dewatering on local ground and surface water and nearby springs
- effect on cultural and historical resources (2 comments)
- effect on nearby State Trust lands
- above-ground storage of heavy-metal-bearing mine tailings
- special status plants and animals (3 comments)
- noise levels
- impacts to upland forest and shrub habitats
- water table under the existing mine and the processing area and contamination of the water
- water quantity/utilization (2 comments)
- requirements, including bonding, for reclamation and spills
- reclamation of the haul road (2 comments)

ALTERNATIVES UNDER CONSIDERATION

Several action alternatives and the no-action alternative were considered for detailed study in this EIS. Each of the action alternatives, including the proposed action, would achieve the overall objective with some modification. Brief descriptions of the alternatives are listed below.

Alternative 1 - No-action Alternative

The permit area and proposed mine site would remain as they are. There would be no diversion of California Gulch and thus no impacts to surface water within the gulch between the proposed pit and the confluence of Deadman Canyon. Existing leach and waste stockpiles from the previous mining operations would continue to affect surface water in California Gulch and ground water quality.

Action Alternatives

The proposed action and action alternatives would all require the diversion of California Gulch. The mine operation described previously (see page S-2) would be essentially the same for any of the alternatives. The proposed action (Alternative 2) would result in a pit lake after mining operations cease;

the lake would be contained within the proposed pit and would eventually reach an elevation of 5,730 feet to 5,800 feet. Alternatives 3A and 3B would require partial backfilling of the pit to allow water to drain.

Alternative 2 - Proposed Action - Construct the open pit and haul route Alternative B (see Figures 2-1 and 2-1b). The haul road begins at the east end of the pit and would cross Deadman Canyon. The mineable ore will be placed on the No. 2 and No. 2A Leach Stockpiles. California Gulch will be diverted into the pit. Ground water in-flow to the pit bottom would be pumped from the pit and discharged to either the No. 1X Tailing Dam or Deadman Canyon while mining is in progress. Dewatering of the pit would also include the water diverted from California Gulch and other surface water inflow (Stream Diversion Alternative SD-3).

Partial Backfill Alternative - Construct a diversion of California Gulch to either the open pit, Whitewater Canyon, or its tributary, and partially backfill the pit to the 5,820-foot elevation. A 100-foot-wide drainage channel would be constructed to prevent upstream surface and ground water collected at the pit from ponding, and allow it to flow through the east wall of the pit into Deadman Canyon. Approximately 45 million tons of waste rock material would be used for the backfill to achieve the necessary gradient for uninterrupted flow and discharge.

Haul Road Alternative Routes

Haul Road Alternative A - This route (Figure 2-1a) begins at the north side of the open pit, goes northeast and east and crosses Deadman Canyon, continuing south to the No. 2 and No. 2A Leach Stockpiles.

Haul Road Alternative B - This route (Figure 2-1b) begins at the east end of the open pit, goes southeast, then north to follow contours across Deadman Canyon at about the 5,900-foot elevation. From the canyon crossing, the route turns to the southeast, continuing to the No. 2 and No. 2A Leach Stockpiles. Waste material would be deposited on Phelps Dodge property near the No. 2A Stockpile.

Haul Road Alternative C - This route (Figure 2-1c) is similar to Alternative B, but more direct. It would require a larger amount of fill at the Deadman Canyon crossing.

California Gulch Stream Diversion Alternative Locations

Pit operations require the diversion of California Gulch once the pit reaches and extends below the level of the drainage channel. The diversion structure would divert normal flows into a pipeline, and runoff from large storm events would be diverted into an open channel, both of which would discharge to one of the following alternative locations:

- Whitewater Canyon (SD-1) - westward diversion by constructed pipe and channel from the pit to Whitewater Canyon; may be temporary or permanent

- Tributary to Whitewater Canyon (SD-2) - westward diversion along pit rim to tributary of Whitewater Canyon; may be temporary or permanent

- Diversion to Open Pit (SD-3) - water diverted to pit is pumped to either No. 1X Tailing Dam, into California Gulch downstream of the pit, or to Deadman Canyon

Each of the alternatives are evaluated in this EIS according to the criteria defined in the scoping report (BLM 1995) and public and agency comments received during the inventory phase of the project.

AGENCY PREFERRED ALTERNATIVE

The BLM and Gila National Forest have identified Alternative 2, the proposed action, as their preferred alternative at this draft EIS stage of the environmental review process. This preferred alternative is an indication of the agencies' preliminary preference and is not a final decision. A preferred alternative will also be selected in the final EIS. The agencies' preference at that time will consider all public and other agency comments that are received on the draft EIS.

MAJOR IMPACT CONCLUSIONS

The following is a summary of the major impact conclusions that have been identified as potentially occurring as a result of the implementation of the alternatives considered in this EIS. Table 2-4 (on page 2-28) provides a detailed description of anticipated results associated with implementation of any of the alternatives considered. Refer to Chapter 4 for detailed discussions on each resource considered in this document.

No Action

Implementation of the no-action alternative would result in the continued degradation of surface and ground water currently being affected by the existing leach and waste stockpiles created during previous mining operations. However, no additional impacts would result to biological, visual, cultural, land use resources, and air quality. The economic life of the Tyrone operation could be shortened by two to four years, resulting in a curtailment of employment and income in the Silver City area.

Proposed Action and Alternatives to the Proposed Action

Potential impacts to soils and earth resources are associated with the increased potential for soil erosion and a decrease in soil productivity due to the creation of a mine pit and haul road. Indirect impacts include increased sedimentation of surface water and loss of topsoil. Implementation of any of the action alternatives would also result in the removal of approximately 160 million tons of mine rock including up to 100 million tons of leachable ore from the permit area.

Impacts to surface water resources are directly related to the diversion of California Gulch at the mine pit. The proposed temporary, or permanent, diversion of California Gulch will result in altered flows in either Whitewater Canyon, a tributary to Whitewater or Deadman Canyon, and decreased flows within the lower portion of California Gulch (dependent upon alternative selected). Rainfall on the pit itself will no longer contribute to flows in both California Gulch or Deadman Canyon. Erosion of the unnamed tributary would occur resulting in increased downstream sedimentation.

Under the best case scenario, the pit lake chemistry will not exceed any WQCC parameters. Under the worst case, copper will slightly exceed the surface water WQCC standard of 0.5 mg/l at 0.55 mg/l. Pit lake water recharging the aquifer will exceed the ground water standard for fluoride (1.6 mg/l) for both best case (2.5 mg/l) and worst case (5.9 mg/l) scenarios. No other ground water or surface water element concentrations are predicted to exceed WQCC or EPA standards.

Implementation of any of the action alternatives, including the proposed action, could potentially result in minor impacts to biological resources. Potential impacts are generally associated with the creation of a mine pit and haul road which would disturb approximately 230 acres of land, including 63 acres that are disturbed from previous mining activities not associated with the Little Rock Mine Project.

Beneficial impacts to socioeconomics are anticipated with the re-establishment of the Little Rock Mine. The benefits are primarily attributed to the continuing revenue generated from state and local taxes, primary employment, and the support of secondary employment opportunities for local and statewide vendors.

Impacts to visual resources are not anticipated to be high. This is primarily due to the existing disturbance at the proposed mine site and the lack of potential viewers in the study area.

Impacts to cultural resources include effects to two prehistoric and four historic archaeological sites (old mines), for the proposed action. However, long-term impacts are considered low due to the implementation of a data recovery plan and documentation of the informational content of the sites.

Impacts to air resources are directly associated with the creation and operation of the mine pit and haul road. Although gaseous pollutants are not expected to be emitted in significant amounts, inhalable particulate matter (PM_{10}; particulate matter less than 10 microns in effective diameter) concentrations are predicted to violate the 24-hour and annual National Ambient Air Quality Standards (150 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively), according to conservative modeling results. The second maximum 24-hour off-site PM_{10} impacts were modeled to be 326, 504, and 466 $\mu g/m^3$ for haul road alternatives "A," "B," and "C," respectively (including background). The maximum annual off-site PM_{10} impacts were modeled to be 169, 299, and 183 $\mu g/m^3$ for haul road alternatives "A," "B," and "C," respectively (including background). These modeled concentrations caused by trucks hauling material and blasting in the mine pit included mitigation through implementation of dust suppression measures.

Although mining operations will exceed ambient noise levels at the mine pit, noise levels at other receptors in the area would be below ambient conditions (and therefore inaudible) except at the ranch residence located to the north of the mine pit area, and at the residence located in Section 21 of T19S R15W.

Chapter 1.0

Purpose of and Need for Action

CHAPTER 1.0 - PURPOSE OF AND NEED FOR ACTION

Chapter 1 provides a detailed description of the purpose, objective, and need for the proposed project. A summary of the project history and background, recent permitting history at the Little Rock Mine site, and existing permits at the Tyrone operations are included. This chapter also includes a description of the authorizing actions that may be implemented by the BLM and cooperating agencies.

1.1 PURPOSE OF THE PROJECT

The purpose of the proposed Little Rock Mine Project is to re-establish the mine and extend the operating life of the copper processing facilities at the Tyrone mine site. The objective of the proposed action is to profitably mine and process the ore body, remove existing leach and waste stockpiles from BLM and Forest Service land, and reclaim the site. The permit area covers approximately 600 acres, of which 164 acres are patented mining claims, 390 acres are administered by the BLM, and 46 acres are administered by the Forest Service. The proposed mine pit will cover approximately 190 acres, and the haul road approximately 40 acres.

The proposed project requires the construction of a haul road to transport the existing stockpiles and newly mined materials to leach and waste stockpiles located at the Tyrone Mine site. Additional temporary facilities required by the project during mining operations include a dewatering system, water pipeline, waterfill station to provide dust suppression, 46 kilovolt power distribution system, and operation and maintenance facilities. Ancillary facilities will be removed after operations are completed and the haul road will be reclaimed. Figure 2-1 (on page 2-3) provides an illustration of the proposed pit boundary, haul road, and the location of various ancillary facilities.

1.2 NEED FOR THE PROJECT

The extraction and processing of copper ore from the proposed Little Rock Mine would extend operations at the Tyrone operation for approximately two to four years. The potential extension of operations at Tyrone would sustain employment at the mine site and continue to provide economic benefits to PDMC surrounding communities, Grant County, and the state. The project would also generate additional revenues for the state and county through continuing indirect employment and tax collection. Economic benefits from the project are described in the socioeconomic section of Chapter 4 of the EIS.

1.3 PROJECT LOCATION

The Little Rock Mine site is located in Grant County, New Mexico, approximately seven miles south of Silver City, the county seat for Grant County (Figure 1-1). Southwestern New Mexico is primarily rural with small towns located throughout the area. Mining, ranching, and related industries as well as a state university and various government services provide the primary employment opportunities for local residents.

Little Rock Mine Project Vicinity Map

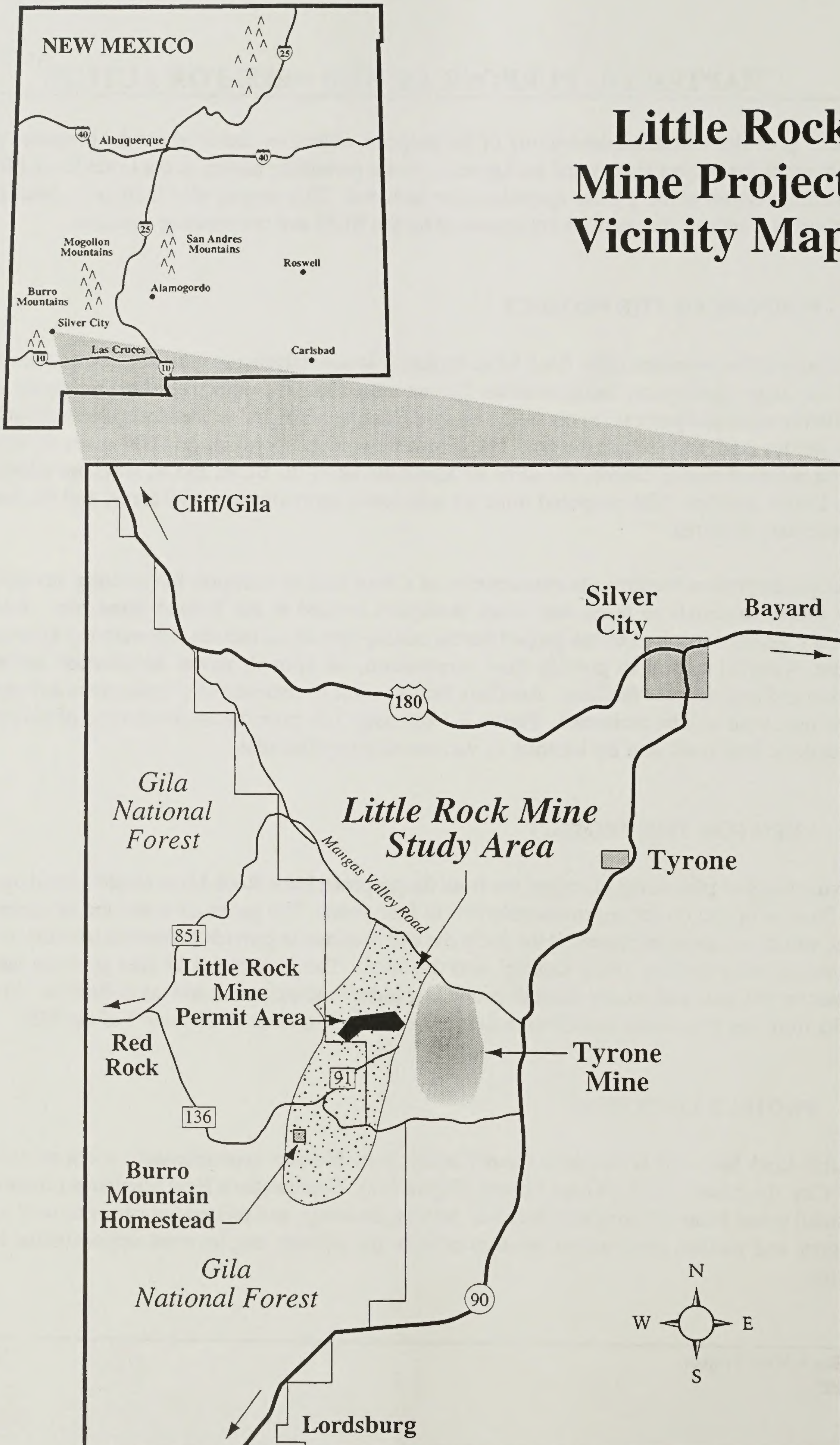


Figure 1-1

The mine site is west of New Mexico Highway 90; adjacent to the existing Tyrone Mine site. The unincorporated community of Tyrone is approximately four miles south of Silver City and three miles north of the Tyrone/Little Rock Mine area, on the west side of Highway 90.

1.4 PROJECT HISTORY AND BACKGROUND

Silver City was founded in 1880 as a result of the discovery of silver deposits in the mountains adjacent to the town. Mining brought merchants to serve their needs, and the community developed from a tent village to prospering city within a few years. Currently, in addition to mining, tourism and recreation in the Silver City area and Gila National Forest are playing an increasing role in the local economy.

The original town of Tyrone and other small towns were founded in the 1870s, after the discovery of turquoise and other copper deposits in the Burro Mountains. Tyrone has been moved and rebuilt two times as a result of historic mining operation. The existing mine and community were developed in the late 1960s by Phelps Dodge, designed and built to accommodate over 300 families in high-quality single family homes. The town also includes a park and recreation area as well as a gas station, mercantile (currently closed), and post office.

Proposed mining will occur in an area with substantial disturbance from previous mining activities. The first recorded mining at the project site was in the 1890s with underground copper mining at the Little Rock, Ohio, Two-Best-in-Three, and Nellie Bly mines. This early mining led to the first patents being issued. The unpatented Southern Star claims (to the north) were mined in the early 1900s and again in the 1960s. Flourspar was mined along California Gulch in the 1940s and resulted in the second group of patents.

During the 1960s, the Little Rock property underwent several periods of limited exploration and leach testing. In 1970, the property was leased to United States Natural Resources, Inc. (USNR). Following an extensive drilling program, approximately 1,000,000 tons of leach material and 660,000 tons of waste were removed and stockpiled by USNR at various locations in the vicinity. Mining and leaching by USNR occurred in the period from 1970 to 1972.

In 1990, PDMC entered into a lease-purchase agreement with the current owner of the Little Rock Mine, MM Holdings, wherein PDMC pursues obtaining all applicable federal and state permits required for the operation of the property. The purchase would not proceed in the event that permitting is not successful or if the project is determined to not be economically feasible.

1.5 RECENT PERMITTING HISTORY

On May 4, 1993, PDMC submitted a Notice to the BLM to conduct exploration drilling and baseline environmental data collection on the Copper Leach claim group. On October 23, 1993, PDMC submitted a Plan of Operations to the BLM Las Cruces District for the re-establishment of a copper mining operation at the Little Rock property near Silver City, New Mexico (PDMC 1993). The Plan of Operations also included the results of wildlife, T&E species, and archaeological surveys conducted within the project area. Over a period of several months, the BLM requested and obtained additional information from PDMC. The BLM ultimately accepted the Plan of Operations as complete and proceeded to evaluate the document based on the NEPA requirements.

Discussions with the BLM indicated that approval of the Plan of Operations by a Finding of No Significant Impact based on the results of an environmental assessment was unlikely and that a full EIS would be required. Consequently, PDMC decided to plan and budget for the preparation of this EIS.

A Memorandum of Agreement (MOA) was entered into between PDMC, BLM, and Forest Service in July 1994. Subsequent to the MOA, a Request for Proposals and Data Adequacy Standards were developed and the Request for Proposals was sent to numerous environmental consulting firms for competitive bid.

Existing Tyrone Operation Permits

The proposed Little Rock Mine would use existing, permitted facilities at the Tyrone operations to the extent possible. A description of the existing permits and regulations which govern activity at the Tyrone site is listed below. For more detailed information consult the Little Rock Mining Operations Site Assessment that was submitted to MMD by the, Phelps Dodge Corporation (Dames & Moore 1994).

The New Mexico Mining Act and other state and federal legislation and regulations require that all operating mines apply for and maintain permits that govern a variety of resources potentially impacted by mining operations. The Tyrone Mine and the proposed Little Rock Mine may both be subject to the following regulations:

- ground water discharge permits
- air quality permits
- surface water permits
- hazardous materials permits
- radioactive materials permits

Permits issued by NMED Ground Water Protection and Remediation Bureau-Ground Water Section are maintained by Tyrone Mine. These permits are issued under Section 3-100 of the New Mexico Water Quality Control Commission Regulations pursuant to Chapter 74, Article 6 NMSA 1978, Water Quality Act. These permits regulate those portions of a facility with the potential to impact the quality of ground water. In order to receive a permit, the owner/operator of a facility must submit a ground water discharge plan. This plan addresses the magnitude and quality of discharge effluent, how it is derived and its intended use, and how it would be managed. These permits can require effluent monitoring, lining holding areas with appropriate materials, and installing and monitoring ground water wells upgradient and downgradient of the facility to detect releases should they occur (Phelps Dodge 1993).

Tyrone Mine currently has eight approved ground water discharge permits and three ground water discharge plan applications that are being reviewed. The Mining Operations Site Assessment, Tyrone Mine (Dames & Moore 1994) provides a detailed description of mining requirements, permits, and other information on the Tyrone Mine operations.

Air quality emissions at the Tyrone Mine are currently governed by the state of New Mexico implementation of the Federal Clean Air Act. The plant's facilities, constructed in the late 1960s and early 1970s, are grandfathered under the New Mexico Air Quality Control Regulation (NMAQCR) 702. Certificate of Registration forms, which identify the stationary sources and summarize potential air pollutant emissions, were submitted to NMED as recently as 1984. In addition, Tyrone Mine was registered with the NMED, pursuant to NMAQCR 752 *Registration of Existing Toxic Air Pollutant Sources*, in February 1989. In December 1993, the Tyrone Mine began submitting payment for air emissions pursuant to NMAQCR 770 and 771. These regulations implement the new Federal Operating Permit Program under Title V of the 1990 Clean Air Act Amendments. Although the state of New Mexico has statutory limits for Total Suspended Particulate matter (TSP) and gaseous pollutants, the NMED has indicated that, due to the nature of air pollutant sources at the proposed Little Rock Mine, they have no mechanism to enforce the New Mexico Ambient Air Quality Standards (NMAAQS). Specifically, since the proposed sources are either mobile, area or fugitive sources (i.e., no stationary point sources are proposed), the mine is not subject to state air quality permitting requirements. Consequently, the NMED cannot impose restrictions or operating practice requirements (such as pollutant monitoring or control measures) to enforce the NMAAQS (NMED 1995). For this reason, potential air pollutant impacts were compared only to National Ambient Air Quality Standards (NAAQS) for PM_{10} and gaseous pollutants.

There are no perennial streams at the Tyrone Mine site, and no discharge of process wastewater streams to any surface water courses occur. Tyrone Mine has developed and has on file a spill prevention, control and countermeasures plan, and is developing a storm water pollution prevention plan as required by the Clean Water Act.

The Tyrone operation has submitted a NOI to be covered under the Environmental Protection Agency's (EPA's) General Stormwater Permit on behalf of the current owner, MM Holdings. All potentially affected regulatory agencies have been contacted and consulted with in order to obtain the necessary information to initiate permitting for the Little Rock Mine site concurrent with the EIS process.

A NOI for a solid waste operation at the Tyrone site was submitted for the existing Tyrone solid waste landfill on January 31, 1992 in accordance with Section 213.B of the New Mexico Solid Waste Management Regulations. Tyrone has also completed a landfill site assessment pursuant to the Solid Waste Regulations. A permit for the facility is expected to become necessary in 1998. The landfill is operated as a Private Class D facility for industrial refuse only and does not receive any hazardous or special wastes as defined by Solid Waste Management Regulations Section 105.JJJ (I-9) for bulk liquids, petroleum wastes, or septage.

The Tyrone Mine holds a Hazardous Waste identification number (NMD-035-806-405) for storage of hazardous waste generated at the mine's operations. In addition, PDMC received a radioactive materials License on December 17, 1968, and it was most recently updated on May 1, 1992 (permit No. GA164-10).

1.6 AUTHORIZING ACTIONS

The BLM Mimbres Resource Area Manager is responsible for evaluating and deciding which alternative will best meet environmental requirements and fulfill economic need. This decision will be based on evaluation of the proposed action or an alternative, including the no-action alternative, as well as measures required to mitigate adverse impacts. Description of the proposed action and alternatives are provided in Chapter 2.

In addition to the EIS, implementing the proposed action or the alternatives would require authorizing actions from the BLM; Forest Service; and other federal, state, and local agencies with jurisdiction over the project. The authorizing actions include environmental permits (ground water discharge, air quality, etc.), licenses, and approvals for project construction and operation.

The proposed action and alternatives, including the no action, are consistent with the current management plans for the BLM Las Cruces District and the Gila National Forest, and the Grant County Comprehensive Plan.

Chapter 2.0

DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

CHAPTER 2.0 - DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

Chapter 2 provides a summary of the Plan of Operations submitted to the BLM for the re-establishment of the Little Rock Mine. In addition, this chapter provides a detailed summary of the proposed action, alternatives considered but eliminated from further consideration, alternatives to the proposed action, and the reclamation plan associated with the initiation of mining activity.

2.1 SUMMARY OF THE PLAN OF OPERATIONS

The proposed mine area has been previously disturbed due to prior mining activity at the site by other parties. The project area is dissected by three major drainages, which generally flow in a northerly direction—California Gulch runs directly through the proposed mine site, and is flanked by Whitewater Canyon to the west and Deadman Canyon to the East (Figure 2-1).

The Plan of Operations was prepared in accordance with 43 CFR 3809.1 Regulations and was submitted in support of the proposed mining activities on the Copper Leach Group of Claims. PDMC does not currently own the mining claims which cover the proposed mining area, but has entered into a lease-purchase agreement with the current claim holder, MM Holdings, Inc. PDMC will purchase the claims prior to the initiation of mining activity, providing that the necessary permits can be obtained. In the event that the required permits cannot be obtained, ownership will remain with MM Holdings. Prior activities by PDMC at the site have included non-surface disturbing activities such as aerial surveys, ground surveys, archeological surveys, and T&E species and wildlife surveys. Sampling of existing mine stockpiles and additional drilling activities have been conducted and continue to be conducted on the property under a Notice submitted May 4, 1993.

PDMC's current plans are to pursue obtaining all applicable federal and state permits required for the operation of the property. Open pit mining methods will be employed on the site. Various geologic and economic parameters were employed to model pit limits and impacts of the proposed project, resulting in different simulations of disturbance and levels of operation. The proposed pit occupies approximately 30 percent of the permit area. Existing disturbed area within the project area is 120 acres. Unpatented claims likely to be impacted, as well as patented claims, and new claims that will potentially be impacted are listed in the land use section of Chapter 3.

Several measures will be taken to prevent unnecessary or undue degradation, as required by all federal and state guidelines, including future regulations adopted pursuant to the New Mexico Mining Act. The Little Rock Mine site qualifies as an "existing mine" under the Act due to mining and processing activities conducted at the site from 1970-1972. It is anticipated that existing Tyrone environmental permits will be applicable to or can be modified to include the Little Rock property. Construction of a haul road would be needed for transporting mined material between the Little Rock Mine and the Tyrone leach processing site. The road would be removed and reclaimed following operations, as described in the proposed reclamation and closure plan (pp. 2-24 through 2-25). No new water rights will be required since all processing is to be conducted at existing permitted Tyrone facilities.

2.2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The proposed action is to mine approximately 100 million tons of leachable ore from within the permit area at the rate of up to 160,000 tons of material per day. The life of the project is anticipated to last from two to four years, and would involve various portions of the permitted area. The leachable ore and existing stockpiles will be hauled to the existing Tyrone leach stockpiles via the proposed haul road and processed at the existing solution extraction/electrowinning (SX/EW) plant at Tyrone.

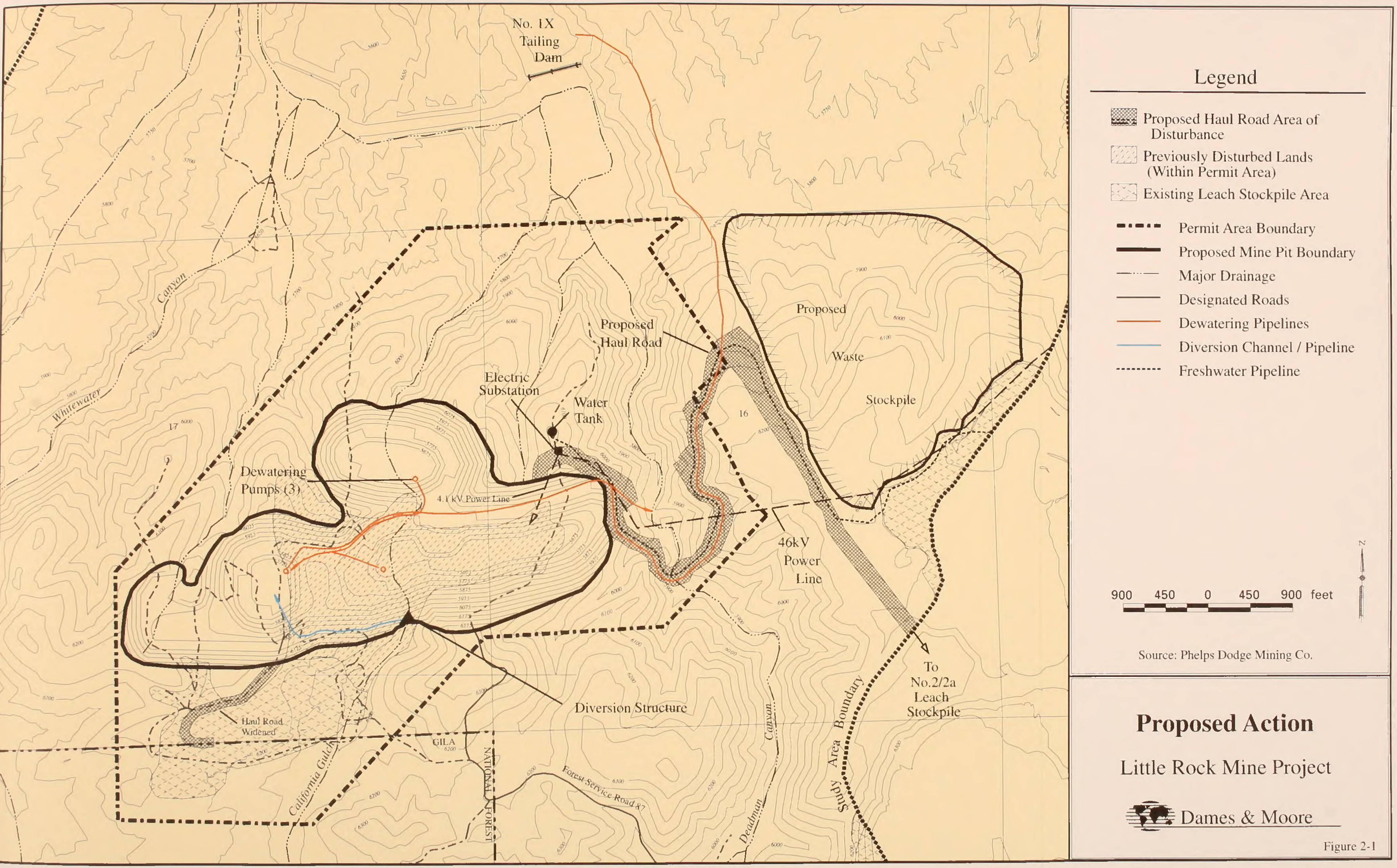
The mining operation will be an open, terraced pit with a potential mine floor elevation of approximately 5,600 feet. The project will require the construction of a haul road and the diversion of California Gulch. A description of the mine plan is shown in Figure 2-1.

Mine Plan Features and Facilities

The proposed project facilities include a mine pit, haul road, stream diversion structure, and channel, and associated operation facilities including 46 kilovolt (kV) and 4.1kV power lines, electric substation, water supply for dust suppression, and temporary operations and maintenance facilities. As indicated in Figure 2-1, the mine pit will cover approximately 190 acres. The depth will vary up to as much as 500 feet below the existing level of California Gulch. The pit will be mined in 50-foot benches creating a terraced pit wall with one or more flat bottoms. A slope stability study was performed for the Little Rock pit (Call and Nicholas, Inc. 1994). Based on the information available during the time the study was performed, the probability for a large-scale failure of the final pit wall is low. Recommended pit design parameters include mean bench face angles of 72 to 75 degrees, mean catch bench widths of 30 to 32 feet, and interramp slope angles of 46 to 49 degrees. The pit design utilizes a 47 degree interramp slope angle and achieves an average reliability of maintaining the catch bench width of 88 percent. Existing mining equipment from the Tyrone Mine will be used at the site including, but not limited to, electric rotary blasthole drills, electric mine shovels, 190-ton haul trucks, and ancillary equipment.

There are three possible alternative haul road routes considered for transporting and placing waste rock and mineable ore. The location for waste rock disposal will depend on the route selected. In each case, mineable ore will be transported to the existing No. 2 and No. 2A Leach Stockpiles at the Tyrone site. The road will exit the proposed pit either at the north or east end and end at the Tyrone site. The haul route alternatives are presented in Figures 2-1a, 2-1b, and 2-1c. The haul road and associated safety berms and drainage channel will be approximately 135 feet wide. The typical section is shown in Figure 2-2.

The proposed Little Rock Mine pit will span California Gulch, requiring the diversion of stream water flowing down the gulch. A diversion channel will be incorporated into the pit design to carry the stream flow either into or around the pit. A typical cross section of the diversion channel and pipe is shown in Figure 2-3, and it is illustrated in Figure 2-4. Alternatives evaluated as part of this EIS include diversion of California Gulch to either of three locations, as well as various scenarios involving pit water drainage or impoundment, as described in Section 2.4.

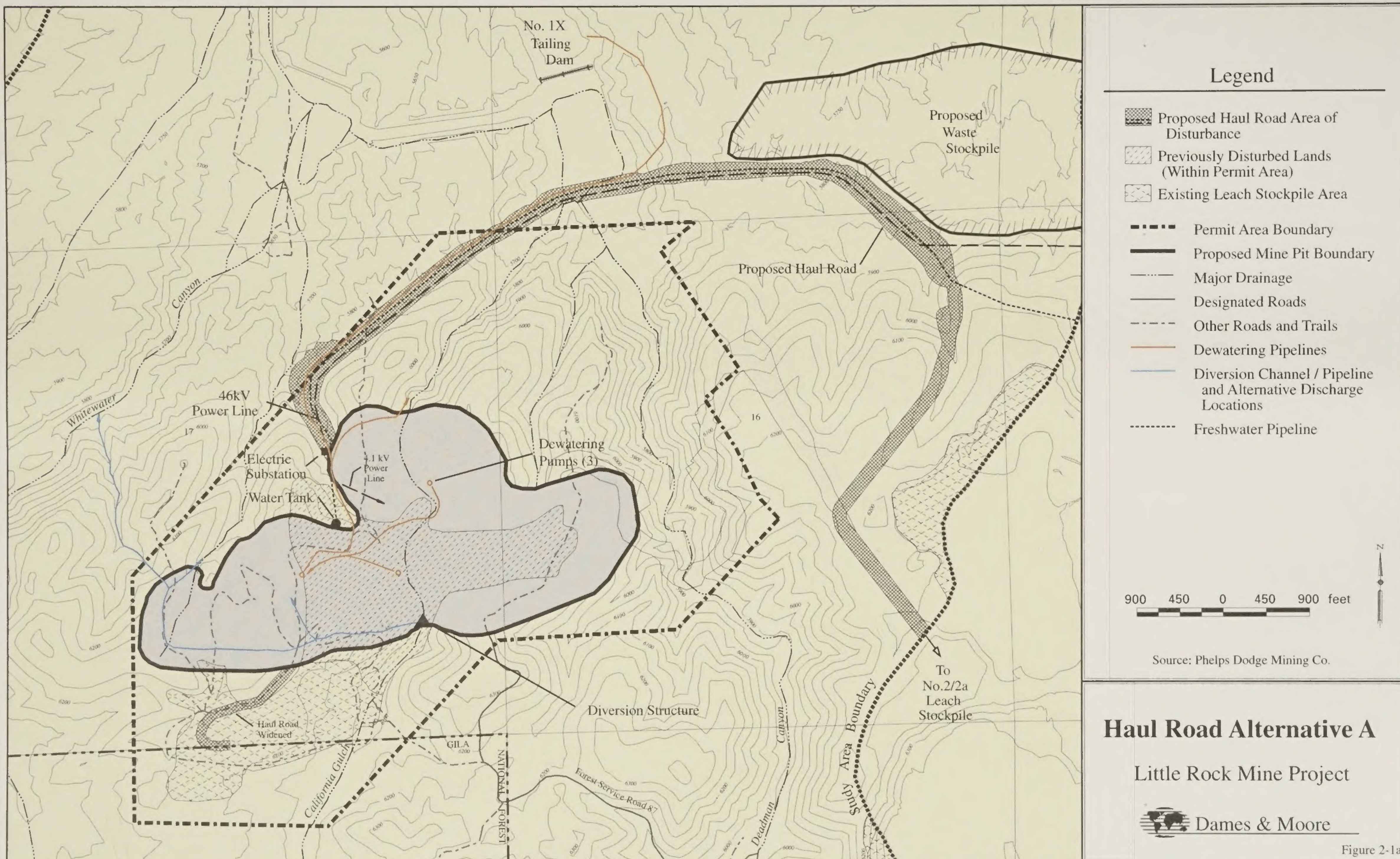


Proposed Action

Little Rock Mine Project

Dames & Moore

Figure 2-1



Haul Road Alternative A

Little Rock Mine Project

Dames & Moore

Figure 2-1a

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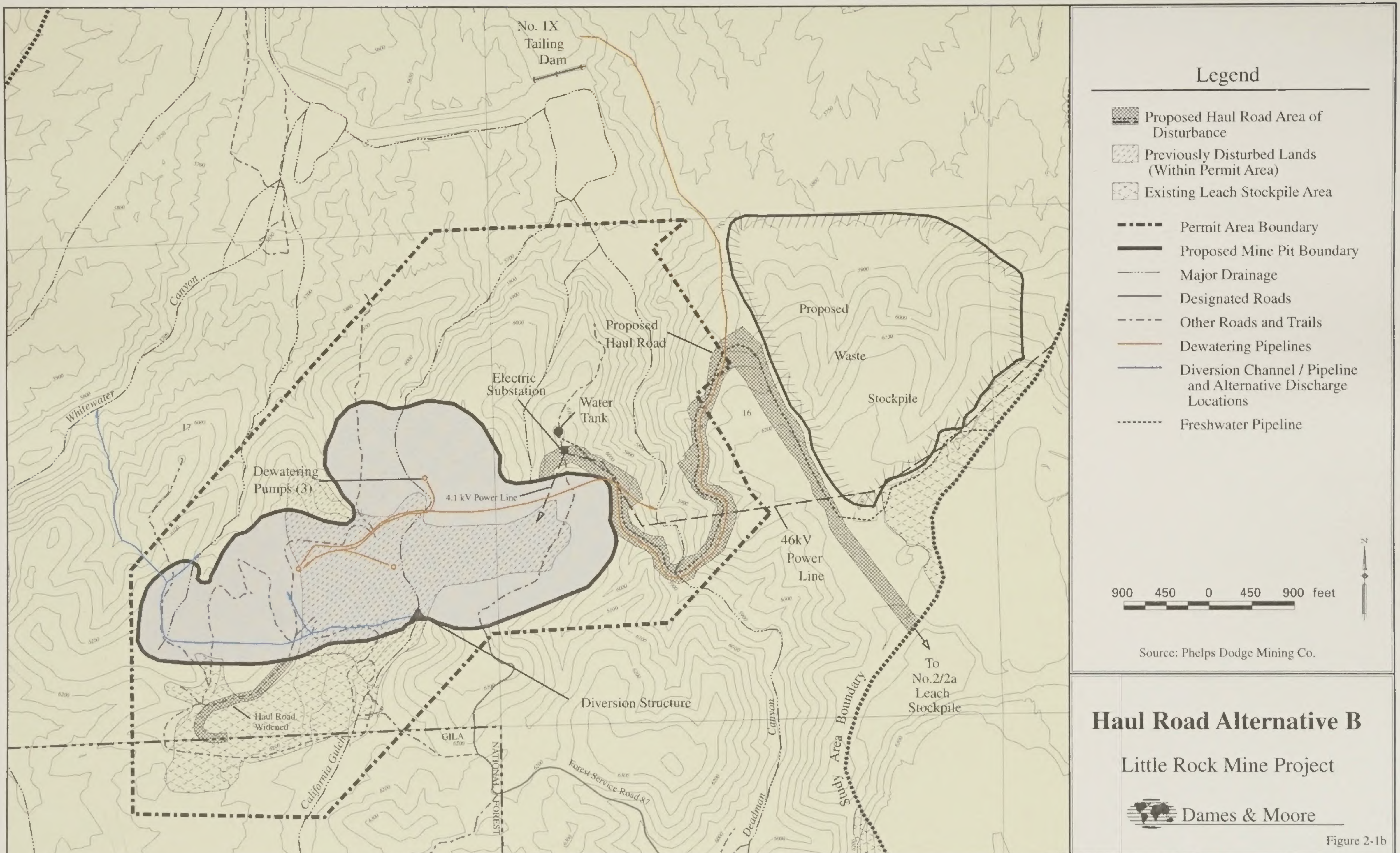


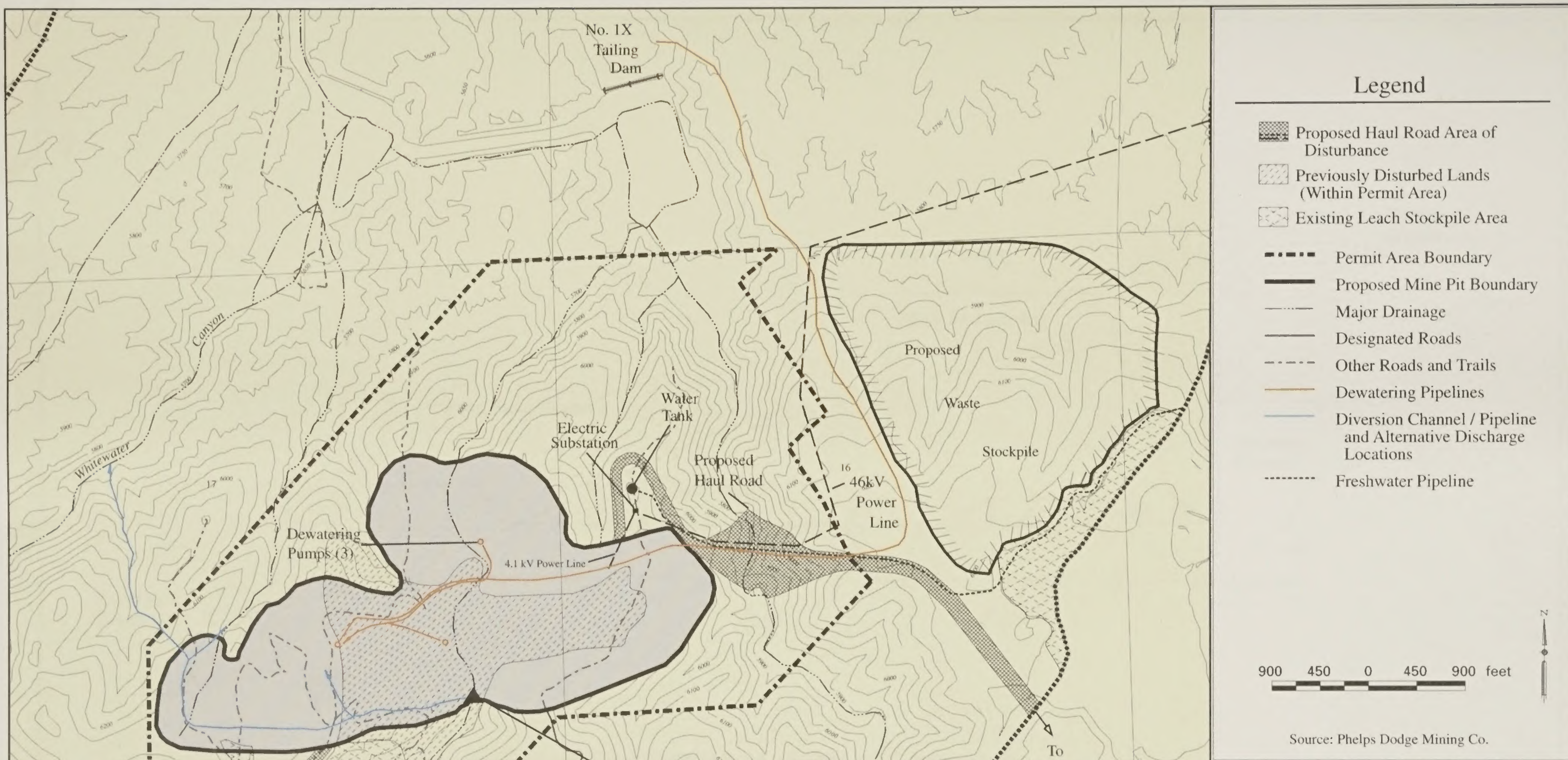
Haul Road Alternative B

Little Rock Mine Project

Dames & Moore

Figure 2-1b

00136073-04-02-061796



Haul Road Alternative C

Little Rock Mine Project

Dames & Moore

Figure 2-1c

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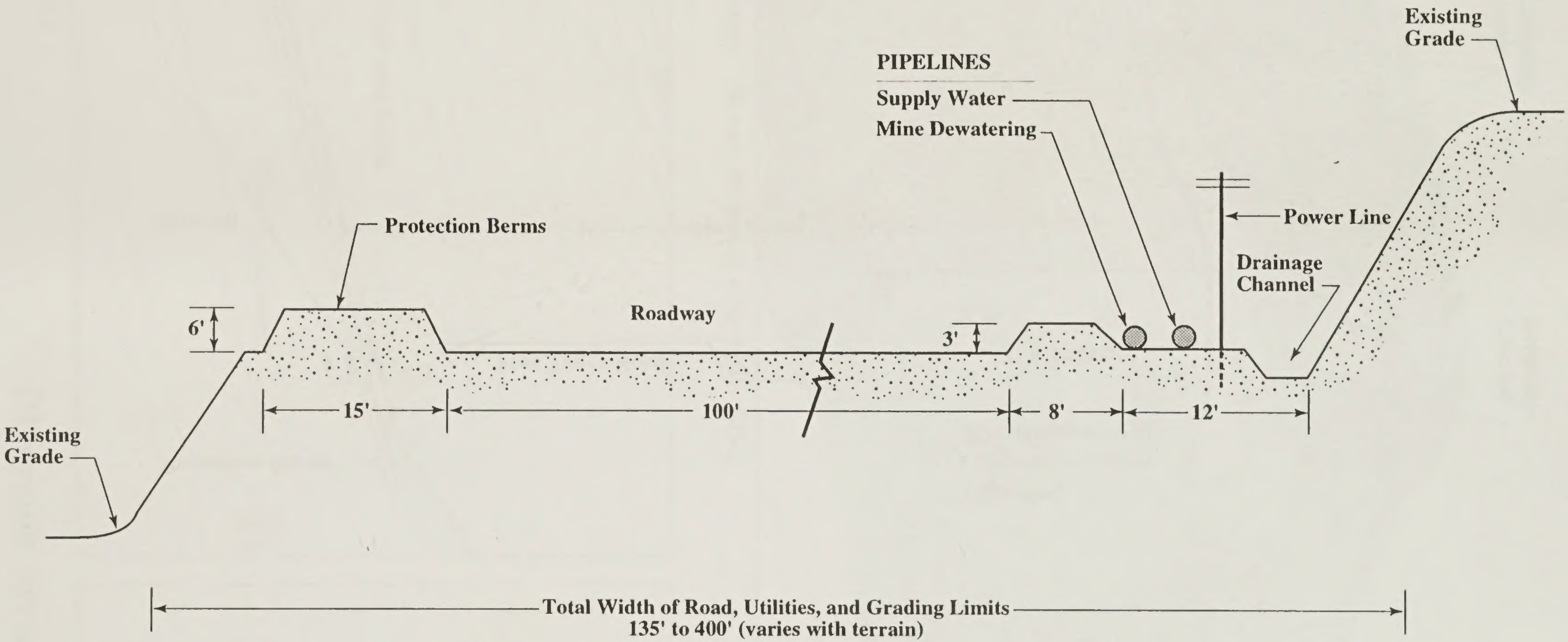
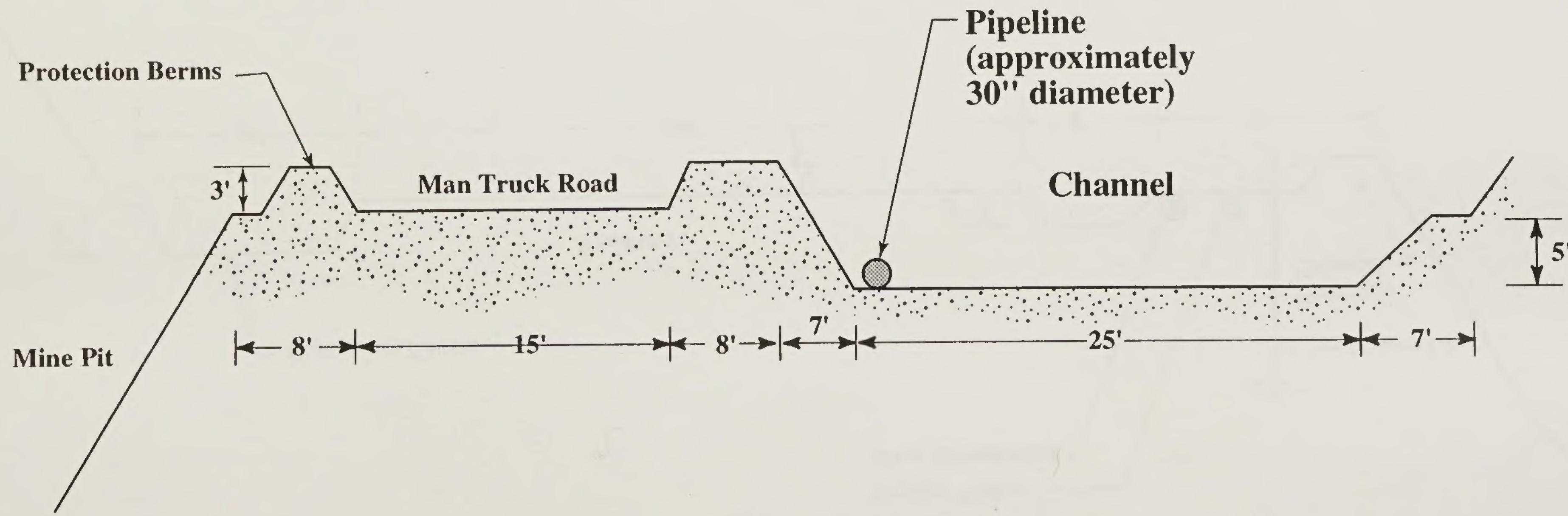


Note: Dimensions shown are approximate and not to scale.

Typical Section of Proposed Haul Road from Tyrone Mine to Little Rock Mine Area
Little Rock Mine Project

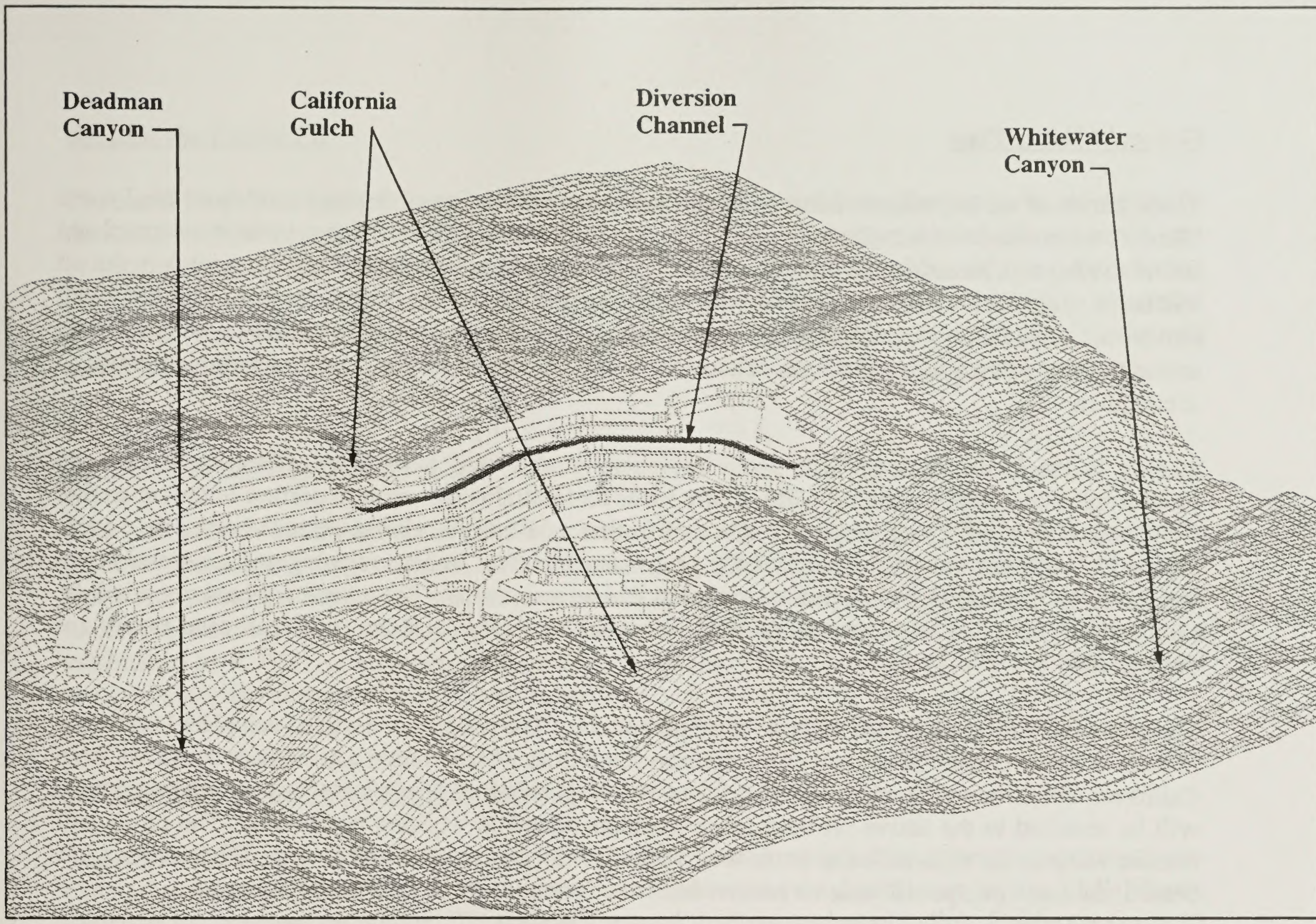
Figure 2-2



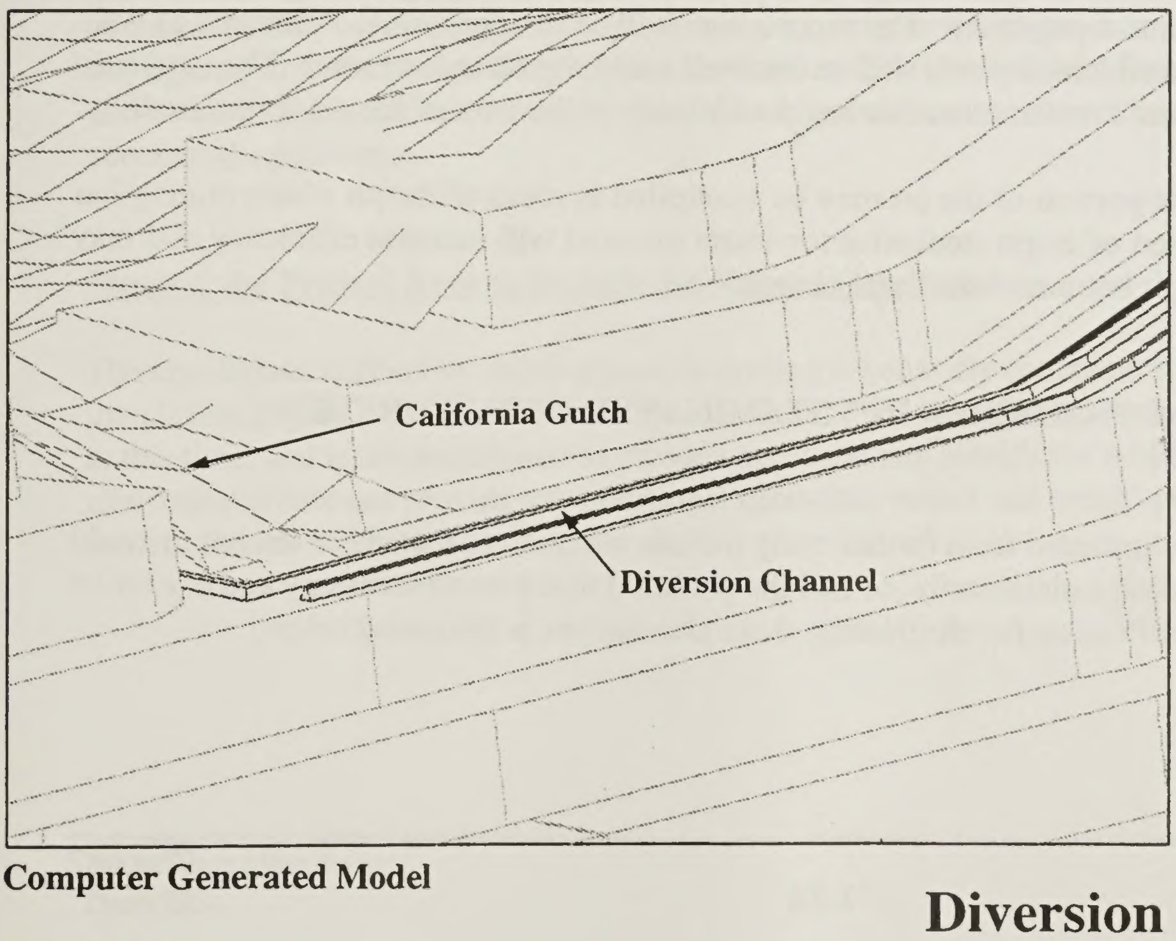
Note: Dimensions shown are approximate and not to scale.

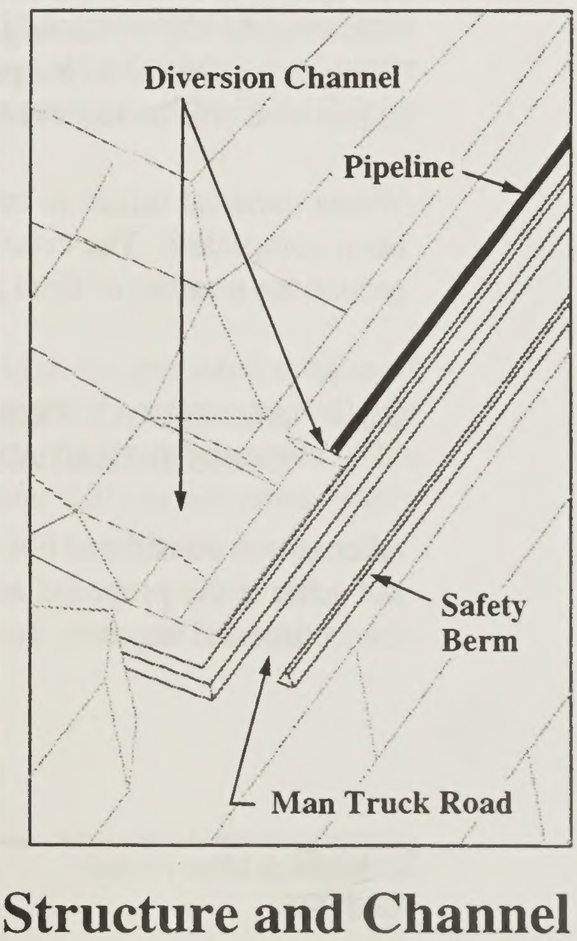
Typical Section of Proposed Diversion Channel
Little Rock Mine Project

Figure 2-3



View of Pit Looking Southwest – Stream Diversion Alternative SD-2





Computer Generated Model

Diversion Structure and Channel
Little Rock Mine Project

Figure 2-4

General Mining Plan

The initiation of mining at Little Rock will begin with the construction of the haul road from the Tyrone Mine, down across Deadman Canyon, and west to the Little Rock pit area. This road must be completed before mining equipment can be brought over to the pit to begin production. Pioneering work in the pit will begin while road construction is underway to prepare the area for production mining. This work will remove hill tops, fill low spots, and establish a temporary haulage ramp across California Gulch to gain access to the western portion of the pit. This work is expected to require approximately three months to accomplish.

Mining in the Little Rock pit will begin immediately after the construction of the haul road and pioneering is completed. Mining will initially focus on finalizing the western portion of the pit so that California Gulch can be subsequently diverted to that area before mining extends below its current channel. While the western portion of the pit is mined to final limits, stripping will continue in the remainder of the pit so that mine production levels can be maintained. The temproary haul ramp will be removed as the focus of mining shifts to the east end of the pit and the final haul road ramps are developed.

The preliminary mine pit design includes three pit bottoms. The western one will be completed first. The mined out western end will be used as a collection sump from which normal and storm water flows from California Gulch, as well as pit dewatering flows, will be pumped. As the pit deepens, dewatering pumps will be installed in the active pit bottoms to maintain adequate working conditions. The pmps will transfer water to the main pit sump in the west where it will be pumped out of the pit. When mining has ceased, the main pumps will also be removed and the formation of the pit lake will begin.

The existing stockpiles will be mined during the first year of operation. The existing haul road to the old stockpile will be widened to accommodate haulage trucks. The stockpile will be mined from west to east, following the dip of the original topography. The asphalt liner will be scrapped up and removed as well. The existing facilities (old precipitation plant) will be removed using the same haul road. The haul road to this area will be removed and reclamation can begin as mining in the west of the pit if finalized.

Waste material mined in one portion of the pit may be stockpiled in areas of the pit where mining has been compelted. The creation of in-pit stockpiles for waste material will increase efficiency and may reduce the number of final pit bottoms from three to two.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER CONSIDERATION

Alternatives considered but eliminated from further study include alternatives that either did not or could not achieve the proposed action satisfactorily, or had the potential to create unnecessary and excessive environmental impacts. Justification for eliminating these alternatives is discussed below.

Backfill the Entire Pit

The backfilling of the pit would require mining of additional material to supplement waste stockpiled by the Little Rock Mine operation. The additional amount of fill is currently not available and could only be obtained through the creation of another pit outside of the permit area. The additional disturbance, permitting, operation cost, and time would exceed the criteria established by PDMC for a successful operation. The substantial ground disturbance, complexity of the operations, and additional cost would make this alternative infeasible and would potentially create unjustified environmental impacts.

Process all Mined Materials on Site

This alternative would require the establishment of a variety of processing facilities at the mine site including the construction, operation, and reclamation of a SX/EW plant and the construction of several lined and permitted stockpiles and pregnant leach solution collection and pumping facilities. The excessive disturbance, permitting, and economic cost of this alternative would exceed the criteria established by PDMC for a successful operation. Since the existing leach stockpiles and SX/EW plant are available, this alternative was not considered.

Daylight (Open the Pit) to California Gulch

The construction of a mine pit at the proposed location would modify the existing topography to the extent that the proposed pit floor would be lower in elevation than the downstream section of California Gulch at the northern pit border. To achieve a natural gradient that would allow California Gulch to return to its natural course, after draining through the pit, would require a substantial amount of earthwork, engineering, cost, and subsequent environmental impact. Daylighting into California Gulch could potentially result in greater impacts to the existing environment than those projected to occur with daylighting into Deadman Canyon (see Partial Backfill Alternative). Removal of the additional waste and overburden is not economically feasible and would exceed the criteria established by PDMC for a successful operation.

Expand the Project Area to Include Additional Ore Bodies

The ore deposit defined by existing sample drilling is generally contained within the proposed outline of the pit (see Figure 2-1). Substantial expansion of the pit would be unlikely, based on the data available at this time, and is not anticipated to provide access to any significant additional mineral deposits. This alternative would not provide any additional economic return and would potentially create unnecessary environmental impacts.

Create a Diversion of California Gulch Along the South Pit Wall to Deadman Canyon

The creation of a pipeline and open channel to divert California Gulch to Deadman Canyon would transport normal and storm flow events, respectively. The diversion, whether temporary or permanent, would begin at California Gulch upstream of the open pit and travel along the south wall of the open pit, discharging into Deadman Canyon. This diversion alternative has been eliminated from consideration because seepage into the pit wall, coupled by the height of the south wall, would create an unacceptable level of risk to operations below due to reduced slope stability.

In addition, the close proximity of the permit area boundary to the south wall of the pit would require a step-out of the pit wall to create a wider catch bench required for the diversion ditch. The modified configuration of the pit wall would preclude the removal of potentially several million tons of mineable ore.

Create an Upstream Diversion of California Gulch

The excessive earth work and modification of existing terrain required to create an upstream diversion would potentially create unjustified environmental impacts and result in increased construction and operational costs. The construction of an upstream diversion would not provide any measurable improvements to surface and ground water flow and quality when compared to the currently proposed diversion. In addition, this alternative is located outside the limits of the permit area.

2.4 ALTERNATIVES CONSIDERED

This section describes the no-action and proposed action alternatives, along with possible modifications to the proposed action, as alternatives to be considered. Each of the alternatives is evaluated in this EIS according to the criteria defined in the scoping report (BLM 1995) and public and agency comments received during the inventory phase of the project. The primary components in the development of the Proposed Action and alternatives are:

- development and configuration of the open pit
- haul road location and disposition of waste rock and mineable ore
- temporary or permanent diversion discharge location for California Gulch
- discharge location of ground water and surface water during pit dewatering
- post-closure open pit or partial backfill of open pit

Alternative 1 - No Action Alternative - Under the No-Action Alternative, the permit area and proposed mine site would remain as they are. There would be no diversion of California Gulch and thus no impacts to surface water within the gulch between the proposed pit and the confluence with Deadman Canyon. Existing leach and waste stockpiles from the previous mining operations would continue to adversely affect ground water quality, and surface water quality in California Gulch.

Alternative 2 - Proposed Action - The proposed action and other action alternatives would all require similar diversion structure, channel, and pipe layout designs for the diversion of California Gulch. The mine operation as described previously in Section 2.2 would be essentially the same for all action alternatives. A description of the primary components of the proposed action are as follows:

- **Development and configuration of the open pit** - The configuration of the open pit is illustrated in Figure 2-1, and described in Section 2.2.

- **Haul Route Alternative B (see Figure 2-1b)** - This route begins at the east end of the open pit. It travels southeast, then north, following the topographic contours after crossing Deadman Canyon at approximately the 5,900-foot elevation. The road then turns southeast to the No. 2 and No. 2A Leach Stockpiles, where mineable ore would be placed. The waste rock would be placed on Phelps Dodge property northwest of the No. 2A Leach Stockpile (in the area shown as the Proposed Waste Stockpile). The stream crossing would be constructed over culverts sized to accommodate storm flow events, or stormwater may be allowed to flow over the road. The culvert would be removed after mine operations are completed.

- **Diversion to Open Pit SD-3** - A diversion would transmit flow to the pit bottom where the main sump is located and diversion water, along with ground water inflow, would be pumped to the No. 1X Tailing Dam. As an optional method, when the pumped water is of good quality, it would be discharged to Deadman Canyon.

- **Discharge location of ground water during mining operation** - The final configuration of the open pit would contain three pit bottoms containing ground water in-flow. The ground water would be pumped from the east and north pit bottoms into the west pit bottom. Water would then be pumped from the pit and discharged to either the No. 1X Tailing Dam or Deadman Canyon, depending on the water quality, as explained under *California Gulch Stream Diversion Alternatives - Alternative SD-3.* Dewatering of the pit would also include the water diverted from California Gulch and other surface water inflow.

- **Post-closure pit lake** - The proposed action is to allow for ground water and the discharge of California Gulch to accumulate in the open pit, creating a pit lake. The pit would not be backfilled.

Partial Backfill Alternative - A diversion of California Gulch to either the open pit, Whitewater Canyon, or its tributary would be constructed. After mining, the pit would be partially backfilled to the 5,820-foot elevation. A 100-foot-wide drainage channel would be constructed to prevent upstream surface and ground water collected in the pit from ponding, and allow it to flow through the east wall of the pit into Deadman Canyon. Approximately 45 million tons of waste rock material would be used for the backfill to achieve the necessary gradient for uninterrupted flow and discharge.

Within the primary components, there are alternatives to the proposed action, which would achieve the objective of the proposed action with some modification. These include:

- **Haul Road Alternative Routes** - considers the haul road route and disposition of waste rock and mineable ore

- **California Gulch Stream Diversion Alternatives** - considers the temporary diversion of California Gulch while the mine is in operation

Haul Road Alternative Routes

- **Haul Route Alternative A (see Figure 2-1a)** - This route begins at the north side of the open pit, travels northeast and then east and crosses Deadman Canyon at approximately the 5,660-foot elevation, to a location near the No. 1X/1A Tailing Dam, where waste rock would be stored. The road continues south to the No. 2 and No. 2A Leach Stockpile, where mineable ore would be placed. The roadbed may be constructed over culverts sized to accommodate storm flow events, or storm flow may be allowed to flow over the haul road.

- **Haul Route Alternative C (see Figure 2-1c)** - This route begins at the east end of the open pit at approximately the 6,000-foot elevation and climbs east at a constant 10 percent grade, to the No. 2 and No. 2A Leach Stockpile. The fill would be approximately 250 to 300 feet deep over Deadman Canyon. A large culvert structure would be required to carry normal and storm flow events. The waste rock and mineable ore would be placed as described in Haul Route Alternative B.

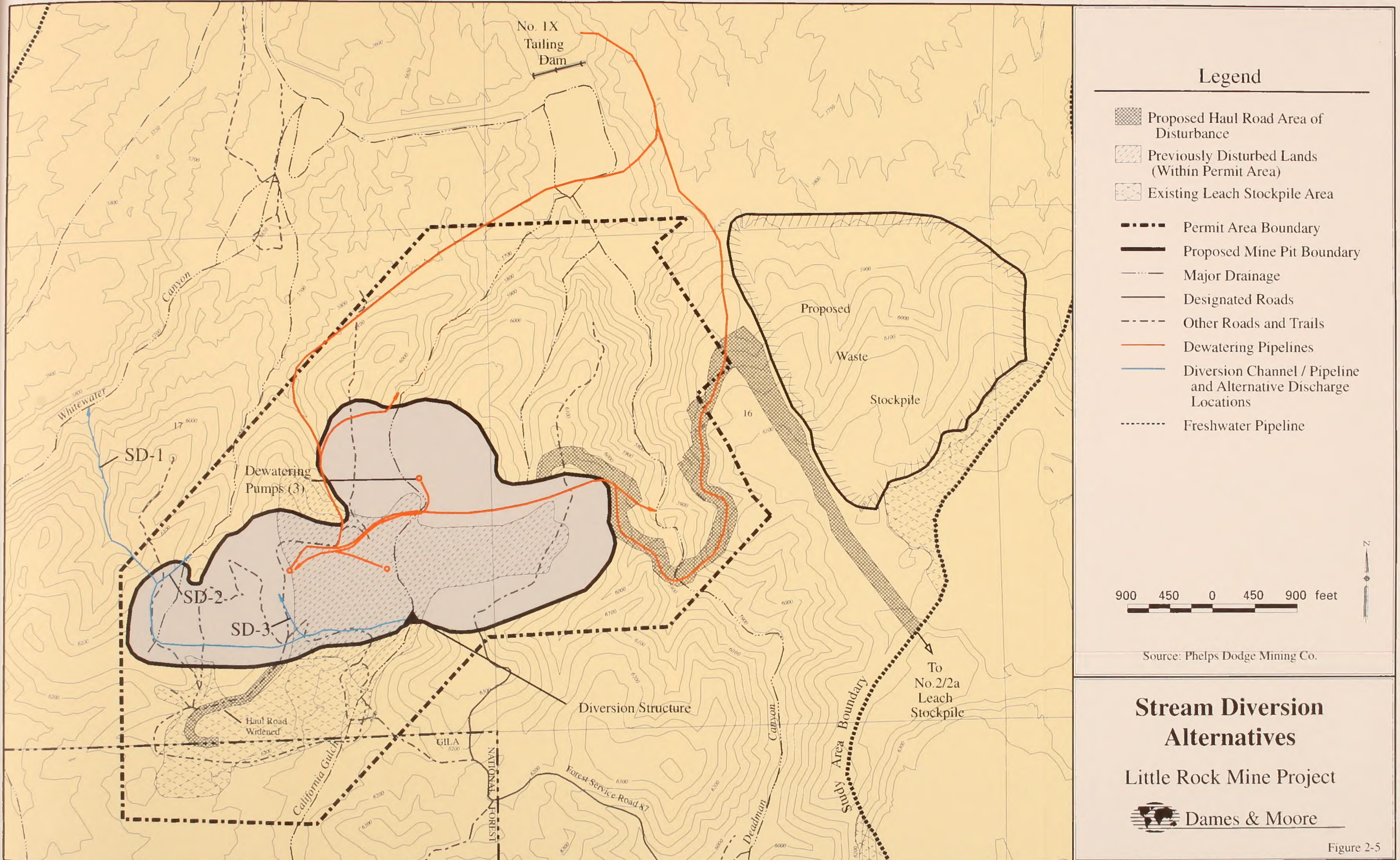
California Gulch Stream Diversion Alternative Locations

Pit operations will require the diversion of California Gulch once the pit reaches and extends below the level of the drainage channel. The diversion structure would be designed to divert normal flows into a high-density polyethylene (HDPE) pipeline. Runoff from large storm events would overflow the pipe inlet and be diverted into an open channel which would discharge, along with the pipeline, into one of the following alternative locations, as shown in Figure 2-5.

- **Whitewater Canyon SD-1** - A west diversion would transmit flow direct to Whitewater Canyon. This option would require that a channel be constructed through the ridge located west of the pit. The channel and pipe would run approximately 2,200 feet from the pit to Whitewater Canyon.

- **Tributary to Whitewater Canyon SD-2** - A west diversion would transmit flow to a tributary of Whitewater Canyon, just below the pit rim.

Diversions to either Whitewater Canyon or its tributary system may be either temporary (i.e., used only during mining operations) or permanent. If temporary, the diversion structure would be removed after mining ceases and the stream would flow into the pit. Alternatives SD-1 and SD-2 would therefore result in forming a pit lake, the same long-term result as Alternative SD-3. A computer generated perspective view of this condition is shown in Figure 2-6.



Stream Diversion Alternatives

Little Rock Mine Project

Dames & Moore

Figure 2-5

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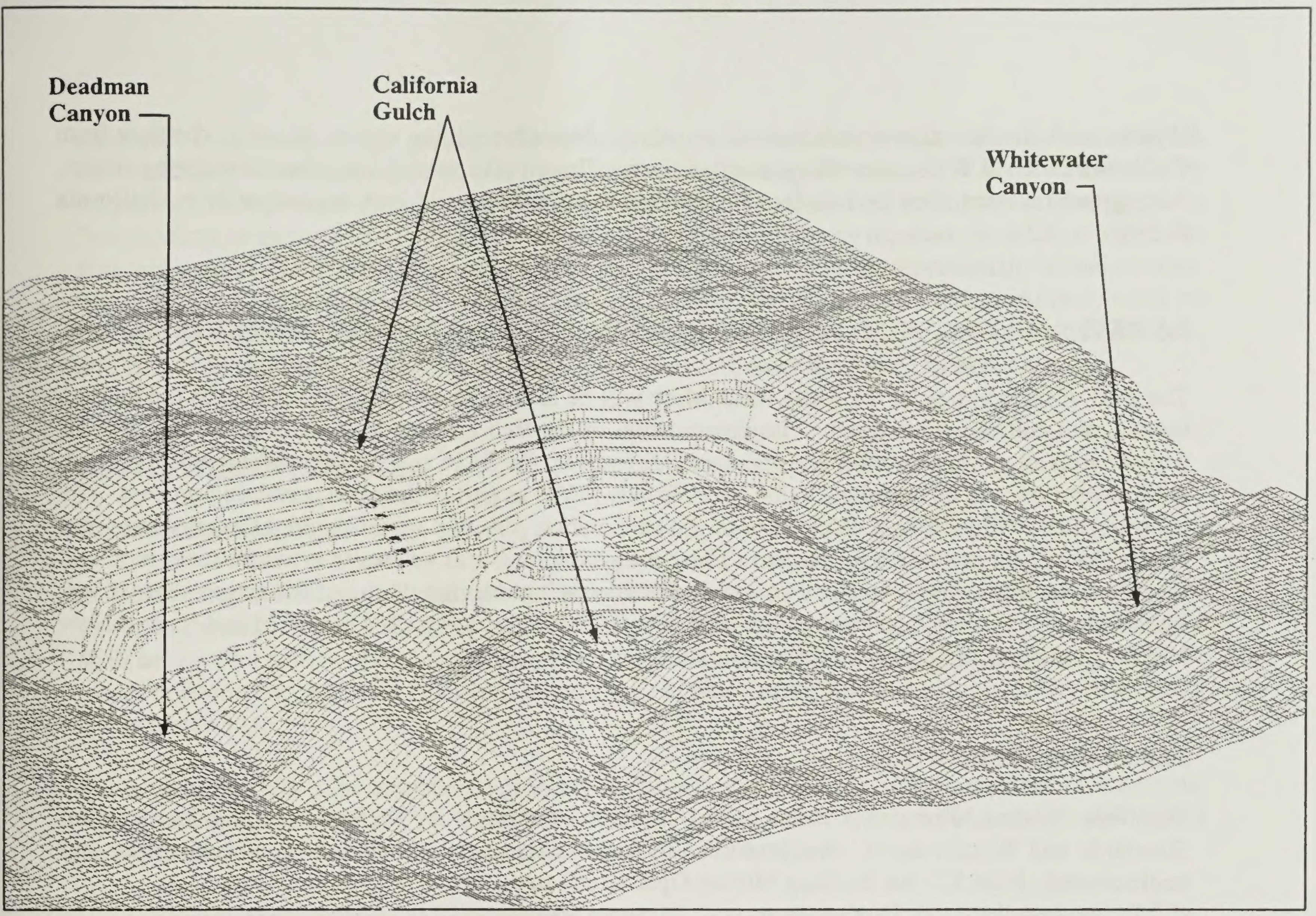
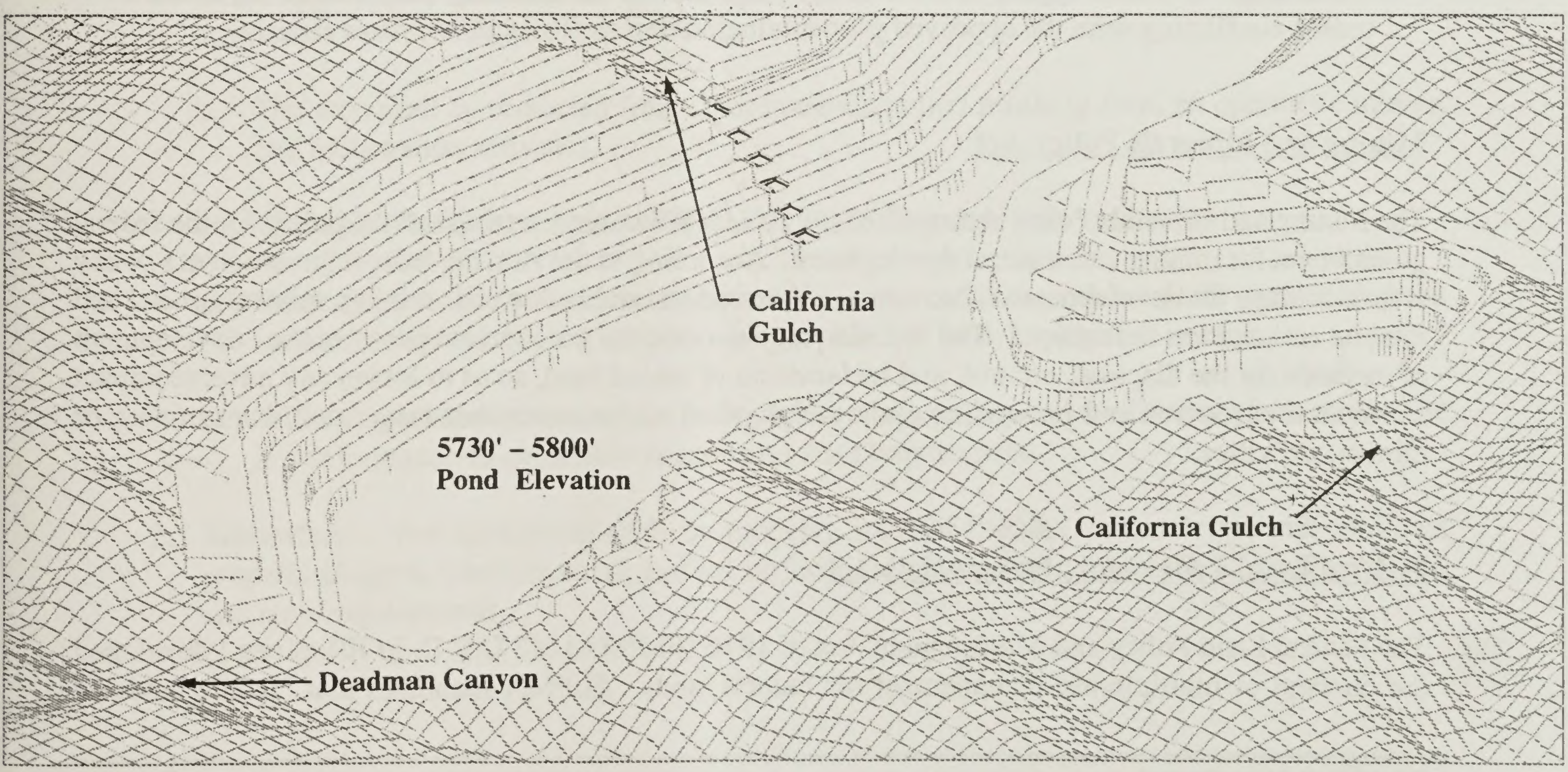


View of Pit Looking Southwest



Computer Generated Model

Diversion Structure and Channel and Pond

Little Rock Mine Project

Figure 2-6

If permanent, the diversion structure would remain in place after mining ceases, diverting the flow from California Gulch to Whitewater Canyon indefinitely. The pit lake would rise, when dewatering ceases, from ground water inflow and surface flow within the pit, but would lack the inflow from California Gulch.

2.5 RECLAMATION PLAN AND ENVIRONMENTAL PROTECTION MEASURES

The goal of reclamation of the Little Rock Mine will be to effectively mitigate impacts to the natural, human, and cultural environment. Implementation of the Reclamation Plan will require that PDMC comply with all applicable rules and standards set forth by the BLM and the New Mexico Mining Act. A Closeout Plan will be submitted to the New Mexico MMD as part of the mine permitting process. The Closeout Plan will include a description of the reclamation plan and specific mitigation measures that Phelps Dodge will commit to implement. These mitigation measures will serve to reduce short-term and long-term environmental impacts associated with the implementation of one of the action alternatives. The intent of the reclamation plan and its implementation will be to satisfy both BLM and state of New Mexico guidelines, described as follows.

New Mexico Mining Act

The New Mexico Mining Act Rules issued July 12, 1994 include “Performance and Reclamation Standards and Requirements” that prescribe certain measures to be included in closeout plans and implemented. Rule 5.7 (for Existing Mining Operations) states that:

> The permit area will be reclaimed to a condition that allows for reestablishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use. (Rule 5.7 A, p.10)

Mining and Minerals Policy Act

The Mining and Minerals Policy Act of 1970 (30 U.S.C. §21 et seq.) established the policy for the federal government for mining and mineral development. According to the Act, the federal government's policy is to encourage the development of "economically sound and stable domestic mining, minerals, metal and mineral reclamation industries." The Act also requires that the government promote the "development of methods for the disposal, control, and reclamation of mined land, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining or mineral activities."

Federal Land Policy and Management Act

The Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. §1701 et seq.) developed the concept of multiple-use management for federal lands. FLPMA mandates that "public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values." FLPMA also mandates, as part of multiple-use management plan, that activities be conducted in a manner that prevents "unnecessary or undue degradation of the lands" (*ibid*). Under statutory mandate the BLM must ensure that reclamation and closure of mineral operations be completed in an environmentally sound manner. To assist in the development of site-specific reclamation, the BLM produced guidelines based on nationwide standards, these include "BLM Manual H-3042-1, Solid Minerals Reclamation Handbook, and BLM Manual 3809, Surface Management (for reclamation of locateable minerals).

BLM Reclamation Guidelines

Reclamation Standards

In developing a reclamation plan, the BLM recommends an interdisciplinary approach to analyze physical, chemical, biological, climatological, and other site characteristics. The reclamation standards shall not conflict with the Resource Management Plan, Management Framework Plan, or other land use planning document objectives. (These standards may not be directly applicable to the Little Rock Mine Reclamation Plan.)

For a disturbed site to be considered properly reclaimed, the BLM identified a number of standards. These standards, established by the BLM in 1992, will be used in developing and implementing concurrent and final closure reclamation plans for Little Rock Mine:

1. Waste Management - All undesirable materials (*e.g.*, toxic subsoil, contaminated soil, drilling fluids, process residue, refuse, *etc.*) shall be isolated, removed, or buried, or otherwise disposed of as appropriate, in a manner providing for long-term stability, and in compliance with all applicable state and federal requirements.

   a. The area shall be protected from future contamination resulting from an operator's mining and reclamation activities.

   b. There shall be no contaminated materials remaining at or near the surface.

   c. Toxic substances that may contaminate air, water, soil, or prohibit plant growth shall be isolated, removed, buried, or otherwise disposed of in an appropriate manner.

   d. Waste disposal practices and the reclamation of waste disposal facilities shall be conducted in conformance to applicable federal and state requirements.

2. Subsurface - The subsurface shall be properly stabilized, holes and underground workings properly plugged, when required, and subsurface integrity ensured subject to applicable federal and state requirements.

3. Site Stability

    a. The reclaimed area shall be stable and exhibit none of the following characteristics:
        1. large rills or gullies
        2. perceptible soil movement or head cutting in drainages
        3. slope instability on, or adjacent to the reclaimed area

    b. The slope shall be stabilized using appropriate reshaping and earthwork measures, including proper placement of soils and other materials.

    c. Appropriate water courses and drainage features shall be established and stabilized.

4. Water Management - The quality and integrity of affected ground and surface waters shall be protected as a part of mineral development and reclamation activities in accordance with applicable federal and state requirements.

    a. Appropriate hydrologic practices shall be used to protect and, if practical, enhance both the quality and quantity of impacted waters.

    b. Where appropriate, actions shall be taken to eliminate ground water commingling and contamination.

    c. Drill holes shall be plugged, and underground openings, such as shafts, slopes, stopes, and adits, shall be closed in a manner which protects and isolates aquifers and prevents infiltration of surface waters, where appropriate.

    d. Waste disposal practices shall be designed and conducted to provide for long-term ground and surface water protection.

5. Soil Management - Topsoil, selected subsoils, or other materials suitable as a growth medium shall be salvaged from areas to be disturbed and managed for later use in reclamation.

6. Erosion Prevention - The surface area disturbed at any one time during the development of a project shall be kept to the minimum necessary and the disturbed areas reclaimed as soon as is practical (concurrent reclamation) to prevent unnecessary or undue degradation resulting from erosion.

    a. The soil surface must be stable and have adequate surface roughness to reduce run-off, capture rainfall and snow melt, and allow for the capture of windblown plant seeds.

    b. Additional short-term measures, such as the application of mulch or erosion netting, may be necessary to reduce surface soil movement and promote revegetation. Gravel or vegetative mulch will be used on the reclaimed sites where there is danger of damaging wind or water erosion or where microclimate improvements are required for assuring successful revegetation. Mulch specifications vary according to type of mulch. Table 2-1 presents suggested rates required for the various mulches.

c. Soil conservation measures, including surface manipulation, reduction in slope angle, revegetation, and water management techniques, shall be used.

d. Sediment retention structures or devices shall be located as close to the source of sediment generating activities as possible to increase their effectiveness and reduce environmental impacts.

TABLE 2-1
RECOMMENDED MULCHING GUIDELINES

Type of Mulch	Rate in Tons per Acre
Grass hay	2.0 to 2.5
Sudans and millets	2.5 to 3.5
Small grain straw	1.5 to 2.0
Corn and sorghum	3.5 to 4.5
Cotton burs	10 to 15
Dry manure	5 to 10
Wood chips	12 tons or approximately 90 to 100% ground cover
Gravel - 0.75" to 2.5" diameter	100 tons or approximately 80 to 100% ground cover
Rock of any size	80 to 100% ground cover
Source: SCS-NM-November 1990	

7. Revegetation - When the final landform is achieved, the surface shall be stabilized by vegetation or other means to reduce further soil erosion from wind or water, provide forage and cover, and reduce visual impacts. Reclamation and reseeding will be completed during the month of June or early July following completion of mining at the site. Specific criteria for evaluating revegetation success must be site-specific and will be included as a part of the reclamation plan.

   a. Vegetation production, species diversity, and cover (on unforested sites), shall approximate the surrounding undisturbed area. Table 2-2 presents the recommended natural plant community for the soil types at the project area (Soil Conservation Service 1986).

TABLE 2-2
POTENTIAL NATURAL PLANT COMMUNITY

Based on mapping completed by USDA-SCS revegetation guidelines, the proposed seed mixes of Table 2-3 would be used to reestablish a natural plant community similar in composition to the one below. This site actually occurs as a complex of plant communities primarily dictated by exposure and to some extent soil textures and depths. North-facing slopes tend to have more shrubs or trees such as juniper, hairy mountainmahogany, and oak brush, while south-facing slopes are usually more open. Sideoats grama is the primary dominant on this site, although a wide variety of productive perennial grasses should be considered characteristic.

Composition of Potential Plant Community (approximate percentage of total annual herbage production)

Grasses and Grasslike (65 to 75%)	Woody* (15 to 25%)	Forbs (5 to 10%)	Canopy Cover	Ground Cover (average percent of surface area)
Sideoats grama (20 to 30)	Shrub live oak (3 to 8)	Wildbuckwheat	Tree, shrub, and half-shrub 15%	Grasses and forbs (24)
Blue grama (5 to 15)	Sacahuista	Wooly Indianwheat (3 to 5)		Bare ground (8)
Hairy grama (1 to 3)	Skunkbush sumac	Threadleaf groundsel		Surface gravel (25)
Black grama (5 to 15)	Hairy mountainmahogany (5 to 8)	Other annual (1 to 3)		Surface cobble and stones (25)
Little bluestem	Wright silktassel	Other perennials (1 to 5)		Litter - percent of surface area (18) average depth in cm. (2)
Cane bluestem	Apacheplume			
Plains lovegrass (5 to 10)	Feather dalea			
Green sprangletop	Rubber rabbitbrush (1 to 5)			
Mountain muhly	Broom snakeweed			
Bullgrass (5 to 10)	Juniper (5 to 8)			

TABLE 2-2
POTENTIAL NATURAL PLANT COMMUNITY

Based on mapping completed by USDA-SCS revegetation guidelines, the proposed seed mixes of Table 2-3 would be used to reestablish a natural plant community similar in composition to the one below. This site actually occurs as a complex of plant communities primarily dictated by exposure and to some extent soil textures and depths. North-facing slopes tend to have more shrubs or trees such as juniper, hairy mountainmahogany, and oak brush, while south-facing slopes are usually more open. Sideoats grama is the primary dominant on this site, although a wide variety of productive perennial grasses should be considered characteristic.

Composition of Potential Plant Community (approximate percentage of total annual herbage production)

Grasses and Grasslike (65 to 75%)	Woody* (15 to 25%)	Forbs (5 to 10%)	Canopy Cover	Ground Cover (average percent of surface area)
Spike muhly	Others (1 to 3)			
Wolftail				
Junegrass (1 to 3)				
Threeawns spp. (1 to 3)				
Bottlebrush squirreltail (5 to 10)				
New Mexico feathergrass				
Others (3 to 5)				

*Shrubs, half shrubs, vines, and trees
Source: USDA-SCS, NMMLRA 036C103N, May 1986

b. The vegetation shall stabilize the site and support the planned post-disturbance land use, provide natural plant community succession and development, and be capable of renewing itself. This shall be demonstrated by:

   1. successful on-site establishment of the species included in the planting mixture and/or other desirable species

   2. evidence of vegetation reproduction, either spreading by rhizomatous species or seed production

   3. evidence of overall site stability and sustainability

c. Where revegetation is to be used, a diversity of vegetation species shall be used to establish a resilient, self-perpetuating ecosystem capable of supporting the post-mining use. Species planted shall include those that will provide for quick soil stabilization, provide litter and nutrients for soil building, and are self-renewing. Native species will be used in revegetation efforts. The potential natural plant community for the soil types in the project area is given in Table 2-2 and is from USDA-Soil Conservation Service (SCS) recommendations. Recommended seed mixes for the various soil types in the site area are given in Table 2-3.

d. Species diversity should be selected to accommodate long-term land uses, such as rangeland and wildlife habitat, and to provide for a reduction in visual contrast.

e. Fertilizers, other soil amendments, and irrigation shall be used only as necessary to provide for establishment and maintenance of a self-sustaining plant community.

f. Seedlings and other young plants may require protection until they are fully established. Grazing and other intensive uses may be prohibited until the plant community is appropriately mature. At this site grazing will be continued on adjacent parcels. Fencing is proposed to prohibit grazing in the revegetated areas from July 15 through September 30 for two summer seasons.

g. Where revegetation is impractical, pit walls, bottom of pit if underwater or inconsistent with the surrounding undisturbed areas, or other forms of surface stabilization, such as rock pavement, shall be used.

8. Visual Resources - To the extent practicable, the reclaimed landscape should have characteristics that approximate or are compatible with the visual quality of the adjacent area with regard to location, scale, shape, color, and orientation of major landscape features.

9. Site Protection - During and following reclamation activities the operator is responsible for monitoring and, if necessary, protecting the reclaimed landscape to help ensure reclamation success until the liability and bond are released.

TABLE 2-3 REVEGETATION SEED MIX BY SOIL TYPE		
Type	**Species**	**LBS/AC Pure Live Seed (PLS)***
Loamy Soils (combination of clay, sand, and silt in equal amounts)		
G	Black grama var. Nogal (*Bouteloua eriopoda*)	.50
G	Side-Oats grama var. Niner or Vaughn (*Bouteloua curtipendula*)	1.50
G	Mesa Dropseed (*Sporobolus flexuosus*)	.25
F	Scarlet globemallow (*Sphaeralcea coccinea*)	1.00
S	Four-wing saltbush (*Atriplex canescens*)	.50
The following species may be substituted for the species listed above of the same plant type (grass for grass, etc.)		
G	Blue grama var. Hachita (*Bouteloua gracilis*)	1.50
S	Winterfat var. Hatch (*Eurotia lanata*)	4.00
F	Bullcods (*Menodora scabra*)	.25
G	Cane bluestem (*Bothriochloa barbinoides*)	1.00
G	Yellowstem var. Ganada (*Bothriochloa ischaemum*)	1.00
Gravelly Soils (contains gravel on the surface)		
G	Black grama var. Nogal (*Bouteloua eriopoda*)	.50
G	Side-oats grama var. Niner or Vaughn (*Bouteloua curtipendula*)	1.50
F	Desert baileya (*Baileya multiradiata*)	.50
G	Cane bluestem (*Bothriochloa barbinoides*)	1.00
S	Winterfat var. Hatch (*Eurotia lanata*)	4.00
The following species may be substituted for the species listed above of the same plant type (grass for grass, etc.)		
G	Arizona cottontop (*Digitaria californica*)	.50
F	Desert globemallow (*Spaeralcea ambigua*)	1.00
S	Bullcods (*Menodora scabra*)	.25

TABLE 2-3 REVEGETATION SEED MIX BY SOIL TYPE		
Type	**Species**	**LBS/AC Pure Live Seed (PLS)***
G	Yellow bluestem var. Ganada (*Bothriochloa ischaemum*)	1.00
G	Bush Muhley (*Muhlenbergia porteri*)	.25
Hills Range Sites (gravelly to bedrock soils)		
G	Black grama var. Nogal (*Bouteloua eriopoda*)	.50
G	Side-oats grama var. Niner or Vaughn (*Bouteloua curtipendula)*	1.50
S	Mountain Mahogany (*Cercocarpos spp*)	0.5
The following species may be substituted for the species listed above of the same plant type (grass for grass, etc.)		
G	Blue grama var. Hachita (*Bouteloua gracilis*)	1.50
G	Cane bluestem (*Bothriochloa barbinoides*)	1.50
S	Little-leaf sumac (*Rhus microphylla*)	3.00
S	Skunkbush sumac (*Rhus aromatica*)	3.00
F	Bullcods (*Mendora scabra*)	.25
G = grass F = forb S = shrub *Double seed rate if broadcasting Source: BLM, Reclamation/Reseeding Guidelines for Mimbres Resource Area, 1989.		

10. Site Specific Standards - All site-specific standards must be met in order for the site to be properly and adequately reclaimed.

Proposed Environmental Protection Measures, Reclamation, and Closure for Little Rock Mine

The primary goal of site reclamation is to ensure long-term protection of the environment and to return the areas subjected to past and proposed mining and related disturbances to post-mining land uses. BLM reclamation standards for post-mining land uses may include wildlife habitat, livestock grazing, dispersed recreation, and wilderness access. Therefore, to provide for these uses it is important that safety hazards and man-made landscape features be an integral focus of the reclamation plans. For the Little Rock Mine, the post-closure land use will likely include a combination of wildlife habitat and livestock grazing.

At this time, the proposed reclamation and closure plans are conceptual and developed to address the general types of concurrent reclamation, final reclamation, and closure. More specific plans will be developed when required, and when more detailed mining operation plans are defined. A final reclamation and closure plan will be developed by PDMC for submittal to and approval by the BLM, Forest Service, and state of New Mexico.

Proposed mining will occur in an area with significant disturbance from previous mining activities. Mining on the site will be by open-pit mining methods using existing equipment at Tyrone Mine. Existing leach stockpiles on the site will be relocated to Phelps Dodge property for further processing and disposal; processing facilities left from past mining activities are proposed for remediation. Existing stockpiles from mining will be among the first sites remediated when mining is permitted. The stockpiled leach material and contaminated subsoils will be removed and the area revegetated. No permanent facilities will be constructed at the mine site with the exception of possible diversion structures. All dewatering equipment will be removed from the mine site once operations have ceased.

The haul road will not connect to any public access road, and will be designed to allow for two-way traffic for 190-ton-class haul trucks. This 135-foot-wide roadway will include side safety berms, drainage, and a maximum gradient of 10 percent. Cuts and fills will be minimized and all drainage crossings will be designed to pass the peak run-off of a 10-year, 24-hour storm event. Culverts and drainage pipes, where used, will be constructed and maintained to avoid plugging, collapsing, or erosion.

The haul road will be surfaced with gravel and watered during haul operations to reduce dust emissions to achieve an average silt loading of either 2 percent (Alternative Haul Route A) or 5 percent (Haul Routes B and C). Sufficient watering will be applied to control particulate emissions outside of the permit area. Continual watering or chemical suppressants will be applied, providing minimum dust control efficiencies of 95 percent. Haulage speeds will average approximately 15 mph over the life of the project but will not exceed 33 mph. The maximum speed would only be attained when trucks are empty and on a flat road; speeds will be lower than average on other portions of the route (i.e., downhill empty, uphill empty, downhill loaded, and uphill loaded).

Following completion of mining activities, reclamation and revegetation, the road will be reclaimed by softening the cuts and fills, installing water bars, removing culverts, and restoring the drainage to its predisturbance configuration to the extent practical. The roadbed will be ripped to reduce compaction, mulch and/or topsoil spread, and revegetated with native plant seed mix. Shaping and grading can range from outsloping the road surface to full restoration of the disturbance to the original contours on a site specific basis.

All mine overburden (waste) will be hauled to the designated stockpile area (see Figure 2-1) and may later be used for reclamation. All suitable leach material mined from the site will be hauled to existing, permitted leach facilities on PDMC property. Remaining solid waste products from mining operations will be negligible since most maintenance, office, and managerial functions will be located at the Tyrone Mine. These materials will be disposed of at Tyrone's permitted landfill.

Salvageable soil will be removed from the areas to be disturbed or developed (i.e., mined) to the extent practicable. This soil will be stored in stockpiles, stabilized, and seeded with native vegetation seed mixes (see Table 2-3) to protect from wind and water in the proposed waste stockpile area. Topsoil will be segregated from waste rock at the waste stockpile site. Since the mine site is located in an area of rugged terrain with outcrops of granite, there is a minimal amount of topsoil anticipated to be available. Table 4-3 provides an estimate of the volume amount of salvageable soil to be used for reclamation.

The hydrologic portion of the reclamation plan will be designed in accordance with the state of New Mexico, and federal and local water quality standards. All aspects of the operation that can cause pollution will be investigated so that each phase of the operation can be designed to avoid contamination. Water from California Gulch may be diverted around the mine area and diverted into Whitewater Canyon or a tributary. The detailed reclamation plan will include designs for surface water runoff; erosion controls; and a water monitoring program to ensure compliance with state, federal, and local water quality standards.

Final reclamation of the site will comply with regulations in place at the time of closure. It is assumed that the New Mexico Mining Act regulations will be the determining regulations for ultimate closure. The BLM will have input into the desired post-mining land use, and the BLM and Forest Service will have input into the reclamation of the area currently occupied by the existing leach stockpiles.

The pit walls will not be recontoured but rather left with barrier berms at the top, where appropriate. Pit walls and benches will gradually fill with rubble from higher benches. Water from surface runoff and ground water seepage may accumulate in the bottom of the pit after closure. Potential hazards to public safety will be minimized by using measures such as berming and fencing.

Stormwater control structures established during mining operations will be reclaimed or left in place as directed by the New Mexico Environment Department, U.S. Army Corps of Engineers, and other permitting agencies. If reclamation is required, channels, ponds, and sediment traps will be recontoured and revegetated. Diversion ditches or channels may require protective measures such as gabions or boulder reinforcement.

As a part of the closure plan, monitoring of revegetation and reclamation will be an integral part of assuring a successful reclamation program. Revegetation will use native plant species. Recommended seed mixes by soil type are given in Table 2-3. Reseeding is recommended during the months of June or July to coincide with the rainy season. Mulching will be used as a part of all seeding projects. Monitoring should be done on a monthly basis for the first year and then at broader intervals as prescribed by the BLM and New Mexico MMD for subsequent years. During monitoring, reclamation will be evaluated. Revisions to the reclamation plan may be necessary.

2.6 COMPARISON OF ALTERNATIVES

There are several alternatives to the proposed action including the no-action alternative. Selection of the no-action alternative would result in no further landform modification or mining activities at the proposed mine site or within the permit area. The existing disturbance at the mine site would be left as is.

The development of the EIS required the careful consideration of any alternative to the proposed action. The alternatives considered for further study are described below and constitute the alternatives to the proposed action. In addition, several alternatives were initially considered and evaluated, but did not meet the purpose and need of the project, or would cause unnecessary environmental impacts and thus were dropped from consideration, as described previously in this chapter.

Table 2-4 provides a summarized comparison of each alternative relative to the resources evaluated as part of this EIS. The results in the table are derived from the impact assessment and potential environmental impacts described in Chapter 4 of this report. For detailed descriptions of the affected environment and environmental consequences, refer to Chapters 3 and 4 of this document.

2.7 AGENCY PREFERRED ALTERNATIVE

The BLM and Gila National Forest have identified Alternative 2, the proposed action, as their preferred alternative at this draft EIS stage of the environmental review process. This preferred alternative is an indication of the agencies' preliminary preference and is not a final decision. A preferred alternative will also be selected in the final EIS. The agencies' preference at that time will consider all public and other agency comments that are received on the draft EIS.

SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES								
No Action Alternative 1	**Proposed Action Alternative 2**			**Haul Road Alternatives**		**Partial Backfill Alternative**	**California Gulch Stream Diversion Alternatives**	
	Mine Plan	**Haul Road Route B**	**Stream Diversion Discharge to Pit SD-3**	**Route A**	**Route C**		**Whitewater Canyon SD-1**	**Whitewater Canyon - Tributary SD-2**
Project Description								
No mining at project site. No change to existing conditions; areas disturbed by previous mining and leach stockpiles would remain.	Construction and operation of an open pit hard rock mine, and removal of up to 160,000 tons of copper ore per day for two to four years. Open pit would remain after mining is completed, with creation of pit-lake. Diversion of California Gulch would be to the open pit. Pit water would be pumped to either No. 1X Tailing Dam or to Deadman Canyon while mine is in operation. Haul Road Route B is proposed (see Figure 2-1).	Begins at east end of the pit and descends to Deadman Canyon, crossing at approximately 5,900-foot elevation. Climbs east side of canyon to No. 2/2A Leach Stockpiles. Waste stockpiled in new area north of haul road.	Construction of pipeline and channel to pit bottom. Pump water to California Gulch or Deadman Canyon downstream of open pit or to No. 1X Tailing Dam.	Begins at north side of the pit and goes northeast down to Deadman Canyon at 5,660-foot elevation. Continues to the southern end of No. 1X/1A Tailing Dam, then south to No. 2/2A Leach Stockpile. Waste stockpiled at No. 1X/1A Tailing Dam.	Begins at east end of the pit at 6,000-foot elevation and climbs east, 10 percent grade, to No. 2/2A Leach Stockpile. Canyon fill from Tyrone Mine, 250 to 300 feet deep over Deadman Canyon. Culvert structure to carry normal and storm event flows. Waste stockpiled in new area north of haul road.	Construct a diversion of California Gulch to Whitewater Canyon and partially backfill the pit if necessary to the 5,800-foot elevation. A drainage channel will be developed to prevent upstream surface and ground water generated at the pit from ponding, and allow it to flow downstream through Deadman Canyon (see Figure 2-6).	Construction of pipeline and open channel outside of current project boundary to Whitewater Creek to carry normal and storm event flows. If temporary, once mining ceases, the discharge would return to the pit.	Construction of pipeline and open channel to tributary to Whitewater Creek to carry normal and storm event flows. If temporary, once mining ceases, the discharge would return to the pit.
Earth Resources - Soils								
There would be no changes to soils from the existing conditions. In undisturbed areas natural erosion rates will continue.	**Permit Area** Direct disturbance in the pit area of approximately 186 surface acres of soils; 63 surface acres of which are previously disturbed. **Cumulative Study Area** Potential impacts to soils include increased rates of soil erosion and a decrease in soil productivity. Indirect impacts include increased stream sedimentation and loss of topsoil. A Reclamation Plan will be implemented with construction and operation of the mine to mitigate soil erosion impacts. A Closure Plan will also be implemented.	An additional 40 surface acres of disturbance will occur outside of the pit area as a result of haul road construction. Reclamation potential of soils is fair.	No or very minimal disturbance beyond pit limits for construction of diversion system. No additional impacts to soils.	An additional 58 surface acres of disturbance will occur outside of the pit area as a result of haul road construction. Reclamation potential of soils is fair to poor.	An additional 27 surface acres of disturbance will occur outside of the pit area as a result of haul road construction. Reclamation potential of soils is fair.	**Permit Area** Partial backfilling of pit would provide 70 acres for revegetation. Area of stream diversion would be reclaimed and revegetated. **Cumulative Study Area** Same as Proposed Action (Alternative 2).	Approximately 2 surface acres of disturbance from construction of channel and pipe beyond pit limits.	Same as SD-3 (Proposed Action).

TABLE 2-4
SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES									
No Action Alternative 1	Proposed Action Alternative 2			Haul Road Alternatives		Partial Backfill Alternative	California Gulch Stream Diversion Alternatives		
	Mine Plan	Haul Road Route B	Stream Diversion Discharge to Pit SD-3	Route A	Route C		Whitewater Canyon SD-1	Whitewater Canyon - Tributary SD-2
Earth Resources - Geology and Minerals								
There would be no changes to the geology and mineral resources at the proposed mine site.	**Permit Area** The proposed action would affect the geology and mineral resources by removing 160 million tons of total mine rock including 100 million tons of leachable ore. **Cumulative Study Area** Other than removal of mineral resources from the mine site there would be no additional effect on geology and mineral resources.	No effect.	No effect.	No effect.	No effect.	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Same as Proposed Action.	No effect.	No effect.
Water Resources								
The no-action alternative would likely have an overall negative impact on the surface water and ground water quality. Water quality in the vicinity of the existing USNR leach pile is poor and may continue to degrade as it flows into California Gulch. This alternative would have no effect on existing surface water flow conditions.	**Permit Area** During mine operations, the diversion of California Gulch will cease flows in California Gulch north of pit. Rainfall directly on the pit area will no longer contribute to natural flows in Mangas Creek. **Cumulative Study Area** Following mine closure, flows from California Gulch entering the pit would either evaporate or recharge the ground water. Due to the large pit capacity relative to potential runoff flows entering the pit, storm events are not expected to overtop the pit sides. The net result would be a decrease in flows ultimately entering Mangas Creek by about nine percent of the contributing drainages in the analysis area. Additional flow into the pit lake would raise the elevation from 5,730 to 5,733 feet.	Anticipated impacts to surface water from construction of the haul road are minimal.	Diversion of California Gulch to the pit will result in cessation of flows in California Gulch north of the pit.	Same as Proposed Action.	Same as Proposed Action.	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Peak flow in Deadman Canyon for the 100-year 24-hour storm will increase by 21 percent as a result of the diversion. Average annual flows would increase slightly due to increased drainage area. Minor additional erosion between the junction of the pit outlet and California Gulch may result. Flow below the confluence of the original California Gulch and Deadman Canyon would be similar to current conditions.	**Permit Area** During mine operations, diversion of California Gulch will cause increased flow into Whitewater Canyon. If a permanent diversion, this would continue after mining ceases.	**Permit Area** During mine operations, diversion of California Gulch would cause increased flows into Whitewater Canyon. If a permanent diversion, this would continue after mining ceases.

TABLE 2-4
SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

No Action Alternative 1	Proposed Action Alternative 2			Haul Road Alternatives		Partial Backfill Alternative	California Gulch Stream Diversion Alternatives	
	Mine Plan	Haul Road Route B	Stream Diversion Discharge to Pit SD-3	Route A	Route C		Whitewater Canyon SD-1	Whitewater Canyon - Tributary SD-2
Water Resources (continued)								
	Under the best-case scenario, the pit lake chemistry would not exceed any WQCC parameters. Under the worst-case scenario, copper would slightly exceed the WQCC surface water standard (0.5 mg/l) at 0.55 mg/l. Pit lake water recharging the aquifer would exceed the ground water standard for fluoride (1.6 mg/l) for both best-case (2.5 mg/l) and worst-case (5.9 mg/l) scenarios. No other ground water standards would be exceeded.					California Gulch and Deadman Canyon would be similar to current conditions. The elevation of ground water within the backfilled pit would stabilize at approximately 5,750 feet. This alternative would not improve water quality relative to the Proposed Action.	**Cumulative Study Area** Some erosion of Whitewater Canyon (to which the diversion discharges) would occur, with eroded sediment being deposited in the streambed below the mouth of Whitewater Canyon.	**Cumulative Study Area** Some erosion of unnamed tributary (to which the diversion discharges) would occur, with eroded sediment being deposited in the streambed below the mouth of Whitewater Canyon.
Biological Resources - Vegetation								
There would be no additional loss of vegetation as a result of this alternative. Vegetation may be adversely impacted by existing leach piles' affect on water quality.	**Permit Area** Approximately 186 acres would be disturbed due to mine pit construction. Of this acreage, 12 acres of grasslands/juniper grasslands, 109 acres of juniper grasslands/piñon-juniper woodlands and 2 acres of ponderosa pine forest would be removed. No direct impacts to riparian areas would result from construction of the haul road or mine pit. **Cumulative Study Area** The water diverted by the channel would likely have a beneficial effect on vegetation along Whitewater Canyon during mine operation.	Disturbs 40 acres: ■ 3 acres grassland, juniper grassland ■ 37 acres piñon-juniper woodland/ juniper grassland	May enhance riparian habitat along drainage.	Disturbs approximately 58 acres ■ 1.4 acres previously disturbed ■ 33 acres grassland, juniper grassland ■ 24 acres piñon-juniper woodland/ juniper grassland	Disturbs 27 acres ■ 2 acres grassland, juniper grassland ■ 25 acres piñon-juniper woodland/ juniper grassland	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Opportunities to increase terrestrial habitat may increase.	Same as Proposed Action (SD-3).	Same as Proposed Action (SD-3).

TABLE 2-4
SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES								
No Action Alternative 1	Proposed Action Alternative 2			Haul Road Alternatives		Partial Backfill Alternative	California Gulch Stream Diversion Alternatives	
	Mine Plan	Haul Road Route B	Stream Diversion Discharge to Pit SD-3	Route A	Route C		Whitewater Canyon SD-1	Whitewater Canyon - Tributary SD-2
Biological Resources - Wildlife and Fisheries								
There would be no additional loss of wildlife habitat and the current seasonal drainage systems would be unaffected. There could be continued degradation of water quality, particularly in California Gulch.	**Permit Area** Some short-term loss of ground dwelling mammals and reptiles and increased vehicle traffic in the area may result in direct mortality due to mining activities. **Cumulative Study Area** The creation of a manmade pit lake would likely be utilized by wildlife and migratory birds.	Same as mine plan.	Same as mine plan.	Same as Proposed Action.	Same as Proposed Action.	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Backfilling the pit may allow for regeneration of terrestrial habitat.	If permanent, potential benefit to riparian habitat.	If permanent, potential benefit to riparian habitat.
Biological Resources - Special Status Species								
The no-action alternative would not result in the loss of potential habitat for special-status species which may occur in the vicinity of the mine.	**Permit Area** The creation of a pond could provide increased foraging opportunities for spotted and occult little brown bats. The lake could also provide habitat for migratory birds and amphibians. **Cumulative Study Area** No significant unavoidable adverse effects would result to special-status species as a result of any action alternatives.	No effect.	No effect.	No effect.	No effect.	**Permit Area** There would be a potential opportunity to revegetate the filled portion of the site which would provide additional habitat for terrestrial wildlife. **Cumulative Study Area** Same as Proposed Action.	No effect.	No effect.
Land Use, Recreation, and Access								
The no-action alternative would not result in any changes to the existing land use and access resources.	**Permit Area** There are no impacts to existing land uses at the proposed mine pit, except for the temporary loss of marginal recreational opportunities and the relocation of a power line. No impact would occur to residences. **Cumulative Study Area** There would be no impacts to existing land uses and access within the cumulative study area.	No effect.	No effect (see Proposed Action).	Conflict with potential mining operation.	No effect.	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Same as Proposed Action.	No effect.	No effect.

TABLE 2-4
SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES								
No Action Alternative 1	Proposed Action Alternative 2			Haul Road Alternatives		Partial Backfill Alternative	California Gulch Stream Diversion Alternatives	
	Mine Plan	Haul Road Route B	Stream Diversion Discharge to Pit SD-3	Route A	Route C		Whitewater Canyon SD-1	Whitewater Canyon - Tributary SD-2
Socioeconomics								
The no-action alternative could result in the exhaustion of mineral resources at the Tyrone Mine site and could potentially dislocate workers and residents in the Grant County area.	**Permit Area** No impacts would occur at the mine site or along the haul road. **Cumulative Study Area** Beneficial effects will be derived from state and local tax revenues generated by the mine operation. Secondary employment and associated revenues from suppliers and contractors in the county will also be a positive impact. Social effects would be negligible.	No effect.	No effect (see Proposed Action).	No effect.	No effect.	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Same as Proposed Action.	No effect.	No effect.
Visual Resources								
Implementation of the no-action alternative would not create any additional impacts to visual resources.	**Permit Area** The proposed action will not result in any high impacts to scenery or viewers. **Cumulative Study Area** Modification of the existing landscape would be compatible with existing agency visual management guidelines.	No significant change.	No effect.	Increased exposure to distant views.	Major visual change at canyon crossing.	**Permit Area** Same as Proposed Action **Cumulative Study Area** Same as Proposed Action.	Greater impact due to cut at ridge; contrast remains compatible.	No effect.

TABLE 2-4
SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

No Action Alternative 1	Proposed Action Alternative 2			Haul Road Alternatives		Partial Backfill Alternative	California Gulch Stream Diversion Alternatives	
	Mine Plan	Haul Road Route B	Stream Diversion Discharge to Pit SD-3	Route A	Route C		Whitewater Canyon SD-1	Whitewater Canyon - Tributary SD-2
Cultural Resources								
If the no-action alternative were to be selected, the ground disturbing activities associated with development of the Little` Rock Mine and related facilities would not occur and the archaeological sites within the project area would not be affected.	**Permit Area** One historic site, the Ohio Mine, is within the footprint of the proposed mining pit and would be destroyed by creation of the mine pit. The significance of this site is being evaluated in consultation with the State Historic Preservation Office (SHPO). If determined to be significant, a treatment plan would be prepared. **Cumulative Study Area** No impacts would occur to other archaeological sites located outside of the disturbed areas for the Little Rock Mine project. Other future mining projects may affect cultural resources in the cumulative study area.	Two prehistoric artifact scatters, and three historic mining claim sites would be disturbed or destroyed. The mining claims appear to lack important historic values, but are being evaluated in consultation with the SHPO. A treatment plan to mitigate impacts is being prepared.	Same as mine plan.	Two prehistoric Mimbres pueblo sites, one prehistoric Mimbres camp, two prehistoric lithic scatters, two historic mining claim sites, and one historic mining camp would be disturbed or destroyed in the haul road or stockpile area associated with this route. Other archaeological sites may be present in unsurveyed parts of the stockpile area.	Same as Proposed Action.	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Same as Proposed Action.	No known cultural resources, but not completely inventoried.	No effect.
Air Resources								
There would be no changes to existing ambient air quality within the proposed mine site and cumulative study area.	**Permit Area** Particulate matter would be the only air pollutant emitted in significant amounts. The highest second maximum 24-hour off-site PM_{10} impact is modeled to be 504 µg/m3 (including background). The maximum annual off-site PM_{10} impact is modeled to be 299 µg/m3 (including background). These predicted values violate the PM_{10} NAAQS of 150 µg/m3 (24-hour) and 50 µg/m3 (annual). These concentrations are primarily due to mine pit and haul road activities in close proximity of the permit boundary and diminish rapidly a few hundred meters from the permit boundary.	**PM_{10} Impact** 24 hour: 504 µg/m3 Annual: 299 µg/m3	No effect.	**PM_{10} Impact** 24 hour: 326 µg/m3 Annual: 90 µg/m3	**PM_{10} Impact** 24 hour: 466 µg/m3 Annual: 183 µg/m3	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Same as Proposed Action.	No effect.	No effect.

TABLE 2-4
SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES								
No Action Alternative 1	**Proposed Action Alternative 2**			**Haul Road Alternatives**		**Partial Backfill Alternative**	**California Gulch Stream Diversion Alternatives**	
	Mine Plan	**Haul Road Route B**	**Stream Diversion Discharge to Pit SD-3**	**Route A**	**Route C**		**Whitewater Canyon SD-1**	**Whitewater Canyon - Tributary SD-2**
Air Resources (continued)								
	Cumulative Study Area Particulate matter would be the only air pollutant emitted in significant amounts. The maximum PM_{10} impacts diminish rapidly as the distance from the pit and haul road is increased. No significant air resource impacts are anticipated in Tyrone, or at the Gila Wilderness PSD Class I area.							
Noise								
No change to existing conditions would occur. Noise level would remain the same.	**Mine Pit and Haul Road** Noise from earth moving activities is expected to be below estimated ambient noise levels (and therefore inaudible) at all receptor locations except the ranch residence north of the mine pit and the residence located in Section 21 of T19S R15W. Noise levels at these locations are expected to be greater than 10 dBA above estimated ambient levels and therefore potentially annoying. **Cumulative Study Area** Wildlife would be temporarily disturbed during the period of mine operations due to increased noise level.	Predicted noise level at ranch residence is 52 dBA.	No effect.	Predicted noise levels at ranch residence is 61 dBA.	Predicted noise level at ranch residence is 53 dBA.	**Permit Area** Same as Proposed Action. **Cumulative Study Area** Same as Proposed Action.	No effect.	No effect.

TABLE 2-4
SUMMARY OF COMPARISON BETWEEN THE PROPOSED ACTION AND ALTERNATIVES

Chapter 3.0

AFFECTED ENVIRONMENT

CHAPTER 3.0 - AFFECTED ENVIRONMENT

3.1 INVENTORY METHODS

This chapter contains an overview of the existing environmental resources in the Little Rock Mine project area. It also provides an explanation of the general methods used to gather and interpret baseline information for the affected environment of the Little Rock Mine cumulative and detailed study areas. In addition, it provides or refers to a number of technical data provided in response to the Data Adequacy Standards for the Little Rock Mine (BLM 1994).

The affected environment portions of this document describe the existing environmental resources that may potentially be affected by direct, indirect, and cumulative impacts associated with the implementation of the proposed action or alternatives. Baseline resource information was collected both within a cumulative study area and a detailed study area. For most resource issues, the cumulative analysis area includes all lands and resources within the California Gulch, Deadman Canyon, Whitewater Canyon, and Upper Mangas Creek watershed boundaries. The cumulative study area for socioeconomic resources includes all of Grant County and communities within a 100-mile radius of the project. For special status species, the cumulative area includes the entire range of affected species. The detailed study area is defined as the area of most probable direct impact resulting from the implementation of the proposed action or alternatives. The permit area has been defined to include the detailed study area, with the exception of the area directly impacted by the proposed haul road and alternatives.

In accordance with the NEPA regulations 40 CFR 1502.15, the affected environment sections discuss the conditions in the human and natural environment which could potentially be affected, beneficially and adversely, by the proposed alternatives. In addition, resources or project elements which are subject to statutory or regulatory requirements are described. The resources studied in detail include:

- Earth Resources
  - geology
  - seismicity
  - soils

- Water Resources
  - surface water
  - ground water
  - water chemistry

- Biological Resources
  - vegetation
  - terrestrial wildlife
  - aquatic wildlife
  - special status species (plants and animals)

- Land Use, Transportation, Recreation, and Range
  - existing and planned land use
  - transportation and access
  - developed and wildland recreation
  - livestock grazing and range

- Socioeconomics
  - population and employment
  - regional economic status

- Visual Resources
  - landscape character
  - compliance with existing agency management guidelines

- Cultural Resources
  - archaeological and historical sites
  - special status cultural resources
  - traditional cultural places

- Noise and Air Quality

Data were collected and analyzed from January through June 1995 by review of existing documentation, consultation with various individuals and agencies, and field reconnaissance for some of the environmental components. Secondary information reviewed during the inventory phase of the project included Forest Service and BLM resource management plans; existing state, county, and city plans; and other documents prepared by agencies and organizations having jurisdiction over lands and resources within the study areas. Chapter 5 contains a list of the individuals and agencies contacted during the preparation of this document.

3.2 EARTH RESOURCES

3.2.1 Soils

The soils in the project area have been mapped by the Natural Resources Conservation Service (formerly SCS) and Forest Service and are presented in the Soil Survey of Grant County, New Mexico—Central and Southern Parts (SCS 1983). Soil classifications are mapped on Figure 3-1 (in pocket at end of document). The soils units in the immediate vicinity of the proposed pit include Santa Fe-Rock outcrop complex with 20 to 45 percent slopes and Santana loamy sand with 15 to 25 percent slopes. The other map unit in the proposed pit area is the Pits-Leach Stockpiles-Disturbed Land unit which includes the USNR leach stockpiles and mine waste remaining from earlier mining operations at the site. Tables 3-1 and 3-2 present physical and chemical data on these soil map units, as well as other units mapped within the project study area boundary.

TABLE 3-1
PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS (Part 1)

Map Unit	Soil Name	Texture	Slope	Rock and Gravel (% volume)	Clay %	Depth to Bedrock (inches)	Organic Matter %	Erosion Hazards	
								Water	Wind
15	Gaddes	gravelly sandy loam, gravelly sandy clay loam, gravelly clay loam	15 to 45	0 to 25	25 to 35	20 to 40; typically weathered bedrock at 22	1 to 3	moderate	high
	Santa Fe	gravelly sandy loam, very gravelly loam, very gravelly clay loam	15 to 45	0 to 10	15 to 35	8 to 20; typically weathered bedrock at 18	—	moderate	high
	Rock outcrop	—	15 to 45	—	—	—	—	—	—
25	Lonti gravelly loam	gravelly loam, gravelly clay loam, gravelly sandy clay loam	15 to 35	0 to 5	20 to 50	>60	1 to 2	moderate	moderate
26	Lonti gravelly clay loam	gravelly clay loam, clay, gravelly sandy loam	0 to 8	0 to 5	10 to 65	>60	1 to 2	moderate	moderate
33	Manzano loam	loam, clay loam	1 to 3	0	10 to 34	>60	2 to 3	slight	moderate
42	Paymaster gravelly sandy loam	gravelly sandy loam, fine sandy loam, very fine sandy loam, sandy loam	3 to 15	0	5 to 18	>60	3 to 4	moderate	high

TABLE 3-1
PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS (Part 1)

Map Unit	Soil Name	Texture	Slope	Rock and Gravel (% volume)	Clay %	Depth to Bedrock (inches)	Organic Matter %	Erosion Hazards	
								Water	Wind
46	Pits-Leach Stockpiles - Disturbed Land	—	—	—	—	—	—	—	—
55	Ruidoso clay loam	clay loam, clay	3 to 5	0	30 to 45	>60	—	moderate	moderate
60	Santa Fe	gravelly sandy loam, very gravelly loam, very gravelly clay loam	20 to 45	0 to 10	15 to 35	8 to 20; typically weathered bedrock at 16	—	moderate	high
	Rock outcrop	—	20 to 45	—	—	—	—	—	—
62	Santana loamy sand	loamy sand, gravelly loam, sandy clay loam, loam	15 to 25	0 to 10	15 to 30	4 to 18; typically unweathered bedrock at 13	1 to 2	—	—
63	Santana	loam, gravelly loam, sandy clay loam, loam	1 to 25	0 to 10	10 to 30	4 to 18; typically unweathered bedrock at 12	1 to 2		
	Rock outcrop		1 to 25	—	—	—	—	—	—
77	Lithic Haploborolls, loamy, mixed, warm	sandy loam, gravelly sandy loam, gravelly loamy sand	1 to 15	0 to 18	—	10; weathered granite bedrock	—	slight	slight

TABLE 3-1
PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS (Part 1)

Map Unit	Soil Name	Texture	Slope	Rock and Gravel (% volume)	Clay %	Depth to Bedrock (inches)	Organic Matter %	Erosion Hazards	
								Water	Wind
78	Lithic Haploborolls, loamy, mixed, warm	sandy loam, gravelly sandy loam, gravelly loamy sand	15 to 40	0 to 30	—	10; weathered granite bedrock	—	moderate to high	slight
79	Lithic Haploborolls, warm	stony sandy loam, gravelly sandy loam, gravelly sandy clay loam	40 to 80	0 to 45	—	15; weathered granite bedrock	—	high	slight
83	Lithic Haplustalfs, loamy-skeletal, mixed, mesic	very gravelly sandy loam, very cobbly sandy loam, very cobbly sandy clay loam	15 to 40	5 to 45	—	18; weathered granite bedrock	—	moderate	slight
	Lithic Haplustolls, loamy-skeletal, mixed, mesic complex, moist	very gravelly sandy loam	15 to 40	15 to 60	—	10; granite bedrock	—	moderate	slight
85	Lithic Ustorthents, loamy-skeletal, mixed, nonacid, mesic	very gravelly sandy loam	40 to 80	20 to 70	—	10; highly weathered granite bedrock	—	moderate to high	slight

TABLE 3-1
PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS (Part 1)

Map Unit	Soil Name	Texture	Slope	Rock and Gravel (% volume)	Clay %	Depth to Bedrock (inches)	Organic Matter %	Erosion Hazards	
								Water	Wind
85 (continued)	Typic Ustorthents, loamy-skeletal, mixed, nonacid, mesic complex, moist	very gravelly sandy loam	40 to 80	20 to 60	—	20 to 60; weathered granite, rhyolite or gneiss bedrock	—	moderate to high	slight

Source: SCS 1983

TABLE 3-2
PHYSICAL AND CHEMICAL PROPERTIES OF SOILS (Part 2)

Map Unit	Soil Name	pH	Sodium Adsorption Ratio (SAR)	Electrical Conductivity (Mmhos/cm)	Permeability (in/hr)	Available Water Capacity (in/in)	Subgroup Classification
15	Gaddes Santa Fe Rock outcrop	6.1-7.3 6.1-7.8 —	—	<2 <2 —	0.2-0.6 0.6-0.2 —	0.07-0.13 0.07-0.13 —	Ustollic Haplargids Lithic Argiustolls —
25	Lonti gravelly loam	6.1-8.4	—	<2	0.06-0.6	0.10-0.16	Ustollic Haplargids
26	Lonti gravelly clay loam	6.6-8.4	—	<2	0.06-0.6	0.09-0.16	Ustollic Haplargids
33	Manzano loam	6.6-8.4	—	<2	0.2-2.0	0.16-0.21	Cumulic Haplustolls
42	Paymaster gravelly sandy loam	7.4-8.4	—	<2	2.0-6.0	0.08-0.15	Cumulic Haplustolls
46	Pits-Leach Stockpiles - Disturbed Land	—	—	—	—	—	—
55	Ruidoso clay loam	6.6-8.4	—	<2	0.06-0.2	0.14-0.21	Pachic Argiustolls
60	Santa Fe Rock outcrop	6.1-7.8 —	—	<2 —	0.6-6.0 —	0.07-0.13 —	Lithic Argiustolls —
62	Santana loamy sand	6.1-7.8	—	<2	0.6-6.0	0.07-0.15	Lithic Haplustolls
63	Santana Rock outcrop	6.1-7.8 —	—	<2 —	0.6-2.0 —	0.12-0.18 —	Lithic Haplustolls —
77	Lithic Haploborolls, loamy, mixed, warm	6.4-6.8	—	—	2.0-6.0	0.06-0.17	Lithic Haploboralls
78	Lithic Haploborolls, loamy, mixed, warm	6.4-6.8	—	—	2.0-6.0	0.06-0.17	Lithic Haploboralls

TABLE 3-2
PHYSICAL AND CHEMICAL PROPERTIES OF SOILS (Part 2)

Map Unit	Soil Name	pH	Sodium Adsorption Ratio (SAR)	Electrical Conductivity (Mmhos/cm)	Permeability (in/hr)	Available Water Capacity (in/in)	Subgroup Classification
79	Lithic Haploborollis, warm	6.2-6.5	—	—	0.6-2.0	0.6-0.17	Lithic Haplustalfs
83	Lithic Haplustalfs, loamy-skeletal, mixed, mesic	7.5-7.8	—	—	0.2-0.6	0.06-0.17	Lithic Haplustalfs
	Lithic Haplustolls, loamy-skeletal, mixed, mesic complex, moist	6.0-6.6	—	—	2.0-6.0	0.06-0.17	Lithic Haplustolls
85	Lithic Ustorthents, loamy-skeletal, mixed, nonacid, mesic	6.0	—	—	2.0-6.0	0.06-0.17	Lithic Ustorthents
	Typic Ustorthents, loamy-skeletal, mixed, nonacid, mesic complex, moist	5.4-6.2	—	—	2.0-6.0	0.06-0.08	Typic Ustorthents

Source: SCS 1983

The Santa Fe-Rock outcrop complex with 20 to 45 percent slopes occurs on hills, mountains, and ridges. This unit is about 55 percent Santa Fe gravelly sandy loam and 25 percent rock outcrop. The Santa Fe soil is shallow and well drained, and formed in residuum derived dominantly from igneous rock. Typically the surface layer is a 2-inch-thick, dark brown gravelly sandy loam. The subsoil is a 14-inch-thick, dark brown very gravelly loam and very gravelly clay loam. Bedrock of weathered igneous rock is typically at a depth of about 16 inches. Permeability is moderate (0.6 to 2.0 inches per hour) while the available water capacity is very low (0 to 3.5 inches). The effective rooting depth is 8 to 20 inches. Runoff is medium and the hazard of water erosion is moderate. The hazard of soil blowing is high. Rock outcrop consists of barren or nearly barren exposures of granite bedrock. Native vegetation in this unit is mainly piñon-juniper and grasses.

The Santana loamy sand with 15 to 25 percent slopes is a shallow, well drained soil that occurs on hills. It is formed in residuum derived dominantly from granite. Typically the surface layer is about 6 inches thick and consists of dark grayish brown loamy sand. The approximately 7-inch-thick substratum is grayish brown loam. Granite bedrock occurs at a depth of about 13 inches. Permeability of the Santana soil is moderate (0.6 to 2.0 inches per hour), while the available water capacity is very low (0 to 3.5 inches). The effective rooting depth is 4 to 16 inches. Runoff is medium and the hazard of water erosion is moderate. The hazard of soil blowing is very high. The native vegetation is mainly ponderosa pine and piñon. Trees are subject to windthrow or uprooting because of the limited rooting depth.

Haul Road Alternatives B (Proposed Action) and C would cross Santa Fe-Rock outcrop complex as well as Gaddes-Santa Fe-Rock outcrop complex, Lonti gravelly loam (15 to 35 percent slopes), Lonti gravelly clay loam (0 to 8 percent slopes), Paymaster gravelly sandy loam, and a small area of Manzano loam (1 to 3 percent slopes). Deadman Canyon crosses primarily Santa Fe-Rock outcrop complex and some smaller areas of Paymaster gravelly sandy loam. The upper portions of Deadman Canyon on the Forest Service portions of the project area, also include Lithic Haploboralls, Lithic Haplustalfs-Lithic Haplustolls, and Lithic Ustorthents-Typic Ustorthents. California Gulch crosses Lithic Haploborolls, Lithic Haplustalfs-Lithic Haplustolls, Santana loamy sand, and Santa Fe-Rock outcrop complex. The physical/chemical properties and additional information for these soils are presented in Tables 3-1 and 3-2.

Within the project area, several soils are subject to high wind and/or water erosion. These soils, when disturbed (or vegetation is removed), may have significant increases in soil erosion rates. The soils within the project area that have high wind and/or water erosion hazard potential include Gaddes-Santa Fe-Rock outcrop, Paymaster gravelly sandy loam, Santa Fe-Rock outcrop, Lithic Haploborolls (15 to 40 percent slope), Lithic Haploborolls (40 to 80 percent slopes), and Lithic Ustorthents-Typic Ustorthents. These soils cover the majority of the project area so soil erosion rates may increase as a result of disturbance.

3.2.2 Geology and Minerals

Geologic Setting

Lithology and Structure

The Little Rock copper deposit is located along the northeastern flank of the Big Burro Mountains. Figure 3-2 (in pocket at end of document) presents a simplified geologic map of the Little Rock Mine and vicinity, and a cross-section from north to south through the proposed pit area. Geologic characterization of the region through surface mapping and subsurface exploration has been performed (Kolessar 1982, 1994; Phelps Dodge, unpublished). The rocks and sediments exposed in the area are primarily igneous and sedimentary ranging from Precambrian to Quaternary in age. The study area as defined in this report consists of four major geologic units:

- **Pc - Precambrian Rocks** - Composed primarily of granite with lesser amounts of other alkaline igneous rocks. This unit forms the majority of the Burro Mountain batholith complex. In the vicinity of the Little Rock ore body, these rocks have been altered by weathering and hydrothermal activity and are host rock to economic grade copper ore.

- **Tqm (Tqmd) - Tertiary Intrusive Rocks** - Composed of quartz monzonite porphyry intrusives (Tqm) and dikes (Tqmd) that crosscut the Precambrian granite and are younger than the primary mineralization and the Tyrone stock. The stock crops out about 2,000 feet east of the project area, and occurs within the southern portion of the site.

- **Tgc - Gila Conglomerate** - The Gila Conglomerate, Miocene in age, outcrops north of the mineralized area. The conglomeratic unit dips 15 to 20 degrees to the northeast and consists primarily of locally derived granitic and monzonitic rocks. It has been reported to be up to 3,000 feet thick (Trauger 1972). Caliche formation is common. The base of the conglomerate is locally cemented by iron oxides which is host to anomalous copper mineralization.

- **Qal - Quaternary Alluvium** - Composed of unconsolidated alluvium deposited in stream channels and basins. Its thickness varies from approximately 0 to 70 feet.

Geologic mapping of the Little Rock Ore body and nearby Tyrone Mine area reveal several fault systems characterized by high angle faults exhibiting some normal component of movement. Displacement of rocks by these faults has produced horst and graben structures. Field evidence suggests the occurrence of subsequent episodic movement along these fault systems as late as Quaternary in age.

Mineralization at Little Rock

The emplacement of copper-bearing minerals in the Little Rock area appears in Figure 3-2. The majority of copper mineralization occurs within and surrounding a steeply dipping mineralized zone trending approximately north 70 degrees east. Primary economic copper deposits are present in Precambrian Granite. This area is hereafter referred to as the Little Rock mineralized zone.

The ore body consists of copper oxide minerals that overlie primary sulfide minerals at depth. Unaltered primary sulphide minerals consist of pyrite and chalcopyrite, with average grades of up to 0.1 percent copper. The economic ore body consists predominantly of copper oxide mineralization that grades 0.15 to 0.70 percent copper. The primary copper oxide mineral is chrysocolla, with minor malachite, and traces of neotocite and native copper. Ore minerals in the oxidized zone occur along fractures, veinlets, and as disseminations within the rock.

The oxide/sulfide boundary varies with elevation throughout the site. Evidence from drilling and core logging indicate the boundary to be approximately 200 feet below ground surface (bgs) at the west end of the mineralized zone and more than 1,000 feet at the east end. The slope direction of this boundary is only a general measure, since the oxide/sulfide boundary undulates and can vary significantly from hole to hole. A transition zone from oxide to sulfide minerals ranges from 5 to 50 feet.

Although the mineralized zone is still being evaluated, it appears the ore body is approximately 4,500 feet long, 1,200 feet wide, and is up to 1,000 feet thick.

Ore Genesis Model

Mineralization in the Little Rock area appears to be structurally controlled. It is believed that the primary mineralization occurred by the emplacement of hot fluids ascending from a source intrusive at depth. These fluids penetrated the more permeable fractured zones, and as the fluid cooled, sulfide minerals such as pyrite and chalcopyrite were precipitated. This process is known as hypogene mineralization.

The presence of the economic grade copper mineralization assemblage of chrysocolla and malachite and associated iron oxides is due to a weathering related phenomenon known as supergene oxidation and enrichment. This process occurs as descending surface water oxidizes the hypogene minerals (chalcopyrite and pyrite), and forms sulfuric acid, which if present in significant quantity transports the copper downwards. If the acid generated is relatively low, the copper is not significantly mobilized and the copper sulfide minerals are oxidized in place to form chrysocolla and malachite.

Mineral Reserves

Evidence from exploratory borings at Little Rock suggests there are approximately 100 million tons of leachable material of economic grade ore. At present, the amount of recoverable copper is being evaluated.

Historic Mine Workings

There has been a long history of mining in the Little Rock area. Turquoise was mined by native peoples for hundreds of years, and the Spanish mined copper as early as 1801 in Santa Rita. The first recorded mining at the project site occurred in the 1890s and consisted of underground copper mining at the Ohio, Two-Best-in-Three, Little Rock, and Nellie Bly mines. This led to the patenting of some claims.

Fluorspar mining in the California Gulch area resulted in a second group of patents. In addition to these, unpatented claims were mined for copper in the 1900s as late as the 1960s. The remnants of these activities can still be seen today as shafts, adits, and dams on surface water courses.

USNR leased the Little Rock property in 1970. Their exploration and mining program resulted in the removal of approximately 1,000,000 tons of copper ore and 660,000 tons of waste rock, creating an open pit within the California Gulch drainage. The ore was stockpiled along California Gulch south of the pit and along the Deadman Canyon drainage and leached with over 30 million pounds of a sulfuric acid solution over the following two years. This method failed to produce copper in quantities large enough to economically benefit USNR, and the site was abandoned in 1972. These activities have resulted in extensive surface disturbances at the project site and is a suspected source of local surface water and ground water impacts.

Seismicity

Seismic activity in New Mexico generally occurs along the Rio Grande rift, primarily extending from Socorro northward to the Los Alamos area. Additional seismic events are associated with the San Juan Basin and the Jemez lineament in the Colorado Plateau region, and within the Datil-Mogollon volcanic field of southwest New Mexico. The proposed mine is located in the Basin and Range physiographic province which is typified by low seismic activities and long recurrence intervals. The Datil-Mogollon volcanic field is located to the north of Tyrone. Earthquake magnitudes in the region have typically been less than 4. There are several northwest-southeast trending faults in the area between Silver City and Lordsburg with known displacement during the Quaternary; the age of youngest known displacement is less than 500,000 years. Based on historic earthquake activity, surface rupture patterns, and an evaluation of geologic evidence, a maximum magnitude earthquake of 7.3 has been determined for the area including the proposed Little Rock Mine project (Algermissen and others 1982; Nakata and others 1982; Sanford and others 1981).

3.3 WATER RESOURCES

3.3.1 Hydrometeorology

The sources of climatological data for the project area include data collected at several sites within the Tyrone Mine, and several stations supervised by the U.S. National Oceanographic and Atmospheric Administration. The most representative stations, and their data, are discussed below, for each type of data collected. Detailed summaries of precipitation and temperature data are included in the *Surface Water Hydrology Technical Report.* (Note that the precipitation and temperature information presented in this section differs slightly from that presented in Section 3.9, "Air Quality and Climatology" since the information sources used are necessarily different.)

Precipitation

Annual rainfall has varied between 8.3 inches and 25.8 inches, with averages between 17.3 and 20.6 inches for sites with complete data records. Rainfall distribution throughout the year shows average monthly rainfall to be roughly an inch or less for March through June, approximately 1.5 to 2 inches during September through December, and peaking during July and August with averages between 2.5 and 3.7 inches.

The elevation within the Deadman Canyon watershed varies between 8,020 feet and 5,620 feet (regional rainfall is strongly influenced by elevation). The nearest, most representative gages are those at White Signal (elevation 6,068 feet), Fort Bayard (elevation 6,142 feet), Pinos Altos (elevation 7,005 feet), and Silver City (elevation 5,919 feet). These gages, because of their longer record lengths than those of the mine gages, are primarily useful in estimating extreme storms, and are discussed in more detail with respect to the derivation of flood flows in the technical report.

Temperature

Daily maximum and minimum temperatures have been collected at the mine vicinity since 1982. For the site, average daily low temperatures are slightly below freezing (32 degrees Fahrenheit) during the months of November through February. Average maximum temperatures year round exceed freezing. Summer maximum temperatures in July and August average in the high 80s.

Evaporation

Daily pan evaporation data for the Little Rock vicinity are summarized in the *Surface Water Hydrology Technical Report* available for review in the Las Cruces BLM District office. The average annual evaporation is about 92 inches per year. The peak average monthly evaporation occurs in June (14.2 inches), while the lowest average monthly evaporation occurs in December-January (2.7 to 2.8 inches). Average evaporation exceeds average monthly rainfall for all months of the year.

3.3.2 Surface Water

General Watershed Characteristics

The proposed project is located in the southwest mountain region of New Mexico. Three watersheds are potentially affected by the proposed action—Whitewater Canyon, California Gulch and Deadman Canyon. The primary hydrological characteristics of the site are summarized in Table 3-3. Several springs are located within the watersheds, and are sited in Figure 3-3 (in pocket at end of document). Springs located in the watershed are generally very small and produce a surface expression for only very short distances. Springs do not create a significant contribution to any of the three watersheds.

TABLE 3-3 WATERSHED DATA SUMMARY			
	Watershed		
	Whitewater Canyon	California Gulch	Deadman Canyon
Basin Area (mi^2)	4.05	1	6.21
Area in Proposed Pit (mi^2)	0.06	0.12	0.09
Basin Area minus Pit Area (mi^2)	3.99	0.88	6.12
Area Upstream of Pit (mi^2)	N/A	0.79	N/A
Area Downstream of Pit (mi^2)	N/A	0.09	N/A
Maximum elevation (ft)	8,020	6,760	8.020
Outlet elevation (ft)	5,620	5,620	5,620
Hydrologic Soil Type Type B Type C Type D	 2% 82% 16%	 71% 29%	 63% 37%
Average channel slope, entire basin	6.0%	5.6%	7.0%
Estimated lag time (hrs), entire basin	1.29	1.0	1.4
N/A: not applicable Source: Dames & Moore 1995			

The sources of surface water data are limited for the site, as no continuous gaging has been performed on any of the mine natural watercourses. Estimates of peak runoff, average runoff, and seasonal flow changes necessarily were derived from other regional data, empirical relations, and modeling. Detailed derivations for the estimates provided below are presented in the *Surface Water Hydrology Technical Report.*

Flood Flows

The estimated flow from a 100-year, 24-hour storm, using hydrologic modeling (HEC-1) is 1,400 cubic feet per second (cfs) for Deadman Canyon, 889 cfs for Whitewater Canyon, and 319 cfs for California Gulch. This flow is based on an estimated 100-year, 24-hour rainfall of 3.69 inches.

For comparison purposes, the estimated 100-year floods using regional empirical equations are 2,333 cfs for Deadman Canyon, 1,930 cfs for Whitewater Canyon, and 1,005 cfs for California Gulch. Estimated extreme floods for other return periods are summarized in Table 3-4. Due to the use of site specific basin/rainfall information used in developing the HEC-1 Model, the results from the model are considered more accurate than results from empirical equations.

TABLE 3-4
ESTIMATED EXTREME FLOODS USING EMPIRICAL RELATIONS DERIVED FROM REGIONAL FLOW DATA

	Whitewater Canyon	Deadman Canyon	California Gulch
Area (mi^2)	4.05	6.21	1.00
Peak Elevation (ft)	8,020	8,020	6,760
Low Elevation (ft)	5,620	5,620	5,620
Average Elevation (ft)	6,820	6,820	6,190
Mean minimum Jan Temperature	22.7	22.7	22.7
From *Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States (USGS OFR 93-419) (1994)*			
Recurrence Interval	**Flowrate (cfs)**		
2-year	109	141	55
5-year	335	420	173
10-year	691	842	361
25-year	1,109	1,351	581
50-year	1,487	1,811	779
100-year	1,930	2,352	1,010
From *Techniques for Estimating Flood-flow Frequency for Unregulated Streams in New Mexico (1986)*			
Recurrence Interval			
2-year	346	383	247
5-year	689	764	493
10-year	1,005	1,114	719

Mean Annual Runoff

The estimated mean annual stormwater runoff, using "Average Annual Runoff in the United States 1951-1980" (U.S. Geological Survey [USGS], 1987), is about 0.4 inch/year. Using synthetic streamflows generated using the White Signal gage (1951-1993) rain data, the estimated mean annual stormwater runoff is about 0.27 inch. Distribution of this 0.27 inch over the year for each watershed and the estimated stormwater flow duration relationships, by month, for the three watersheds are presented in the *Surface Water Hydrology Technical Report.*

Erosion and Sedimentation

The channels in question have alluvial, sandy beds and are subject to natural geomorphic changes (erosion, deposition, meandering, gullying). The channels are also subject to externally induced changes if baseline conditions are altered. Data characterizing the suspended sediment loads and bed sediment load are not available for the studied watersheds. Thus, the baseline for channel erosion and sedimentation within the studied watersheds is best reflected in the existing geomorphic characteristics for the basin. These characteristics include:

- Longitudinal profile (bed slope) of the channels. This profile has been derived from USGS maps for the study area, and is presented in tabular form in the *Surface Water Hydrology Technical Report.*

- Amount of runoff (annual, seasonal, extreme floods) delivered from drainage basin. Estimates of runoff for the drainage basins are presented in the preceding discussion within this section.

Erosion, and potentially gullying, will typically occur within the downstream portion of a channel reach whose bed profile is convex upwards (i.e., progressing from a relatively shallow to steep slope). This condition occurs naturally within the upper reaches. For example, from distance 27,500 feet to 27,350 feet, the slope steepens from a 5.7 percent grade to a 13.3 percent grade (refer to Table A-1 in the *Surface Water Hydrology Technical Report*). Some downcutting and gullying are evident within selected natural reaches of the studied watershed.

Surface Water Quality

Water Quality Standards

Surface water quality standards have been established by the New Mexico Water Quality Control Commission (NMWQCC) under "State of New Mexico Standards for Interstate and Intrastate Streams", pursuant to NMSA 1978, Section 74-6-4.C. Surface water standards have been set based on designated use of the resource. These standards have been established to ensure a safe supply of water to livestock, wildlife, and plants, and maintaining a quality that is not pathogenic to humans. Discussions with personnel of the New Mexico Environment Department Surface Water Quality Bureau reveal that the surface waters in the study area have been designated for Livestock Watering and Wildlife Habitat with its associated numeric standards as defined in Section 3-101 (K) and (L). Table 3-5 presents applicable standards that are relevant to the site. The numeric standard for mercury applies to the concentration present in both the suspended and dissolved states.

TABLE 3-5 APPLICABLE NMWQCC STANDARDS FOR INTERSTATE AND INTRASTATE STREAMS FOR LIVESTOCK WATERING AND WILDLIFE HABITAT	
Aluminum	5.0 mg/l
Arsenic	0.2 mg/l
Boron	5.0 mg/l
Cadmium	0.05 mg/l
Chromium	1.0 mg/l
Cobalt	1.0 mg/l
Copper	0.5 mg/l
Lead	0.1 mg/l
Total Mercury	0.01 mg/l
Selenium	0.05 mg/l
Vanadium	0.1 mg/l
Zinc	25.0 mg/l
Radium 226 + 228	30.0 pCi/l
Tritium	20,000 pCi/l
Gross Alpha	15 pCi/l
Source: State of New Mexico, Standards for Interstate and Intrastate Streams 1995	

<u>General Surface Water Quality</u>

Surface water samples were collected in the three watersheds in January and March 1995, and April 1996. For this study, the area has been divided as follows:

- California Gulch
- Deadman Canyon to confluence with Whitewater Canyon
- Whitewater Canyon including confluence with Deadman Canyon

Figures 3-3 and 3-4 (in pocket at end of document) display sampling locations for streams and seeps that were utilized to collect baseline information discussed in the following sections.

A detailed description of surface water quality, laboratory results, quality assurance/quality control (QA/QC), and interpretive diagrams are presented in a separate *Hydrogeologic Investigation Technical Report* available for review in the BLM Las Cruces District office. A summary of the water chemistry for each drainage is presented below and includes:

- major one or two cations and anions that make up the dissolved species
- range of values for total dissolved solids (TDS) and pH
- analytes which exceed NMWQCC standards, and possible source(s)

Table 3-6 provides a matrix for water quality along various stretches of each drainage and for seeps located adjacent to, or that flow into, drainages within the study area.

TABLE 3-6
SURFACE WATER CHEMISTRY FOR DRAINAGES AND SEEPS - 1994-1996

Drainage	Sample Locations	Water Type	Range of Values		Analytes Which Exceed WQCC Surface Water Standards
			TDS (ppm)	pH	
California Gulch	CG-1	Calcium-bicarbonate	204-206	7.60-7.90	None
	CG-2, OMP	Calcium-bicarbonate and sulfate	572-1,230	3.90-5.50	Aluminum and copper
	CLDS (seep)	Calcium-bicarbonate	5,680-6,710	3.79-3.80	Aluminum, cobalt, and copper
Deadman Canyon	DC-1, DC-3	Calcium-bicarbonate and sulfate	168-206	6.31-7.56	None
	DC-2, DC-4, DC-5	Calcium-bicarbonate and sulfate	198-518	5.29-7.39	Copper
	Seeps 2 lower and upper, 3 and 4	Calcium-sulfate	2,700-4,500	3.64-3.97	Aluminum, cobalt, and copper
	Seep 5, Seep 5E	Calcium-sulfate	420-1,800	3.90-6.36	Aluminum, cobalt, and copper
Whitewater Canyon	WWC-1	Calcium-bicarbonate	202-244	7.68-8.05	None
Confluence of Whitewater Canyon and Deadman Canyon	DCWC-1	Calcium-bicarbonate and sulfate	234-274	7.40-7.62	None

Source: Dames & Moore 1995; PDMC 1994

The primary contribution to base flow in the three drainages occurs at relatively high elevations, upgradient of the mineralized area. Thus, contributions to streamflow are of relatively good quality. Many of the analytes in surface water which exceed NMWQCC standards, such as aluminum, copper, cobalt, and manganese, appear to be due to past mining activities or naturally occurring outcrops of mineralization, where seeps with relatively high TDS water of low quantity contributes to the total makeup of surface water in the area.

California Gulch

Surface water samples within California Gulch include CG-1, CG-2, and OMP (see Figure 3-4). TDS and pH range from 204 to 1,230 parts per million (ppm) and 4.09 to 7.60 respectively, in January; and 206 to 776 ppm and 3.90 to 7.88, respectively, in March. Sample location CG-1 is upgradient of the mineralized zone and past mine workings and the surface water is of relatively good quality. TDS and pH values for CG-1 are 204 to 246 and 7.17 to 7.90, respectively, for samples collected in 1995 and 1996. CG-1 can be classified as a calcium-bicarbonate water. No analytes exceeded NMWQCC standards. Surface water samples from CG-2 and OMP possess elevated dissolved constituents, and appear to be the result of past mine activities along the gulch. TDS and pH values range from 572 to 1,230 ppm and 3.90 to 5.50 for January and March. These surface water samples are best described as calcium-bicarbonate + sulfate water. Both waters exceed standards for aluminum and copper.

A seep (CLDS) located at the toe of the existing USNR leach pile upgradient of CG-2 has been sampled several times over several years. It has consistently had elevated TDS and low pH results. Laboratory results of samples collected in January and March for TDS and pH are 5,680 and 6,710 ppm, and 3.79 and 3.80, respectively. This water contains very high sulfate concentrations (parts per thousands). It is likely that the cause for the quality of the seep is due to the application of sulfuric acid onto leach stockpiles by USNR during their operation of the mine. CLDS is best described as a calcium-sulfate water. It exceeds standards for aluminum, cobalt, and copper.

Deadman Canyon

Surface water samples collected along Deadman Canyon include DC-1 through DC-5 (see Figure 3-4). TDS and pH range from 180 to 348 ppm and 5.90 to 7.56, respectively, in January, and 168 to 518 ppm and 5.29 to 7.50, respectively, in March. The largest shift in TDS and pH occurs between DC-3 and DC-4. Deadman Creek is best classified as a calcium-bicarbonate + sulfate water.

Seeps to the east of Deadman Canyon sampled by Phelps Dodge personnel in 1994 indicate elevated concentrations of sulfate, certain heavy metals, such as copper, and low pH (see Figure 3-4). The low pH values create a water chemistry outside the stability field of bicarbonate and into carbonic acid. These seeps are a calcium-sulfate water. One stretch of seeps (Seeps 2 lower and upper, 3 and 4) lies between DC-1 and DC-2. The TDS and pH of these seeps range from 2,700 to 4,500 ppm and 3.64 to 3.97, respectively. The chemistry of these seeps may be influenced by past mine workings located adjacent on the hillslope. These seeps exceed standards for aluminum, copper, manganese, and occasionally cobalt. The water chemistry of Deadman Creek, based on sample DC-2, indicates that copper exceeds standards. There is an additional seep east of these seeps; however, laboratory results were not available at the time of this study.

There is another series of seeps between the tributary confluence with Deadman Creek and DC-4. These seeps (Seeps 5 and 5 East) have a TDS and pH that range from 420 to 1,800 ppm and 3.90 to 6.36, respectively, for samples collected in 1994. The chemistry of Deadman Creek along this reach exceeds the standard for copper. The seeps exceed standards for aluminum, copper, and occasionally cobalt.

The water chemistry between DC-4 and DC-5 is similar. This stretch also includes streamflow from California Gulch which has its confluence with Deadman Creek approximately one-half mile upstream of DC-5. Based on samples collected in January and March of 1995, copper exceeds standards along this reach.

Whitewater Canyon and Confluence with Deadman Creek

Whitewater Creek was sampled (WWC-1) at one point, just above its confluence with Deadman Creek (see Figure 3-4). TDS and pH values were 202 to 244 ppm and 7.68 to 8.05, respectively, in January and March of 1995. A sample collected below the confluence with Deadman Creek (DCWC-1) has a TDS and pH range from 234 to 274 ppm and 7.40 to 7.62, respectively, for January and March. This is a calcium-bicarbonate water. No standards were exceeded in these water samples.

3.3.3 Ground Water

Regional Hydrogeology and Ground Water Use

Ground water within the region occurs within Tertiary to Precambrian igneous rocks, Gila Conglomerate, and Quaternary Alluvium. The lithology and structural setting of these units are described in Section 3.2.

The igneous rocks in the region consist primarily of granitic rocks of Precambrian age, and quartz monzonite of Tertiary age. Regionally, yields from these bedrock complexes are normally 1 to 15 gallons per minute (gpm) (Trauger 1972).

The Gila Conglomerate is the principal aquifer in Grant County. The Gila Conglomerate consists of two members which are similar lithologically. The upper member is less consolidated than the lower member and can provide large yields in wells, up to 1,000 gpm. The more consolidated lower member is generally a very poor producer, with yields averaging less than 2 gpm.

Alluvium is generally thin to nonexistent except along surface water courses and inner valley areas. Yields from wells along perennial streams can be high, due to surface water recharge. However, wells completed in the alluvial valleys have wide seasonal fluctuations in water levels, and large yields cannot be sustained.

In general, depths to ground water are greater in the mountain areas than in the valleys. Ground water tends to move from the upland areas towards major valleys, and then along the direction of major valleys. Perched water layers can be found within the alluvium of some tributaries, at least seasonally.

Recharge to the regional aquifer primarily comes from infiltration of snowmelt and rainfall events through bedrock fractures. Recharge to the perched alluvial aquifer is seasonal and comes primarily through infiltration from surface waters. It is believed there is hydraulic communication between the perched and regional aquifers, and that recharge occurs from the alluvial to the regional aquifer, at least on a seasonal basis.

Ground water within the region is primarily used for domestic and mining purposes. In addition, the ranching and farming communities withdraw ground water for livestock and irrigation purposes.

Hydrogeology and Ground Water Use in the Project Area

The discussion of the hydrogeology of the project area is based on historic information provided by Phelps Dodge and studies performed by Dames & Moore. As part of the preparation of this EIS, Dames & Moore conducted a hydrogeologic investigation and water sampling program to evaluate existing hydrogeologic conditions and water quality in the study area. These objectives were met by performing the following tasks:

- installing seven monitor wells
- conducting an aquifer pump test
- measuring depth to water in new and existing wells, and collecting water samples from springs and from new and existing wells

A detailed discussion of the objectives, methods, and results are provided in a separate *Hydrogeologic Investigation Technical Report*. A summary of the findings as pertinent to this section is provided below.

Figure 3-4 presents the locations of monitor wells and springs used to evaluate existing hydrogeologic conditions in the study area. Seven newly installed wells, six existing wells, and four springs were used for gathering data.

Site Hydrogeology

The local water-bearing lithologic units for regional ground water are primarily Precambrian granite and Gila Conglomerate. Evidence from the drilling program reveals that ground water flow is controlled by secondary permeability such as fractures, joints, and faults. At most areas of the Little Rock site, quaternary alluvium is non-existent or occurs as a thin veneer over the Tertiary and Precambrian rocks. In the area of the Mangas Valley at the north end of the site, the alluvium is tens of feet thick, and harbors a perched water zone, characterized by porous flow in unconfined conditions.

Figure 3-5 (located in pocket at end of document), Ground Water Elevation, presents a piezometric surface for depth to water measurements collected on March 25-27, 1995. The regional ground water flow direction varies from north to northeast across the site. Depth to water varied from 20 feet to over 320 feet below ground surface and appears to be topographically controlled, with shallower depths found in the drainages, and deeper ground water depths found on the ridges. The resultant gradient from these measurements is approximately 0.06 ft/ft.

On March 24, 1995, an aquifer pump test was performed at monitor well LRW-3 located within Precambrian granite and in the approximate location of the proposed pit area to evaluate aquifer parameters. Water levels were measured while a constant rate discharge of 1.25 gpm was pumped for approximately two hours followed by nearly 14 hours of recovery. Resultant transmissivities for drawdown (Theis 1935) and recovery (Cooper and Jacob 1946) data are calculated to be approximately .006 ft^2/min and .007 ft^2/min, respectively. Storativity values could not be calculated due to the lack of response in water levels of nearby observation wells during the aquifer pump test.

Work has been performed at the Tyrone Mine to evaluate aquifer parameters within the regional aquifer. In December 1994, aquifer tests were conducted within the regional aquifer. Preliminary results suggest transmissivity and storativity values of .08 to .38 ft^2/min and .02 to .08, respectively (Daniel B. Stephens and Associates 1994, unpublished). Earlier studies show a large range in transmissivity (0.0003 - 2.2 ft^2/min) values (Dames & Moore 1986; Science Applications, Inc. 1981).

North of the proposed pit area there is a surface contact between Precambrian granite and Gila Conglomerate. In addition, at the northern edge of the site along Mangas Valley, the Quaternary alluvium contains a perched aquifer layer. Aquifer tests performed on the alluvium and Upper Gila resulted in a range of transmissivities from 0.01 - 5.8 ft^2/min (Science and Engineering Resources, Inc. 1977).

<u>Local Ground Water Use</u>

Phelps Dodge holds water rights in the Tyrone and Little Rock Mines area. No additional water rights would be needed to develop Little Rock into an open pit copper mine. The closest water users within the study area are the Burro Mountain Homestead (a trailer park located over two miles upgradient of the proposed pit area), a resident located approximately 3,000 feet north of the proposed mine pit, and a resident located approximately one-half mile east of the proposed pit near TWS-9 in Deadman Canyon.

Ground Water Quality

<u>Ground Water Quality Standards</u>

Ground water quality standards have been established by the State of New Mexico under the NMWQCC regulations pursuant to Chapter 74, Article 6 NMSA 1978, Water Quality Act. Numeric water quality standards are based on human health or aesthetic reasons. Table 3-7 lists relevant standards for ground water in New Mexico. In some cases, the State of New Mexico adopted the EPA's maximum

TABLE 3-7
APPLICABLE NMWQCC (AND USEPA) GROUND WATER STANDARDS

Parameter	NMWQCC	USEPA
Aluminum (i)	5.0	NS
Arsenic	0.1	0.05
Barium	1.0	1.0
Boron (i)	0.75	NS
Cadmium	0.01	0.01
Chloride (a)	250	250
Chromium	0.05	0.05
Cobalt (i)	0.05	NS
Copper (a)	1.0	1.0
Fluoride	1.6	4.0
Gross Alpha (pCi/L)	NS	15
Gross Beta (pCi/L)	NS	50
Iron (a)	1.0	0.3
Lead	0.05	0.05
Manganese (a)	0.2	0.05
Mercury	0.002	0.002
Molybdenum (i)	1.0	NS
Nickel (i)	0.2	NS
pH (units) (a)	6-9	6.5-8.5
Radium (226 and 228; pCi/L)	30.0	5
Selenium	0.05	0.01
Silver	0.05	0.05
Sulfate (a)	600	250
TDS (a)	1000	500
Uranium	5.0	NS
Zinc (a)	10.0	5

* All units are mg/L unless otherwise specified. All standards listed are based upon health concerns except for the parameters followed by (a) aesthetic standard or (I) irrigation standard.

Source: State of New Mexico Water Quality Control Commission Regulations 1978 NS = No standard contaminant levels (MCL), and in others established a separate MCL; all MCLs are enforceable under the NMWQCC regulations. The purpose of this section is to present the ground water chemistry of the study area.

General Ground Water Quality

The water quality data used to evaluate ground water chemistry include samples collected in 1995 and 1996 from new and existing wells and springs, and water samples collected by Phelps Dodge in 1992 and 1994. A detailed description of ground water quality, laboratory results, QA/QC, and interpretive diagrams are presented in the *Hydrogeologic Investigation Technical Report.*

Certain ground water samples collected from sources for this project exceed the standards for several parameters, and appear to be associated with natural processes and/or past mining activities. In general, ground water in the study area varies from a calcium-bicarbonate type water to a calcium-bicarbonate and sulfate type water. Ground water samples from wells that do not appear to be affected by past activities occasionally exceed standards for chromium, manganese, copper, sulfate, and fluoride. Ground water samples from wells that may be affected by past mining activities often exceed standards for several metals, fluoride, sulfate, pH, and TDS.

Ground Water Analyses

Table 3-8 presents a summary of laboratory analyses for ground water samples collected from new wells, existing wells and springs for this study, and from water samples collected from Wells 26, 27, and P-3 by Phelps Dodge during 1994. For purposes of this discussion, the study area is divided as follows:

- area upgradient of the Little Rock mineralized zone in relatively nonmineralized Precambrian granite, and mineralized and nonmineralized quartz monzonite porphyry
- area within the Little Rock mineralized zone
- area downgradient of the mineralized zone within the Gila Conglomerate

Ground Water Upgradient of Little Rock Mineralized Zone

Ground water samples collected from this area include wells LRW-5, 6-1, TWS-8, and TWS-9, and springs TWS-7 and Mud Spring. All of these sources, with the exception of TWS-9 and 6-1, are upgradient of past or present mine activities and not believed to be within any known mineralized areas. Well TWS-9 is downgradient of leach piles from past mining activities, and 6-1 is located within the Tyrone stock (mineralized quartz monzonite porphyry). In general these waters appear to be primarily calcium-bicarbonate water with total dissolved solids ranging from 112 to 520 ppm, and pH ranging from 6.80 to 7.60. In monitor well 6-1, in addition to calcium and bicarbonate, sulfate appears to contribute to the overall water signature.

TABLE 3-8 GROUND WATER CHEMISTRY FROM WELLS AND SPRINGS 1995-1996					
Area	Sample Locations	Water Type	Range of Values		Analytes Which Exceed WQCC Standards
			TDS (ppm)	pH	
Upgradient of LR Mineralized Zone	LRW-5, 6-1, TWS-8, TWS-7, and Mud Springs	Calcium-bicarbonate and sulfate	112-520	6.80-7.60	Chromium and fluoride
	TWS-9	Calcium-bicarbonate	156	7.00	Chromium
LR Mineralized Zone-Unimpacted	LRW-2, LRW-3, LRW-7, and Sugarloaf Spring	Calcium-bicarbonate and sulfate	430-808	7.00-7.90	Chromium and manganese
Impacted	LRW-1, LRW-4	Calcium-sulfate and bicarbonate	1,160-3,740	5.82-7.23	TDS, fluoride, sulfate, chromium, cobalt, copper, iron, manganese, nickel, and pH
Downgradient of LR Mineralized Zone	LRW-6, 26, 27, P3, McCain Spring	Calcium-bicarbonate and sulfate	150-594	5.30-7.61	Copper, manganese, and pH

In this area, the analytes that exceed state or federal ground water standards are chromium in TWS-9, and chromium and fluoride for 6-1.

Ground Water Within Little Rock Mineralized Zone

Samples collected during 1995 and 1996 from this area are monitor wells LRW-1, 2, 3, 4, 7, and Sugarloaf Spring (see Figure 3-4). TDS and pH range from 430 to 3,740 ppm and 5.82 to 7.90, respectively. Of these wells, LRW-1 and 4 were placed in locations to assess possible impacts from past mining activities. If these two sources are deleted, the range of TDS and pH from the remaining three wells are 430 to 808 ppm and 7.10 to 7.90, respectively. With the exception of LRW-7, this appears to be a calcium-bicarbonate water. Monitor well LRW-7 contains elevated sulfate relative to the other wells in this group. Of LRW-2, 3, and 7 only LRW-7 has parameters exceeding standards (chromium and manganese).

The source of the elevated signature of the ground water collected from LRW-7 is not known. It is offgradient of past mining activities, and occurs in a highly mineralized zone. Although it has elevated dissolved constituents, it only exceeds NMWQCC standards for chromium and manganese, which appear to occur naturally elevated elsewhere in the study area.

The TDS and pH values in LRW-1 and 4 are 1,160 to 3,740 ppm and 5.82 to 7.23, respectively. It appears there have been impacts from existing leach piles near LRW-4. The source of elevated concentrations in ground waters in LRW-1 may also be due to surface water flow through California Gulch from the leach stockpiles adjacent to LRW-4. The signature of the waters reveal that sulfate and calcium are major contributors to increased TDS values, often accompanied by lowering of pH values. Other available ions, such as copper, also increase in ground water near impacted areas. These impacts result in the signature of this water being calcium-sulfate + bicarbonate water, with the major anion being sulfate. These two wells exceed standards for TDS, fluoride, sulfate, and several heavy metals, and LRW-4 also exceeds standards for pH.

Ground Water Quality Downgradient of Mineralized Zone

A selection of monitor wells sampled in this region are completed within the Gila Conglomerate north of the granite intrusion. Samples collected during 1995 and 1996 include monitor wells LRW-6, 26, 27, P-3, and McCain Spring. Laboratory results from these sources have a range of TDS and pH of 150 to 594 ppm and 5.30 to 7.61, respectively (see Figure 3-4). In general, the water quality is good. McCain Spring has a relatively low pH of 5.30 which is not within standards, but also has low TDS and sulfate values of 290 and 22.7 ppm, respectively. Ground water from these wells tends to exceed standards for copper and manganese.

3.4 BIOLOGICAL RESOURCES

3.4.1 Overview

The following section describes biological resources including vegetation types, associated wildlife, and special status species that are known or have the potential to occur in the vicinity of the Little Rock Mine. Impacts to native vegetation at the Little Rock Mine from past mining activities range from relatively minor disturbances to denuded habitat. General habitat characteristics appear relatively intact in areas where no mining activity has occurred. Approximately 20 percent of the detailed study area has been disturbed from previous mining activities including approximately 35 percent of the proposed mine pit itself. The project area is characterized by a mix of woodland and grassland vegetation types and is traversed by several ephemeral drainages which support very limited riparian vegetation.

3.4.2 Methods

Information on biological resources likely to occur at the Little Rock Mine was largely obtained from existing data sources including agency data, regional publications, and reports. In addition to secondary data sources, a one-day site visit to the mine site was conducted on March 28, 1994 for completion of a mining operation site assessment per State of New Mexico MMD requirements (Dames & Moore 1994).

During that site visit and tour provided by Phelps Dodge, notes were kept on species of plants and wildlife observed at the mine, aerial photographs were examined, and non-structured interviews were conducted with several mine personnel. A two-day site visit was conducted by a Dames & Moore biologist and geologist, accompanied by a mine employee, on January 30-31, 1995 for completion of this document.

Secondary sources included species lists from and personal communications with USFWS, BLM, Forest Service, New Mexico Department of Game and Fish (NMDGF), New Mexico Natural Heritage Program, and a threatened and endangered floral and wildlife surveys conducted at the Tyrone site by the Metric Corporation (1993, 1996). Previous lists provided by the USFWS were reviewed and a request for an updated list of sensitive species which might occur at or near the mine was submitted (USFWS 1995a).

3.4.3 Vegetation Types

Brown and Lowe (1977) mapped the vegetation types in the vicinity of the Little Rock and Tyrone mines as semidesert grassland, interior chaparral, madrean evergreen woodland, and Great Basin conifer woodland with a small area of petran montane conifer forest a short distance west of the Tyrone Mine. The existing vegetation at the Little Rock Mine site is complex, an ecotonal mix of all these vegetation types as shown in Figure 3-6 (located in pocket at end of document). The species occurring or likely to occur in the vicinity of Little Rock Mine are presented in Appendix A, Table A-1. This table includes the common and scientific name of each species and the vegetation types with which each is most often associated.

The predominant woody vegetation at Little Rock Mine consists of a mix of netleaf oak, shrub live oak, alligator bark juniper, and piñon pine. Small stands of ponderosa pine (petran montane conifer forest) are present in canyons and on shaded north slopes. One stand occurs along California Gulch south of the proposed pit site. In addition to this set of large shrubs and small trees, a number of other shrubby species are present on the mine site and include rubber rabbitbrush, fairy duster, apache plume, desert willow, broom snakeweed, pale hackberry, mesquite, squawbush, and fourwing saltbush.

A prominent feature of the vegetative communities in the vicinity of the Little Rock Mine is the presence of a numerous species of grasses that dominate open areas and occur under the canopy of shrubs and trees. Semidesert grassland is potentially a perennial grass-scrub dominated landscape which is transitional between desertscrub at lower elevations and evergreen woodland or chaparral at higher reaches (Brown 1982). Species characteristic of semidesert grasslands include several species of grama grass along with three-awns, dropseeds, and representatives of several other genera as listed in Appendix A, Table A-1.

Several species of cacti, yuccas, and beargrass also contribute to the floral diversity of the Little Rock Mine site. Notable are individuals of sotol, beargrass, banana yucca, soaptree yucca, prickly pear, cholla, and hedgehog cactus.

Typically, riparian associations are structurally diverse; however, in the southwest these habitats are characterized by simple species composition when compared to those within less arid regions (Minckley and Brown 1982). Well-developed riparian areas do not exist within the permit area; however, some riparian habitat elements are present in the study area and are primarily characterized by individual or small stands of cottonwood and ash trees. Occurrence of these species is limited to canyon bottom locations in Deadman Canyon, California Gulch, and Whitewater Canyon, which are ephemeral drainages. No riparian areas exist within the proposed boundaries of the pit, and none occur in the area between the pit and Mangas Creek. Small groups of cottonwood occur along California Gulch, immediately upstream of the proposed pit site; along Whitewater Canyon, west of the proposed site; and along Deadman Canyon, southeast of the proposed site.

3.4.4 General Wildlife Species

Vegetation and associated wildlife species present at the Little Rock Mine reflect an ecotonal mix of several distinct plant communities. Existing wildlife habitats associated with the Little Rock Mine are largely upland, terrestrial habitats. Deadman Canyon, California Gulch, and Whitewater Canyon provide ephemeral aquatic habitats during spring snowmelt or following episodes of rainy weather.

Mammals

Based on a review of pertinent regional literature and an inventory performed for the NOI/Plan of Operation, the suspected mammalian fauna of the Little Rock Mine area is presented in Appendix A, Table A-2. Most of the mammals which may be present are small, nocturnal species of rodents (12 nocturnal species, 5 diurnal species) and bats that are unlikely to be observed without specific sampling efforts. Larger, often diurnal species include coyote, gray fox, mountain lion, black bear, desert cottontail, black-tailed jack rabbit, and two species of deer. Presence of these species and several others has been documented (Appendix A, Table A-2) by Metric Corporation (1993, 1996) and Dames & Moore (March 28, 1994 site reconnaissance, 1995).

Birds

The avifauna likely to be encountered at Little Rock Mine over the course of a year is diverse and likely to consist of at least 100 species. Metric Corporation (1993) documented the presence of 40 bird species during site reconnaissance of the area over a two-day period in late August 1993. A subsequent survey identified five additional birds which are winter residents in the area (Metric 1996). Bird species which are likely to occur in the area are presented in Appendix A, Table A-3.

Included among the species likely to be present are representatives of most North American orders of birds with the probable exception of marine and aquatic species, herons, waterfowl, rails, shorebirds, parrots, trogons, and kingfishers. Most of the bird species present are small, insectivorous or granivorous species that glean insects from bark, twigs, and leaves or forage primarily on the ground in search of seeds. Large, predatory species include several species of hawks and owls. Appendix A, Table A-3 is a literature-based inventory of approximately 60 bird species that potentially occur as permanent residents and/or summer breeding species in the general vicinity of the Little Rock Mine.

Bird species that have been observed (Dames & Moore 1994; Metric Corporation 1993, 1996) on the Little Rock Mine and associated haul road are illustrative of the wide diversity. These species include Gambel's quail (characteristic of semidesert grassland), acorn woodpecker and bridled titmouse (characteristic of oak woodlands), plain titmouse (characteristic of Great Basin conifer woodlands), rufous-sided towhee (characteristic of interior chaparral), and Steller's jay (characteristic of ponderosa pine and mixed conifer forest). Similar patterns of diverse occurrence are likely to hold for other groups of vertebrates (e.g., mammals and reptiles) that are known or have the potential to occur in the Little Rock Mine area.

Reptiles and Amphibians

The herpetofauna of the Little Rock Mine area likely consists of small species of lizards, small to medium-sized snakes, several toads, and possibly several species of frogs (Appendix A, Table A-4). Metric Corporation (1993, 1996) does not indicate whether any species of reptiles or amphibians were observed during their reconnaissance of the site. Dames & Moore's one-day reconnaissance in late March 1994 occurred on a chilly, windy day when one would not expect to encounter any cold-blooded vertebrates. Similarly, the two-day visit in January of 1995, although clear and sunny, was too cool for most reptiles and amphibians to be active. Consequently, no documented occurrences of amphibians or reptiles are available; however, Metric Corporation indicated that none of the sensitive species they sought during their wildlife surveys in August 1993 or January 1996 were found.

Fish

No fisheries exist within the immediate vicinity of the proposed mine. The drainages which traverse the site are ephemeral and flow only in response to storm events or spring snowmelt. No fisheries exist within the immediate vicinity of the proposed mine. Downstream reaches of Mangas Creek might support fish seasonally, however, the proposed pit for the Little Rock Mine does not cross this stream or alter its flow.

3.4.5 Special Status Species

Overview

Special status plant and wildlife species have the potential to occur within the various habitats in the study area. Special status species are those species listed by USFWS as endangered, threatened, or proposed and candidates for such listing; Forest Service or BLM sensitive; or species of concern at the state level. USFWS has provided species lists for the various phases of this project. The most recent lists were sent to Dames & Moore for completion of the DEIS (USFWS 1995a) and Metric Corporation for the special status species surveys (Metric 1996). Table 3-9 presents the species listed by the various agencies and includes the common and scientific names, legal status, and potential for occurring in the study area. A summary of the potential for occurrence of such species is provided and detailed species accounts are presented in Appendix A. A draft Biological Assessment was prepared for the Little Rock Mine Project

TABLE 3-9
SPECIAL STATUS SPECIES.
Special Status Plant and Wildlife Species that may occur in the vicinity of the proposed Little Rock Mine.

KEY:

Federal Status

E = Endangered
T = Threatened
P = Proposed
C1 = Candidate Category 1
C2 = Candidate Category 2

State Status - Wildlife

E1 = Endangered (Group 1)
E2 = Endangered (Group 2)

State Status - Plants

1 = List 1 (endangered)
2 = List 2 (rare or sensitive)
3 = List 3 (rare and up for review)

Species		Habitat Type and Species Range in the Project Area	Status		Potential for Occurrence
Common Name	Scientific Name		Fed	NM	
MAMMALS					
Occult Little Brown Bat	*Myotis lucifugus occultus*	Roosts in rock crevices, buildings, hollow trees; inhabits ponderosa pine and oak-pine woodland near water	C2	--	moderate
Spotted Bat	*Euderma maculatum*	Rocky outcrops of riparian, piñon-juniper, ponderosa pine and spruce pine forests; Mogollon Mountains and Lake Roberts area in Grant County	C2	E2	low to moderate - foraging
Great Western Mastiff Bat	*Eumops perotis californicus*	Roosts in caves, rock crevices, and buildings	C2	--	low
White-sided Jackrabbit	*Lepus callotis gaillardi*	Grasslands; extreme southwestern corner of New Mexico	C2	E1	low to no
BIRDS					
American Peregrine Falcon	*Falco peregrinus anatum*	Nests on cliffs; breeds regularly in mountainous areas, winter migrant statewide	E	E1	moderate - foraging

TABLE 3-9
SPECIAL STATUS SPECIES

Species		Habitat Type and Species Range in the Project Area	Status		Potential for Occurrence
Common Name	Scientific Name		Fed	NM	
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Riparian woodlands; occurs statewide in spring and fall migration, occurrences in Cliff and Redrock, New Mexico, and Gila Basin	E	E2	low to no
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	Open country and savanna habitats; very rare in southern New Mexico with historic range in Grant County	E	E2	low to no
Northern Goshawk	*Accipiter gentilis*	Open woodlands, deciduous and coniferous forest edges; breeds from central to northern New Mexico, winters statewide except in southeast	C2	--	low to moderate - winter
Ferruginous Hawk	*Buteo regalis*	A variety of habitat types including grasslands, sagebrush, saltbush-greasewood shrub and pinon-juniper woodlands; rolling terrain and foothills with rock outcroppings.	C2	--	low - winter
Northern Gray Hawk	*Buteo nitidus maximus*	Riparian deciduous areas; rare breeder in Gila and Mimbres River Valleys	C2	--	low to no
AMPHIBIANS AND REPTILES					
Texas Horned Lizard	*Phrynosoma cornutum*	Semiarid open country with cacti, bunch grass, juniper and mesquite; statewide, southwest corner to northeast corner	C2	--	low to no
Gila Monster	*Heloderma suspectum*	Outwash plains and lower mountain slopes; in canyons and arroyos where water is periodically present, irregular around Cliff, New Mexico and eastward to Las Cruces, New Mexico	--	E1	low
Yavapai Leopard Frog	*Rana yavapaiensis*	Aquatic; desert grassland, oak and oak-pine woodland; permanent pools of foothill streams	C2	E1	no to low

TABLE 3-9
SPECIAL STATUS SPECIES

Species		Habitat Type and Species Range in the Project Area	Status		Potential for Occurrence
Common Name	**Scientific Name**		**Fed**	**NM**	
Chiricahua Leopard Frog	*Rana chiricahuensis*	Aquatic habitats; chaparral, grasslands, desertscrub, oak, mixed oak, and pine woodlands; rocky streams with deep rock-bound pools	C2	E1*	no
Arizona Toad	*Bufo microscaphus microscaphus*	Washes, streams, and arroyos in semi-arid areas.	C2		low
Narrow-headed Garter Snake	*Thamnophis rufipunctatus*	Streams; below Mogollon Plateau in Grant County	C2	E2	low to no
		PLANTS			
Night-blooming Cereus	*Cereus greggii* Engelm var. *greggii*	Chihuahuan desert scrub; sandy gravelly areas of flats or washes from 3,000 to 5,000 feet	C2	1	low to no
Slender Spider Flower	*Cleome multicaulis* DC.	Alkali sinks and saline meadows or old lake beds; not seen in state since 1851, may be extinct, found from 4,000 to 7,000 feet	C2	1	low to no
Green-flowered Pincushion	*Mammillaria viridiflora* (Britt. & Rose) Boedeker	Arid grasslands; found on dry slopes or along desert margins from 4,500 to 6,500 feet	---	---	moderate to high
Parish Alkali Grass	*Puccinellia parishii*	Moist, saline soils within a variety of vegetation types	P	1	low to no
Mimbres Figwort	*Scrophularia macrantha* (Gray) Greene	Dry, steep slopes; rocky transition zones between piñon-juniper and ponderosa pine in canyon bottoms and rocky slopes, widespread from 7,000 to 8,000 feet	C1	2	low to no
Pinos Altos Flame Flower	*Talinum humile* Greene	Rocky south facing slopes of chaparral habitat; first collected near Pinos Altos, but not found in state since the late 1800s	C2	---	low
Wright's Dogweed	*Adenophyllum wrightii* Gray	Depressions formed from ephemeral puddles in late summer; rare, open slopes from 4,500 to 8,000 feet	C2	3	low to no

TABLE 3-9
SPECIAL STATUS SPECIES

Species		Habitat Type and Species Range in the Project Area	Status		Potential for Occurrence
Common Name	Scientific Name		Fed	NM	
Dwarf Milkweed	*Asclepias uncialis* Greene	Short grass plains; widespread but rare, plant if grasslands below 7,500 feet	C2	3	low to no
Pringle's Hawkweed	*Hieracium pringlei* Gray	Pine and juniper stands with grasses and shrubs	C2	3	low to moderate
Wright's Pincushion	*Mammilaria wrightii* var. *wrightii*	Piñon-juniper woodlands and plains/Great Basin grasslands	--	1	low
Grama Grass Cactus	*Pediocaactus papyracantha* (Engelm.) Britt. & Rose	Grasslands and flats with piñon-juniper woodlands; sandy soils from 5,000 to 7,300 feet	C2	--	low to moderate
Porsilid's Starwort	*Stellaria pursildii* C.C. Chinappa	Presently known only from Signal Peak in Mogollon Mountains	C2	2	low to no
Orcutt's pincushion cactus	*Caryphantha orcuttii* (Rose ex. Orcutt) D. Zimmerman	Chihuahuan desertscrub and interior chaparral; occurs in limestone habitat		3	low to no
Golden lady's slipper	*Cypripedium pubescens* Wild, var *calciolus*	Found in moist soils of montane and subalpine coniferous forests in the Rocky Mountains; occurs on north facing slopes with springs and seeps		1	low to no
Cluster hedgehog cactus	*Echinocereus fasciculatus* (Engelm.) L. Benson var. *fasciculaius*	Chihuahuan desertscrub; not distinguishable from *E. Fendleri*		3	low to no
Giant Helleborine orchid	*Epipactis gigantea* Douglas ex Hook	Found in riparian areas near springs and seeps; widespread but very rare		2	low to no

Sources: New Mexico Department of Fish and Game 1988; Sivinski and Lightfoot 1995 with a determination of no effect for all federally listed species potentially occurring in the project area (Dames & Moore 1996).

Special Status Species Discussion

Table 3-9 lists 12 special status plant species and 14 special status wildlife species which have the potential to occur within the study area. Detailed species accounts, including references, for these species are presented in Appendix A. Three species of birds are listed as endangered. None of the plants are federally listed as threatened or endangered; some are Federal Candidates Category 1 or 2 species. Four species of mammal, three bird species, two reptile, and one amphibian species are Federal Candidate Category 2 species. One reptile and five plant species have state listing only. No fish species were listed by USFWS as potentially occurring in the study area (Cervantes, Personal Communication 1995; USFWS 1995a).

The occult little brown bat and spotted bat have low to moderate potential for occurrence as foraging species. Spotted bats occupy a variety of habitat types and are apparently rare throughout their range There are potential roost sites for occult little brown bat. There is low potential for the greater western mastiff bat. The white-sided jackrabbit is very rare in the United States, known only from the extreme southwestern corner of New Mexico and is unlikely to occur in the project area.

Of the three endangered bird species, northern aplomado falcon and southwestern willow flycatcher have little to no potential for occurrence in the project area. Nesting habitat for the southwestern willow flycatcher is absent and the aplomado falcon is known historically from the area. American peregrine falcon has moderate potential for foraging in the area although no sightings have been recorded. The northern goshawk and ferruginous hawk, both Federal Candidate C2 species, have low potential to occur during the winter months. Suitable habitat is absent in the study area for northern gray hawk, which is a rare breeder in the Gila and Mimbres river valleys.

Three reptiles—Gila monster, narrow-headed garter snake, and Texas horned lizard—have low potential for occurrence in the study area. The narrow-headed garter snake requires a permanent water supply which is lacking in the project area and Texas horned lizards are generally found in mesquite-bunchgrass habitats, which are not present. Gila monsters prefer semi-arid habitats and may occur in the rockier areas of the study area. The Arizona toad is unlikely to occur due to the lack of a permanent water supply.

Of the plant species listed in Table 3-9, Wright's dogweed, dwarf milkweed, night-blooming cereus, slender spider flower, Pringle's hawkweed, green-flowered pincushion, grama grass cactus, Mimbres figwort, Porsilid's starwort, and Pinos Altos flameflower were thought to be the most likely to occur on the Tyrone Mine site. Metric Corporation conducted surveys for these species in August and September 1993. On-site survey work at a location just west of the Tyrone Mine has revealed the presence only of green-flowered pincushion cactus (Metric Corporation 1993) and it is likely that additional populations occur within the Little Rock Mine site where suitable habitat occurs. The only species listed as potentially occurring on the Little Rock Mine site, which was not listed during previous studies for the Tyrone Mine, is Parish alkali grass, a species proposed as federally endangered. The largest population of this species occurs in Grant County in a seep area. Although this species may not be known from the mine site, it is known from a variety of disjunct locations and populations change with climate and precipitation. It is associated with moist, saline soils within a variety of vegetation types and has low potential for occurrence. Two federal candidate Category 2 amphibian species, Yavapai and Chiricahua leopard frogs, have low potential for occurrence. Both are associated with aquatic systems ranging from low elevation desertscrub habitats, to chaparral, and oak-pine woodlands (Stebbins 1985). No populations are known to occur and it is highly unlikely that either species would occur at the project site (Jennings, personal communication 1995; Painter, personal communication 1995).

3.5 LAND USE AND ACCESS

3.5.1 Inventory Method

The objective of the land use inventory is to identify, map, describe, and document all existing, planned, and officially designated land uses within the project area. Detail levels are sufficient to assess the potential impacts that may result from the construction, operation, and maintenance of the proposed open-pit mine operation and haul road.

Data were collected and mapped for features within the project area. The initial effort for the investigation consisted of reviewing, refining, and updating existing information accumulated from reports of previous studies in the area. Also, existing maps of various scales and aerial photographs were intensively reviewed and interpreted for the affected area.

Following this initial inventory effort, relevant federal, state, and local land resource management agencies were contacted to update, refine, and verify the information, and to solicit information regarding agency issues, concerns, policies, and regulations. County comprehensive plans and federal resource management plans were reviewed, and land management and planning agencies were contacted as part of the effort to predict future land uses in the project area.

The data obtained were compiled and mapped onto 7.5-minute USGS topographic quadrangles. All data were digitized into a geographic information system, which provided graphic and analytic output for the land use inventory including counts of land use features, mileage, acreage, and proximity of manmade features within the study area.

Information was obtained from PDMC, governmental agencies, and special interest groups in the form of maps, published and unpublished reports, environmental and planning documents, management plans, pamphlets, brochures, etc. Data sources included:

- BLM, Mimbres Resource Area, Resource Management Plan
- Gila National Forest Plan
- Grant County Comprehensive Plan
- Grant County Assessors Maps
- Phelps Dodge (patented claims)
- Aerial Photographs, Cooper Aerial, Phelps Dodge (February 2, 1995)

Once the data from the initial effort were compiled and reviewed, additional and more specific data were obtained through field reconnaissance, and discussions with federal, state, regional, county, and local governmental agencies and organizations. Aerial photographs were used to interpret existing land uses including residential, commercial, and industrial uses. The data mapped from the interpretation of the aerial photographs were then verified in the field on January 27, 1995 by Dames & Moore's principal investigators.

This section of the land use report defines, by study category, the land use features described in the results section. Descriptions of each of the six major land use categories are provided as follows:

- land jurisdiction and ownership
- existing land use
- range resources
- utilities/transportation
- future land use
- recreation

3.5.2 Land Jurisdiction and Ownership

Land jurisdiction depicts the limits of administrative or jurisdictional control maintained by the major landholders within the study area; this does not necessarily represent ownership. With the exception of PDMC, names of private landowners were not individually identified, but were grouped together under "private lands." The jurisdiction map, Figure 3-7 (located in pocket at end of document), shows jurisdiction and ownership within the cumulative study area.

Land jurisdiction was identified and delineated from BLM surface management status maps and master title plats, Forest Service maps, and county assessor's maps. The Little Rock Mine study area contains 5,000 acres of national forest land; 597 acres of BLM land; 1,211 acres of private land; 3,580 acres of PDMC land; and 175 acres of patented mining claims. Land status areas within the permit area (detailed study area) are approximately 46 acres national forest; 390 acres BLM; and 164 acres patented mining claims.

Bureau of Land Management

This subcategory includes all land administered by the BLM. Management authorization stems from FLPMA and calls for principles of multiple use and sustained yield in accordance with developed land use plans. While any number of agreements may be associated with these lands, including lease agreements, management responsibility agreements or policies, no attempt was made in this study to identify specific parcels affected by these agreements, except grazing allotments and patented mining claims. Approximately 375 acres of BLM land are affected by the project.

Forest Service

In 1905, the Department of Agriculture established the policy that national forests were to be administered in a manner that would provide multiple use and sustained yield of goods and services in a way that maximizes long-term net public benefits consistent with resource integration, environmental quality, and management considerations. This multiple use concept was further strengthened with passage of the Multiple Use Sustained Yield Act of 1960, which states that the national forests are to be administered and managed for outdoor recreational uses, range, timber, watershed, and wildlife purposes. The National Forest Management Act of 1976 charges each national forest unit to prepare, with the aid of interdisciplinary teams and public participation, an integrated, comprehensive land management plan. Under the Secretary of Agriculture, the Forest Service is the agency responsible for carrying out the intent of these and other applicable laws on national forest lands.

Approximately 46 acres of the Gila National Forest are included within the Little Rock Mine permit area. This portion of the area includes five acres from previous mining activities.

<u>Private Land</u>

Other land in the study area is privately held, currently by MM Holdings, Inc., PDMC, and other private entities.

3.5.3 <u>Existing Land Use</u>

All existing land uses within the cumulative and detailed study areas were inventoried. The cumulative study area encompasses the drainages of Deadman Gulch, California Gulch, and Whitewater Canyon. The cumulative analysis area begins just north of the Big Burro Mountains and State Route 90, to the west of the current Tyrone Mine operations, and terminates at Mangas Valley Road, just north of the Tyrone Mine tailing ponds (Figure 3-8 located in pocket at end of document).

The Little Rock mining site is characterized by an abandoned open-pit mine site with remnants of leach solution processing facility and associated leach stockpiles, manmade levees, roads, and ponds. Disturbance levels vary from a slight modification of fence lines to mining operations and construction throughout the project area.

Residential - This category incorporates all types of residential development including occupied and vacant single-family dwelling units; recreational vehicle and mobile home parks; and other miscellaneous buildings such as abandoned mills, garages, and sheds. Residential land use within the proposed project area includes two rural residences and a recreational vehicle park.

A ranch is located in Whitewater Canyon (NW1/4NW1/4NE1/4 Section 17, T19S, R15W). The residence consists of four structures including a house, two sheds, and a trailer. Several operable and scrapped vehicles surround the residence.

The second residence is a double-wide mobile home located near the center of Section 21, T19S, R15W.

The Burro Mountain Homestead recreational vehicle park is located in the southern portion of the cumulative study area, also in Whitewater Canyon (NE1/4NW1/4, Section 31, T19S, R15W). The park contains approximately 12 to 15 trailers, 2 permanent residences, and 2 outbuildings.

Industrial

The industrial category includes extraction, which is any major active surface mining activity such as hard rock and gravel operations. Other industrial uses include initial and final processing of mined ore.

A number of individual mining claims are scattered throughout the study area. According to the United States Mining Law of 1872, mining claimants not only acquired the mineral interest in a mining claim, but also acquired the exclusive right of "possession and enjoyment of all the surface" included within the boundaries of the claim. In 1955, Congress enacted the Multiple Use Surface Mining Act to curtail non-mining uses of the surface of unpatented mining claims. Therefore, the unpatented claimant has possession exclusively for mining purposes. The government and its licensees may, under proper circumstances, exercise rights-of-way across the claim as long as the mineral development of the claim is not interrupted.

The abandoned processing facilities used by the Copper Leach Claim Group are located in the California Gulch (SE1/4, SW1/4, SE1/4, Section 17, T19S, R15W). Only the foundation of the precipitation plant remains.

3.5.4 Range Resources

The grazing category identifies all existing livestock grazing allotments including the number of acres and grazing capacities occurring within the project area. Grazing capacities are measured by the number of acres of land required to sustain one cow/calf combination, or a single cow or steer, for one month. This measurement is known as animal unit months (AUMs). The type of agreement for use of this area is either a term permit or a term lease.

Range allotments and improvements are shown on Figure 3-8. The Burro Mountain Allotment has a permit obligation for 50 head of cattle year-long, with 600 AUMs on approximately 7,519 acres. The permittee has requested and is currently being allowed to run 75 head of cattle for the periods of June 1 to October 15 and November 15 to February 28, with 606 AUMs.

The Bullard Peak Allotment has a permit obligation for 475 head of cattle year-long, with 5,779 AUMs on approximately 50,784 acres. The permittee is currently running the full permitted number of cattle on this allotment under a five pasture deferred rotation grazing system.

3.5.5 Transportation/Utilities

This category includes all existing and proposed utilities, and surface transportation routes within the study area.

Transportation - The transportation subcategory includes significant state, county, and other major roads and highways within and near the study area, as listed in Table 3-10.

TABLE 3-10
EXISTING ROADS AND HIGHWAYS

Road	Class
State Highway 90	paved, two-lane
Mangas Valley Road (County)	improved dirt
Forest Service Road #136	improved dirt
Forest Service Road #91	unimproved dirt
Forest Service Road #87	unimproved dirt

State highways include routes maintained by the New Mexico State Department of Transportation. County roads include all major roads maintained by the respective counties that represent major interconnections between interstate or state highways with major access routes in agricultural areas.

Unpaved roads include improved/light duty roads which are graded and maintained, as well as unimproved dirt roads which vary widely in their condition. Forest Service roads #136, #91, and #87 exist within the study area.

Utilities - Utilities include electrical transmission lines, water pipelines, and designated major BLM or Forest Service designated utility corridors (proposed or recommended).

A Texas-New Mexico Power Company power line transects the permit area in a generally north to south direction, serving the Burro Mountain Homestead trailer park. No agency designated or proposed utility corridors were identified in the study area.

3.5.6 Future Land Use

The intent of the future land use component is to inventory all general and specific planned and proposed land uses within the study area boundary. Future land uses were identified from (1) projected uses included in the officially adopted general and comprehensive plans for the area (Grant County); (2) specific development plans recorded by county and state land management agencies; and (3) on county lands outside of municipalities where planned or proposed land use data were not available (Grant County assigns these areas a single-family residential and agricultural zoning classification).

Planned Land Use - Planned land use category information was obtained from general or comprehensive plans adopted by each federal, state, county, and municipal agency. The planning efforts and information available for the BLM resource area, Forest Service, and Grant County all represent short- and long-term goals and expectations, but vary significantly in complexity and level of accuracy.

Resource management plans for the BLM, Mimbres Resource Area and the Gila National Forest were reviewed to identify major management prescriptions on federal lands. The Gila National Forest plan for Management Area 9A prescribes to manage the area for a long-term increase of herbaceous forage for wildlife, keep featured species population levels established and managed, and establish livestock numbers through updated standard range analysis procedures. The planning efforts and information from the Grant County Comprehensive Plan generally represent long-range goals and expectations of the residents and elected officials within the county.

Proposed Land Use - The proposed land use subcategory discusses specific land development proposals that have been recorded by federal, state, and county land management agencies. Other than the proposed Little Rock Mine project, and existing BLM and Forest Service management prescriptions, there are no recorded planned or proposed land uses occurring within the study area.

3.5.7 Recreation Resources

Recreation land use includes all existing, proposed, or potentially specially designated or managed park, recreation, and/or preservation areas within the study area boundary. Recreation facilities and related management areas were initially identified from existing sources, and were subsequently verified through the use of aerial photography, field verification, and individual agency contacts.

The primary recreational activities in the study area are hunting and dispersed recreation, which includes hiking, exploring, rockhounding, horseback riding, picnicking, camping, and off-road vehicle use. Relatively moderate temperatures, scenic values, and access to national forest lands and BLM lands provide a variety of recreational opportunities for local and non-local users.

Hunting statistics for the Game Management units covering the project area are listed in Table 3-11. Dispersed recreation opportunities exist throughout the region, especially in the proximity of Silver City, and within the Gila National Forest.

TABLE 3-11
HUNTING STATISTICS
New Mexico Department of Game and Fish, Harvest Surveys

1992-93 Season - GMU 23	Deer Harvested -665-1,024	Hunters - 2,565-2,983
1993-94 Season - GMU 23	Javelina Harvest - 54	Hunters - 135
1993-94 Furbearer Survey - Grant County	Furbearer Harvest - 806	Trappers - 72

Recreation Opportunity Spectrum - The recreation opportunity spectrum (ROS) was developed by the Forest Service to aid land managers in planning for and managing recreational uses on national forests. The framework that supports ROS was developed out of the need to manage for certain recreational opportunities that are available on public lands. The ROS system provides a method that can be used to evaluate the natural resource base and its ability to provide users with areas that may sustain desired recreational opportunities. These opportunities are defined by the resource characteristics that dominate an area. The ROS system rates the opportunity to realize various recreational experiences, within a particular location, according to five criteria—remoteness, size of the area, evidence of humans, user density, and amount and noticeability of managerial control. Six classes of opportunities exist within the framework:

- primitive
- semi-primitive non-motorized
- semi-primitive motorized
- roaded natural
- rural
- urban

Of these, the three classes occurring within the study area are defined as follows.

Primitive includes wilderness characteristics with pristine conditions, and as the spectrum approaches urban more human modification exists. The primary determinant of the ROS classes is their setting opportunity. It describes the overall outdoor recreation environment where activity occurs, influences the types of recreation activity that can occur, and ultimately determines the resulting types of experience that can be achieved.

Semi-primitive motorized (SPM) and roaded natural area (RNA) are the only ROS classes existing within the study area. SPM is characterized by a predominantly natural or natural-appearing environment of moderate-to-large size. Minimum on-site controls and restrictions may be present but are subtle, and motorized use is permitted. The RNA is characterized by a substantially modified natural environment, where the sights and sounds of humans are readily evident (see Figure 3-13 located in map pocket at end of document) for ROS class delineations.

3.6 SOCIOECONOMICS

A comprehensive description of the local and regional socioeconomic setting for the PDMC Little Rock Mine project was produced in June 1994, as part of the Little Rock Site Assessment (Dames & Moore 1994). Portions of that report are summarized here together with additional data on economic and fiscal activities.

3.6.1 Population

Located in Grant County, New Mexico, the Little Rock Mine site is about 10 miles southwest of the county seat, Silver City, adjacent to Phelps Dodge's Tyrone Mine and near the townsite of Tyrone. As shown in Table 3-12, the trend of Grant County's population has been gradually upward over the past several decades, with the exception of the 1950s. The average annual growth rate in the last decade was only 0.55 percent, with the majority of that population added in the 65 and older age group (Census Bureau 1995). Silver City's population in 1990 was 10,683 versus 9,887 ten years earlier, indicating slightly more rapid growth (averaging 0.78 percent per year over the decade). The majority of Grant County's residents live within a 10-mile radius of Silver City, including the towns of Bayard (2,598 residents in 1990), Santa Clara (1,835) and Hurley (1,534). Ninety-three percent of the population is white, including 51 percent Hispanic. Over 70 percent of the residents in 1990 had completed high school, and 21 percent were college graduates (Census Bureau 1995).

TABLE 3-12
GRANT COUNTY POPULATION
1900-1990

Year	Population
1900	12,883
1910	14,813
1920	21,939
1930	19,050
1940	20,050
1950	21,649
1960	18,700
1970	22,030
1980	26,204
1990	27,676

Source: U.S. Census Bureau 1995

Historically, Silver City and the surrounding area of Grant County have grown with mining activities since the early nineteenth century. Local growth trends due to mining and milling activities have been cyclical, typically expanding or contracting with the demand for copper and other metals. However, as the Silver City area has grown, it has become more diversified, and it is therefore less subject to large fluctuations in population from changes in the mining economy. While the role of the mining industry remains predominant, increased levels of tourism and interest in Silver City as a retirement and "new west" city are also contributing to population growth in addition to service sectors, government, and the university in the 1990s.

3.6.2 Employment and Income

In 1991, Grant County's resident civilian labor force numbered 9,952 persons, of whom 8.4 percent were unemployed (Census Bureau 1995). Thus, the economically active population represented 36 percent of the county population. This is a relatively low labor force participation rate, which is typical of rural areas, and reflects a high proportion of both young and elderly persons in the local population. Total employment in the county was higher (12,228), however, due to a net inflow of workers commuting from neighboring counties. Copper mining, farming, and ranching are the basic economic activities in the region. Mining, retail trade, business services, and state and local government (including education) generate most of the county's jobs.

Phelps Dodge is the single largest employer in Grant County, employing nearly 2,300 workers among its various operations in 1993 (Tyrone Mine - 383 employees; Chino Mines - 1,308 employees; and Hidalgo Smelter - 599 employees) (Silver City/Grant County Economic Development Corporation 1994). Other major employers include the Gila Regional Medical Center (475 full- and part-time employees) and the Silver City Public Schools (400 employees). Table 3-13 presents the distribution of county employment in 1991.

TABLE 3-13
GRANT COUNTY EMPLOYMENT 1991

Sector	Number Employed	Percent
Farm	360	2.9
Agricultural Services, Forestry, Fishing	97	0.8
Mining	1,484	12.1
Construction	732	6.0
Manufacturing (includes copper production)	717	5.9
Transportation, Public Utilities	473	3.9
Retail, Wholesale Trade	2,405	19.7
Finance, Insurance, Real Estate	576	4.7
Services	2,506	20.5
Federal Government	343	2.8
State and Local Government	2,535	20.7
Total	**12,228**	**100.0**

Source: Bureau of Economic Analysis 1994

In 1991, total personal income of Grant County was $352.9 million, yielding a per capita personal income of $12,596 per resident (Bureau of Economic Analysis 1994). Sixty percent of income was based on labor earnings, of which 80 percent came from wages and salaries and the balance from proprietors' earnings. Social security and disability payments, pensions, dividends, interest, and rent receipts totaled $143.8 million, or 40 percent of total income. On a place of work basis, average earnings per job were $19,140 in 1991. The median household income in Grant County in 1989 was $21,350. The 1990 census showed that 17.7 percent of the families (1,315) were below the poverty level (Bureau of Economic Analysis 1994).

The total value of goods and services produced in Grant County in 1991 (including intermediate inputs and value added before delivery to final demand) was $1.39 billion (IMPLAN 1994), of which almost 70 percent ($962.3 million) came from the mining and manufacturing sectors. Production of copper ore and refined copper metal are the principal activities of the two latter sectors. Table 3-14 presents the distribution of total industry output in 1991.

Tourism is a growing source of business in the county, drawn primarily by the attractions of the Gila National Forest. Visitors support nearly 800 jobs in the lodging and food and drink sectors, and in 1990 generated $4 million in lodging establishment receipts and $8.5 million in food and drinking places gross receipts. Gross receipts of Grant County retail establishments in 1990 totalled $128.8 million (NMED 1995).

TABLE 3-14
GRANT COUNTY INDUSTRY OUTPUT 1991
(in millions of 1991 dollars)

Sector	Total Output	Percent
Agriculture, Forestry, Fishing	19.87	1.4
Mining	513.71	37.0
Construction	82.59	5.9
Manufacturing	448.57	32.3
Transportation, Public Utilities	45.10	3.2
Retail, Wholesale Trade	56.70	4.1
Finance, Insurance, Real Estate	57.25	4.1
Services	102.18	7.4
Government	62.89	4.5
Total	**1,388.86**	**100.0**

Source: IMPLAN 1994

Two other open-pit copper mine operations are planned in the area that would also influence the local and regional economy. The Continental Mine Expansion, located about 15 miles from Silver City, is proposed by the Cobre Mining Company. If permitted, the Continental operation would produce and process 10 million tons of ore per year and employ a full-time workforce of about 160 people for several years. The Copper Flat Project, as proposed by the Alta Gold Company, will re-establish an open-pit copper mine near Hillsboro, located about 40 miles from Silver City in Sierra County. The Copper Flat Project would produce and process about 6 million tons of ore per year and employ approximately 150 people for at least 10 years.

There is one underground copper mine operating in Grant County, but it is scheduled to close within the year. The Cyprus Pinos Altos Mine, located near Silver City, currently employs 22 people and produces 600 to 800 tons of ore daily.

3.6.3 Housing

As of the 1990 Census, Grant County had a total of 11,068 year-round dwelling units, of which 6,875 were occupied by their owners and 2,898 were renter-occupied. Silver City had 2,816 single-family dwellings, 777 multi-family dwellings, and 635 mobile homes. The median value of single-family homes was $58,600, while the median rent for apartments was $227 per month (Grant County Chamber of Commerce 1994).

The Tyrone Mine and Little Rock Mine site are located close to the town of Tyrone, which was originally developed by Phelps Dodge to provide housing and services for employees of the Tyrone Mine. The townsite originally contained approximately 309 homes plus a mercantile, post office, service station, bank, and park and recreation facilities. The houses were leased or rented to Phelps Dodge employees while they were employed at the mine. In the early 1990s, when Tyrone's production shifted entirely to the SX/EW process and manpower requirements were reduced, Phelps Dodge divested itself of ownership of the town's housing and facilities. Renters and the general public have since purchased the homes as private residences. Tyrone has a volunteer fire department staffed by local residents.

3.6.4 Public Services and Finances

Silver City

Public facilities and services in Silver City include fire and police protection, community centers, parks, pools, and golf courses. Electric power is supplied by the Texas New Mexico Power Company, while natural gas is supplied by the Gas Company of New Mexico (New Mexico Educational Development Department 1995). In 1992 the town had 33 full-time police and 23 full-time firefighters, 3 banks ($203.8 million in assets), 1 hospital (Gila Regional, 58 beds), 24 churches, and 5 motels with a total of 308 rooms (New Mexico Educational Development Department 1995). The city provides water and sewer services.

In FY 1993-94 the town of Silver City's total revenues for governmental activities amounted to $6.47 million of which $4.55 million came from property taxes and $1.25 million came from intergovernmental transfers (primarily of gross receipts tax (i.e., sales tax) revenues rebated by the state government) (Town of Silver City 1994). General government functions (administration, public safety, streets and roads, health and welfare, and recreation) accounted for the bulk of expenditures, absorbing $5.01 million. Capital projects absorbed $1.75 million of which slightly more than one-half ($0.96 million) was funded by intergovernmental transfers (mainly gross receipts tax revenues), with the balance covered by drawdowns of reserve funds. The city's water and sewer services operate as government enterprises with independent funding. Enterprise fund operating revenues in FY 1993-94 totalled $3.58 million, of which service charges produced $2.95 million (82 percent), while intergovernmental transfers (mainly of gross receipts tax revenues) provided another $0.60 million (Town of Silver City 1994).

Grant County

The County of Grant had $9.40 million in revenues in FY 1992-93, of which local property taxes contributed $4.69 million (50 percent), intergovernmental transfers (mainly gross receipts taxes and in lieu of tax payments); $3.99 million (42 percent); and licenses, service fees and miscellaneous other, $0.72 million (8 percent) (Grant County 1994). Property tax revenues included proceeds from the Copper Production Ad Valorem Tax (AVT), which is collected from copper producers and then distributed to the county and state governments, local school districts, and special districts according to a formula embodied in the statute. In FY 1992-93, the Copper Production AVT in Grant County yielded $2.63 million to local (non-state) jurisdictions (Cardoza 1995). The county government's share was $1.89 million, of which $1.47 million was allocated to government operations and $0.41 million to debt repayment. Thus the Copper Production AVT supported approximately 20 percent of the county budget. Another $755 thousand of the AVT went to the county's two school districts (Cardoza 1995). Based on the distribution of AVT between the two school districts—one of which (Silver City) includes the Tyrone Branch while the other (Cobre School District) includes Phelps Dodge's other copper mining activities in Grant County—it is estimated that the Tyrone Branch's AVT payments accounted for 27 percent of the county's AVT receipts, and therefore, supported 5.4 percent of the total county government budget.[1]

Out of total expenditures of $9.18 million in FY 1992-93, Grant County spent $7.66 million on general government activities, with administration absorbing about $2.27 million and public safety, highways and streets, and health and welfare each taking another $1.5 million. Debt service absorbed $0.95 million while capital projects absorbed $0.57 million (Grant County 1994).

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[1]Silver City School District received $203,971 in AVT in FY 1992-93 while the Cobre School District received $551,111 (whose district includes Phelps Dodge's Chino Mine and Hurley smelter). Thus the Tyrone Branch's share: $203,971/$755,082 x 100 = 27.01 percent.

School Districts

Grant County has two public school districts—Silver City (District 1) and Cobre (District 2)—plus the Western New Mexico University whose campus is located in Silver City. County-wide public school enrollment amounted to 6,045 in FY 1988-89.while Western New Mexico University's enrollment was 2,500 (New Mexico Educational Development Department 1995).

The Tyrone mining operation lies entirely within the Silver City School District. Silver City's schools had a total enrollment of 4,187 pupils in FY 1991-92 (1,827 elementary; 917 middle; 1,089 high; and 354 special) (Census Bureau 1995). The District's FY 1993-94 budget was $18.52 million ($14.06 million operations, $3.62 million capital, and $0.84 million debt service), of which state funding through the State Equalization Guarantee was the principal source of funds ($13.46 million). Funding for this program is based on a variety of taxes, including the state income and gross receipts taxes. The distribution of funds to school districts is based on an equalization formula that subsidizes districts with small tax bases. Local property taxes generated about $1.21 million of the Silver City District's revenues, of which the Copper Production AVT accounted for about $204,000, or 17 percent of the district's funding from local sources (Cardoza 1995).

3.7 VISUAL RESOURCES

This section provides a description of the visual resources associated with the landscape in the area proposed for the Little Rock Mine. Included are discussions of (1) the visual character and scenic quality of the mine site and the components of the proposed project; (2) potential viewers within the vicinity of the proposed Little Rock Mine, and (3) a description of the visual resource management objectives established for the BLM and adjacent Forest Service lands.

3.7.1 Visual Character and Scenic Quality

The study area for the inventory and evaluation of the proposed mine activity is located in the southwest corner of New Mexico, within the Basin and Range Province, and is identified specifically within the Mexican Highlands (Fenneman 1931). The region consists of mostly rolling hills and valleys, at elevations ranging from approximately 5,000 feet to 7,000 feet. The majority of the vegetation within this area is piñon-juniper and cedar, with stands of fir and pine along some of the drainages. The study area is located along the southern edge of the Mangas Valley between the Burro and Little Burro Mountain Ranges, within three miles from the Mangas Creek. The proposed action and alternatives are associated with the existing Little Rock Mine located approximately nine miles south of Silver City, in Grant County approximately one mile to the west of the operating Tyrone Mine.

The setting for the expansion of the Little Rock Mine consists mostly of land that has previously been modified by mining activity. The adjacent Tyrone mine immediately to the east is still active and is presently being utilized for mineral exploration and production. Both the Little Rock and Tyrone mines are pre-NEPA facilities, and visually dominate the local landscape with the amount of open pit development that has occurred. Both mines are industrial in appearance and include such features as open pits, overburden and ore residue piles, leach stockpiles, tailing ponds, and other elements that visually contrast with the surrounding landscape. Several well-defined south to north trending drainages cross the area, three of which are in close proximity to the proposed project site. The central of these is California Gulch, which bisects the existing Little Rock operation. Deadman Canyon is the largest of the local drainages, and lies to the east of the existing open pit within the proposed permit area, separating the Little Rock and Tyrone mines. Whitewater Canyon lies to the west outside of the proposed permit area.

Open Pit

The excavation that previously occurred on site resulted in a small pit that was cleared of vegetation and topsoil. This resulted in large tracts of exposed rock which differ in texture and color from the character of the surrounding landscape. The existing pit is comprised of multiple terraces, each approximately 20 feet high that vary in width and culminate in a bottom elevation approximately 200 feet below existing grade. The photo in Figure 3-9 illustrates the present conditions of the existing pit.

Haul Road

The area which is proposed for the haul road alignment consists of mostly natural landscape indicative of the surrounding terrain. The character is common, comprised of low rolling hills covered with juniper and cedar. The road alignment crosses at the base of Deadman Canyon, halfway between the proposed mine and the presently operating Tyrone Mine. Figure 3-10 illustrates the character of this landscape.

California Gulch Drainages

California Gulch presently drains through the existing mine, and at this point is severely altered from its original character within the previous mine area and downstream to the intersection of Deadman Canyon. The upper portion of the drainage, along with Deadman Canyon and Whitewater Canyon, consists mostly of the existing natural terrain, native vegetation, and exposed river rock common along riparian areas in this region. These drainages are common to the area and characteristic of the surrounding terrain. Figure 3-11 illustrates the upper portion of California Gulch.

Existing Waste and Leach Stockpiles

The leach stockpiles located on the west side of the existing pit are comprised of the native rock extracted during previous excavation. The landforms associated with the leach stockpiles contrast with the color of the soil and vegetation of the natural terrain surrounding it. This area is illustrated in Figure 3-12.

View of Proposed Mine Site
Little Rock Mine Project

Figure 3-9

View of Characteristic Landscape
Little Rock Mine Project

Figure 3-10

View of California Gulch
Little Rock Mine Project

Figure 3-11

View of Leach Stockpiles
Little Rock Mine Project

Figure 3-12

3.7.2 Potential Viewers

The landscape changes resulting from the existing Little Rock and Tyrone mines are most prominent from a local perspective within foreground views; however, due to the large scale of the sites, there is the potential for visibility from several miles away. Locations where viewers may potentially be sensitive to visual changes in the landscape which may result from the proposed mine activities include Mangas Valley Road, located more than two miles away; Continental Divide Trail, approximately two miles away; Gila National Forest; and local rural residences at various distances.

Mangas Valley Road

Mangas Valley Road, which follows the northeast side of Mangas Creek, is primarily an access to the Tyrone Mine processing facilities, and continues approximately nine miles northwest of State Route 90 adjacent to pre-existing tailings ponds and mining activities. Exposed to the south is a view of the Tyrone Mine and its associated tailings along the south side of Mangas Creek. Most of the viewers traveling along this road are primarily associated with the mining activity in the area. Sensitivity along Mangas Creek Road is expected to be relatively low, due to the type of viewers using the road, and the existing condition of the adjacent landscape. There are several other travel routes in the area including State Route 90, and Forest System Road 136, but these both lie outside any potential visibility of the mine.

Continental Divide Trail

Few recreational viewers will directly be affected by the mine due to the lack of recreational facilities located in the area. The Continental Divide Trail is the only designated recreation facility in the area, crossing the southeast edge of the study area in the Gila National Forest and terminating at the forest boundary approximately two miles south of the proposed mine. The trail is located along ridge lines which define the divide, as well as along the base of Deadman Canyon. There are two locations along the trail where users could potentially see the mine. These middleground views would be from Jacks and Burro Peaks looking north, approximately four miles from the mine area. The views would, in most cases, be screened by pine and fir forests which predominate the higher elevations along these ridges south of the study area. This recreational trail has been designated as Sensitivity Level 2 by the Gila National Forest.

Residential Viewers

The only residential viewers within the study area are located either in the Burro Mountain Homestead, which serves as both temporary and permanent residence for its occupants, or among several rural residences. The Burro Mountain community is located almost two miles directly southwest of the mining permit area, and is heavily screened by adjacent landforms and vegetation. There are no views of the mine from this location. There are several rural residences in the study area, but only one has any potential visibility of the proposed mine expansion. Located at the base of Whitewater Canyon, this residence and associated structures are approximately one-half mile north of the permit area, within foreground distance of the mine pit. Due to its inferior position to the proposed site and screening from surrounding vegetation and landforms, the extent of the mine visible to any viewers from this point could be non-existent.

3.7.3 Visual Resource Management

The proposed activity for the Little Rock Mine will occur primarily within the jurisdiction of the BLM, and is subsequently subject to the Visual Resource Management (VRM) Classes within the Mimbres Resource Management Plan. This plan was prepared in December 1993, and currently designates the parcel in which the mine permit is located as a Management Class IV. This management designation allows for major modification of the existing landscape. As defined by this prescription, "The activities which occur can dominate the landscape and be the major focus of viewer attention; however, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic elements" (Mimbres Resource Management Plan, December 1993). Table 3-15 provides a listing of criteria VRM classes management objectives. Table 3-16 provides a listing of BLM resource management classes and Forest Service Visual Quality Objectives (VQOs).

Visual management classifications are shown on Figure 3-13 (located in map pocket at end of document). The southern half of the study area is within the jurisdiction of the Gila National Forest, though only a small portion of the permit area is actually on forest lands. The forest has developed VQOs which provide measurable standards for the management of visual resources within the forest. The southern portion of the permit area which is located within the forest is designated as modification. Under this objective, "management activities may visually dominate the original characteristic landscape; however, activities must, at the same time, utilize naturally established form, line, color, and texture." The activity should appear as a natural occurrence when viewed in the foreground or middleground (Forest Service 1974).

3.8 CULTURAL RESOURCES

Cultural resources or "historic properties" are defined as prehistoric and historic sites, buildings, structures, districts, and objects included in, or eligible for inclusion in the National Register of Historic Places, as well as artifacts, records, and remains related to such properties (National Historic Preservation Act (Section 301[5]). Traditional cultural places rooted in a community's history also may be eligible for inclusion in the National Register because of their association with cultural practices or beliefs that are important in maintaining the cultural identity of that community (*National Register Bulletin* 38). The label "cultural resources" is used in this environmental impact statement to encompass all types of heritage resources worthy of inventory and evaluation for listing on the National Register, or counterpart state and local registers.

TABLE 3-15 BLM VISUAL MANAGEMENT GUIDELINES	
Criteria for VRM Classes	**Management and Contrast Rating Objectives for VRM Classes**
After class ratings are completed, scenic quality, visual sensitivity, and distance zones areas are assigned to one of four management classes. These classes are designed to maintain visual quality and describe the different degrees of modification to the basic elements of the landscape allowed.	For activities proposed on public land, impacts are evaluated with the visual resource contrast rating system, a method of evaluating the visual contrast of a proposed activity with the existing landscape character. The amount of contrast is measured by separating the landscape into major features (land and water surface, vegetation, and structures) and then predicting the magnitude of change in contrast of each of the basic elements (form, line, color, and texture) to each of the features. Assessing the amount of contrast for a proposed activity in this manner which indicates the severity of impact and serves as a guide in determining what is required to reduce the contrast so it will meet the visual management class requirements for the area.
CLASS I: Those areas where a management decision has been made previously to maintain a natural landscape (e.g., wilderness areas, wild sections of National Wild and Scenic Rivers, and other congressionally or administratively designated areas).	CLASS I: Objectives for the VRM classes are to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
CLASS II: Landscapes with Class A scenic quality, or Class B scenic quality in the foreground/middleground zone with high visual sensitivity. Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the characteristic landscape.	CLASS II: The objectives of this class are to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may not be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
CLASS III: Landscapes with Class B scenic quality and high visual sensitivity in the background zone, or with Class B scenic quality and medium visual sensitivity in the foreground/middleground zone or with Class C scenery of high visual sensitivity in the foreground/middleground zone. Changes in basic elements (form, line, color, texture) caused by management activity may be evident in the characteristic landscape; however, the changes should remain subordinate to the visual strength of the existing character.	CLASS III: The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
CLASS IV: Landscapes with Class B scenic quality and high visual sensitivity in the seldom seen visual zone, or with Class B scenic quality and medium or low visual sensitivity in the background.	CLASS IV: The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities through careful location, minimal disturbance, and repeating the basic elements.
Sources: BLM 1993	

TABLE 3-16 BLM VISUAL RESOURCE MANAGEMENT CLASSES AND FOREST SERVICE VISUAL QUALITY OBJECTIVES	
VRM	**VQO**
Class I: This class provides primarily for natural ecological changes; however, it does not preclude very limited activity. Any contrast created within the characteristic environment must not attract attention.	**Preservation:** Management activities, except for very low visual impact recreation facilities, are prohibited. This VQO allows for only "ecological" changes. This management objective applies to wilderness areas, primitive areas, other special classified areas, and some unique management units that do not justify other special classification.
Class II: Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the characteristic landscape. A contrast may be seen but should not attract attention. It is important to note that wilderness study areas, considered to be Class II by the BLM, had not been identified when the original BLM visual analysis was completed.	**Retention:** Management activities must not be visually evident to the casual forest visitor. Modifications must repeat form, line, color, and texture found in the surrounding natural landscape.
Class III: Contrasts to the basic elements (form, line, color, texture) caused by a management activity may be evident and begin to attract attention in the characteristic landscape. However, the changes should remain subordinate to the existing characteristic landscape.	**Partial Retention:** Modifications may be visually evident, but must be integrated into and visually subordinate to the surrounding landscape. Activities may introduce form, line, color, and texture not common in the surrounding landscape, but they should not attract attention.
Class IV: Contrasts may attract attention and be a dominant feature of the landscape in terms of scale; however, the change should repeat the basic elements (form, line, color, texture) inherent in the characteristic landscape.	**Modification:** Management activities may visually dominate the surrounding natural landscape; however, they must repeat the naturally established elements of form, line, color, and texture to appear compatible with the natural surroundings.
Class V: No longer used (VRM 1986).	**Maximum Modification:** Modifications may visually dominate the surrounding natural landscape, yet when viewed from background distance, activities must appear as natural occurrences within the landscape. Alterations in foreground and middleground views may be out of scale or introduce visual elements not found in the natural landscape.
Source: BLM 1986; Forest Service The Visual Management System 1974	

3.8.1 Regulatory Requirements

NEPA (Section 101[b][4]) establishes a federal policy of preserving not only the natural aspects, but also the historic and cultural aspects of our national heritage when undertakings regulated by federal agencies are planned. Implementing regulations for *Protection of Environment* (40 CFR Part 1502.16[g]), issued by the Council on Environmental Quality, stipulate that the consequences of federal undertakings on historic and cultural resources be analyzed. In accordance with those regulations, cultural resources are considered in this EIS. Additional regulatory protection of cultural resources has been established by other federal, state, and local legislation.

At the federal level, requirements for protecting historic properties are identified in the Antiquities Act of 1906, National Historic Preservation Act of 1966, as amended, and Archaeological Resources Protection Act of 1979. In addition, the American Indian Religious Freedom Act of 1978 requires that all federal agencies take into account the effects of their actions on traditional Native American religious and cultural values and practices. Also, the Native American Graves Protection and Repatriation Act of 1990 expressly provides for the protection of Native American graves, funerary objects, sacred objects, and items of cultural patrimony, and gives Native American groups priority in determining the disposition of such human remains and artifacts.

Regulations for *Protection of Historic Properties* (36 CFR Part 800), which primarily implement Section 106 of the National Historic Preservation Act, define key regulatory requirements beyond those of NEPA. These regulations define a process for consulting with State Historic Preservation Officers, the federal Advisory Council on Historic Preservation, and other interested parties to ensure that significant historic properties are duly considered as federal projects are planned and implemented. The steps in the "Section 106 consultation" process involve:

1. determining the area of potential effect

2. identifying and evaluating the significance of properties that may be affected by a proposed undertaking

3. assessing the potential effects of the undertaking on historic properties (that is, properties included in or determined eligible for inclusion in the National Register)

4. consulting with the SHPO, the Advisory Council on Historic Preservation, and other appropriate interested parties to determine ways to avoid or reduce any adverse effects

5. providing the Advisory Council a reasonable opportunity to comment on the proposed undertaking and effects on historic properties

6. proceeding with the undertaking under the terms of a memorandum of agreement or in consideration of comments from the Advisory Council

The Council on Environmental Quality regulations (40 CFR Part §1502.25) encourage agencies to coordinate preparation of environmental assessments and impact statements with other environmental review and consultation requirements, such as those of the National Historic Preservation Act.

3.8.2 Culture History Summary

The project area, as much of North America, probably has been occupied by human societies, at least intermittently, since about 10,000 BC. From about 10,000 to 6,000 BC, highly mobile Paleo-Indian groups lived by hunting game and gathering natural plant foods. Their hunting strategy focused on large Pleistocene game animals, many of which became extinct as the last Ice Age waned. Evidence of Paleo-Indian occupation in southwestern New Mexico is limited to only a few sites possibly dating to the Paleo-Indian period and isolated finds of distinctive spear points.

During approximately the next six millennia of the Archaic era (circa 6000 BC-AD 200), local groups hunted and gathered a diversity of animals and plant foods. During the later part of the period, use of domesticated cultigens, especially maize, was adopted along with pit house architecture. The local Archaic cultures are identified as the Cochise culture, and sites dating to this era are more common than Paleo-Indian sites but still constitute a small percentage of the regional archaeological record.

The making and using of ceramic jars and bowls mark the advent of the Formative era (circa AD 200-1450). Sites dating from this time period dominate the archaeological record of the region. Although Formative groups continued to hunt game and gather native plant foods, they relied more and more on farming and adopted a more sedentary lifeway.

The local Formative cultural sequence, identified as the Mimbres, is divided into numerous phases based on changes in ceramics, architecture, and other cultural traits. At the beginning of the sequence, settlements tended to be small clusters of a few pit houses located on high knolls or mesas. Subsequently, village locations shifted primarily to terraces adjacent to drainages, and sites become more structured. At about AD 1000, cobble masonry pueblos replaced pit houses, and about two centuries later these are replaced by adobe pueblos.

By AD 1400 to 1450, the sedentary farmers appear to have abandoned the region. When the first Spanish explorers entered the region in the sixteenth century, the region was used by mobile groups pursuing a subsistence and settlement strategy reminiscent of the Archaic era. Most of these groups probably were Southern Athapaskan speakers (Apaches), who probably moved into the area in the late AD 1500s or 1600s.

The historic occupation reflects a variety of themes but is dominated by mining activities. Exploitation of copper deposits at Santa Rita began under Spanish hegemony in 1804. However, Apache raiding greatly limited Euro-American occupation of the area until the 1880s when the Apaches were conquered by U.S. Army troops. Skirmishes occurred until 1885.

Silver City was founded in 1870 as a result of the discovery of silver deposits. Within a few years, the original tent town evolved into a prospering city. Construction of railroads in the 1880s opened the area for further settlement, and stimulated more silver and gold mining activities.

Closer to the Little Rock Mine itself, Tyrone was founded in 1879 after the discovery of turquoise and copper deposits. Technology to effectively exploit these copper deposits was not developed until after the turn of the century. The Phelps Dodge Company consolidated the many small claims that had been developed and by 1913 was ready to initiate large scale copper mining. The town of Tyrone was moved to accommodate these mining activities. In the 1960s, Tyrone once again had to be relocated to accommodate opening of an open pit mining operation by Phelps Dodge.

During the 1960s exploratory drilling and leach testing was pursued on the Little Rock property. From 1970 to 1972 approximately 660,000 tons of waste rock and 1,000,000 tons of leaching ore were excavated and stockpiled on the site.

3.8.3 Cultural Resources Within the Project Area

The cultural resource inventory addressed three types of resources:

- archaeological and historical sites
- special status cultural resources
- traditional cultural places

Archaeological and Historical Sites

In August and September 1993 approximately 507 acres were intensively surveyed in the vicinity of the project area (Michalik 1993). The survey encompassed

- the proposed mining pit
- an area for stockpiling waste rock
- a haul road for use in transporting the excavated waste rock to the stockpile, and the ore to the existing processing facilities at the Phelps Dodge Tyrone Mine
- an alternative haul road to avoid archaeological sites found along the original alignment

In April 1995, a supplemental survey was undertaken to inventory the modified pit and adjacent facilities, as well as another realignment of the haul road. Approximately 181 more acres were intensively inventoried for archaeological and historical sites (Michalik 1995). In January 1996, an additional 300 acres of supplemental survey was completed to inventory other alternative locations for the haul road and stockpiling of waste rock (Michalik 1996).

A total of 15 archaeological sites and 22 isolated finds were discovered by the intensive surveys, which encompass an aggregate of about 1.5 square miles. Seven of the archaeological sites date from the prehistoric era, seven from the historic era, and one has both prehistoric and historic components (Table 3-17).

The most complex prehistoric site is a Mimbres pueblo that may have had some 20 to 30 rooms (LA 102,132). The site with mixed components may include another, much smaller Mimbres pueblo, as well as a historic well and livestock tank developed at McCain Spring (LA 102,133). Another prehistoric site is a scatter of chipped stone and ceramic sherds, probably representing a temporary Mimbres camp (LA 102,135). The other five prehistoric sites are scatters of chipped stone that may reflect the making of stone tools and hunting activities (LA 102,134; LA 102,136 through 102,139). Consultations between BLM and SHPO concluded that all but one of the sites with prehistoric components have been potential to yield important information about prehistoric use of the region, and therefore are eligible for listing on the National Register of Historic Places under criterion "d." The BLM and SHPO agree that test excavations are required to determine whether site LA 102,137, the smallest of the lithic artifact scatters, has potential to yield important information.

The most substantial historic site is the remnants of the Ohio Mine, an underground copper mine. The principal workings of this mine date to the early 1900s, but other features at the site include a dam and pump shed dating to the 1960s, reflecting the most recent mining activities in the area. This historic mine apparently produced only three carloads of copper ore, and the claim on which it is located was never patented (Gillerman 1964:60). Therefore, the mine did not play an important role in the development of copper mining in the Burro Mountain District. However, consultations regarding the possible historical significances of the archaeological remnants of this limited mining activity are ongoing between BLM and the SHPO.

The other six historic sites appear to reflect limited prospecting activities. Two appear to be remnants of small, temporary miners' camps (LA 109,239 and LA 112,576). Both have such meager archaeological remnants that they probably lack significance. The three other mining sites have diggings and waste rock but very few artifacts, if any. These sites appear to reflect proof of labor activities on the Morrill Lode Claim (LA 109,238 and LA 112,579) and the Zona Load Claim (LA 112,577). These sites also appear to lack historic significance, but consultations among the BLM and SHPO are still ongoing.

Sixteen of the isolated finds include single prehistoric artifacts or small cluster of prehistoric artifacts. Two isolated finds are pieces of broken historic bottles, one is a lard can, another two are piles of mining timbers or lumber, and one is a waste rockpile from surface workings. None of the isolated finds are characterized as having significant historic values.

TABLE 3-17 SUMMARY OF ARCHAEOLOGICAL SITES IN PROJECT AREA			
Site Number	**Description**	**Probable Function**	**Evaluation**
LA 102,132	masonry pueblo (about 20 to 30 rooms) and artifact scatter	prehistoric Mimbres habitation	significant information (criterion d)
LA 102,133	possible small masonry pueblo and artifact scatter; historic well and livestock tank	prehistoric Mimbres habitation?; historic spring development for ranching	significant information (criterion d)
LA 102,134	scatter of (about 350) lithic artifacts; others may be buried	prehistoric lithic tool production or hunting	significant information (criterion d)
LA 102,135	scatter of (about 10) ceramic and (about 100) lithic artifacts; others may be buried	prehistoric Mimbres work station or camp	significant information (criterion d)
LA 102,136	scatter of (about 100) lithic artifacts; others may be buried	prehistoric lithic tool production or hunting	significant information (criterion d)
LA 102,137	scatter of (about 50) lithic artifacts; others may be buried	prehistoric lithic tool production or hunting	possibly significant information (criterion d); needs testing
LA 102,138	scatter of (about 600) lithic artifacts; others may be buried	prehistoric lithic tool production or hunting	significant information (criterion d)
LA 102,139	scatter of (about 450) lithic artifacts; others may be buried	prehistoric lithic tool production or hunting	significant information (criterion d)
LA 102,140	historic Ohio mine; recent dam	historic mining and water control	probably insignificant ; evaluation ongoing
LA 109,238	Merrill Lode claim (adit, trench, tailings pile, and a few artifacts)	historic prospecting	probably insignificant ; evaluation ongoing
LA 109,239	scatter of historic (about 25) artifacts; others may be buried	historic mining? camp	probably insignificant ; evaluation ongoing
LA 112,576	scatter of historic (about 20) artifacts; others may be buried	historic mining? camp	probably insignificant ; evaluation ongoing
LA 112,577	Zona Lode claim (trench and waste rock, no artifacts)	historic prospecting	probably insignificant ; evaluation ongoing
LA 112,578	Cabinet Lode claim (shaft, pit, trench, and waste rock, and a few artifacts)	historic prospecting	probably insignificant ; evaluation ongoing
LA 112,579	Morrill Lode claim (shaft, pit, rock pile, and a few artifacts)	historic prospecting	probably insignificant ; evaluation ongoing
Source: Michalik 1993, 1995, 1996			

Special Status Cultural Resources

Special status cultural resources are defined as properties formally listed on the National Register of Historic Places, the New Mexico State Register of Cultural Properties, or specially designated and managed by other agencies such as the BLM or the Forest Service. Inventories maintained by the SHPO were reviewed and agency cultural resource specialists were consulted to identify any such special status cultural resources.

No special status cultural resources are located within or in the immediate vicinity of the project area, The files of the SHPO indicate that 43 properties in Grant County have been listed on the National Register. Most of these are historic buildings, structures, or districts within the small towns of Grant County, although six are archaeological sites in rural settings. The closest of these to the proposed Little Rock Mine is the Burro Springs Site #2, a large prehistoric pit house village situated about seven miles to the southwest on the opposite side of the Big Burro Mountains. Twelve of the listed properties are in Silver City approximately 10 miles to the northeast. All of the other National Register listed properties in the county are even farther away.

Another 23 properties in Grant County are listed on the State Register. The closest include 12 buildings, 4 districts, and an archaeological site at Silver City. Other archaeological sites, historic sites, and historic buildings are even more distant.

Traditional Cultural Places

None of the reviewed agency files had any information regarding known traditional cultural places within or in the vicinity of the project area. Information regarding traditional cultural concerns was solicited from American Indian groups with possible aboriginal ties to the region. Letters providing background information and requesting comments were sent to the San Carlos Apache, White Mountain Apache, Mescalero Apache, Fort Sill Apache, and Zuni Pueblo.

In response to these letters and follow-up telephone conversations, the contacted groups have not identified any specific concerns. The historian for the Fort Sill Apache indicated they had no concerns. The cultural resource director for the White Mountain Apache indicated that representatives of the tribe would like to review the project area in the field but they had no funds for such a trip. The other groups indicated they had reviewed information about the project and might submit comments, but no written comments were received from any of the tribes.

3.9 AIR QUALITY AND CLIMATOLOGY

3.9.1 Climatology/Meteorology

The Little Rock Mining Project is located approximately 10 miles southwest of Silver City, in Grant County, New Mexico, at an elevation of approximately 6,000 feet above sea level. The Little Rock Mine is a small oxide copper deposit located approximately one mile west of the existing Phelps Dodge mining operation at Tyrone, New Mexico. Meteorology data are collected at the Fort Bayard, New Mexico, National Weather Service Station, located 10 miles northeast of Silver City. Data from this location are considered representative of the site area (EarthInfo, Inc. 1994). However, the reader should note that the precipitation and temperature information presented in this section differs slightly from that presented in Section 3.3, "Water Resources," since the information sources used are necessarily different.

Precipitation

Southern New Mexico has a dry desert climate. However, the immediate site area is elevated terrain and likely receives additional precipitation over the surrounding lower areas. Annual rainfall has varied between 7.1 inches (1950) to 31.1 inches (1905), with an annual average rainfall of 15.7 inches (1897-1993). Rain distribution throughout the year shows July and August to be the wettest months with average rainfalls between 3.2 and 3.4 inches. The months of November through June receive approximately one inch or less of rainfall per month, while precipitation in the months of September through October average 2.1 to 1.3 inches each. Annual snowfall has varied between 39 inches (1913) and zero inches (1991), with an annual average of nearly 10 inches. Snowfall is possible from October through May, but most likely (greater than one inch) between December through March. Precipitation and snowfall data for the years 1897 through 1993 are presented in Table 3-18.

Temperature

The average maximum daily temperature reported at Fort Bayard varies between 87 degrees Fahrenheit in June and July and 52 degrees Fahrenheit in December and January. The average minimum daily temperature reported at Fort Bayard varies between 58 degrees Fahrenheit in July and 25 degrees Fahrenheit in January. The mean annual temperature for the region is about 55 degrees Fahrenheit during the period of 1897 through 1993. Mean daily temperatures for this area are presented in Table 3-19.

Surface Winds

The Little Rock Mine area is under the influence of two separate and different air masses during the course of a year. A maritime tropical air mass, associated with the subtropical high pressure system, dominates from mid-June to October with southeasterly winds. The wind speeds during the summer are usually moderate, although relatively strong winds sometimes occur just in advance of thunderstorms.

As the sun moves south during the winter, the subtropical high pressure cell moves southward. This allows the polar jet stream to move southward from the Arctic regions and brings the area near Silver City under the influence of a continental polar air mass. This polar air mass is associated with frontal systems and dominates from November to March. Spring is typically the windy season. The wind directions are still generally from the northwest, but they can also be variable and blow from any direction.

TABLE 3-18 **TOTAL PRECIPITATION AND SNOWFALL (INCHES)** **Fort Bayard, New Mexico (1897-1993)**		
Month	**Snowfall**	**Precipitation**
January	2.9	0.88
February	2.5	0.85
March	1.8	0.74
April	0.2	0.39
May	0.0	0.45
June	0.0	0.77
July	0.0	3.16
August	0.0	3.37
September	0.0	2.07
October	0.0	1.26
November	0.7	0.74
December	2.5	1.08
Annual Maximum	39.4 (1913)	31.08 (1905)
Annual Minimum	0.0 (1991)	7.10 (1950)
Annual Average	**10.4**	**15.73**
Source: EarthInfo, Inc. 1994		

TABLE 3-19 MAXIMUM MEAN AND MINIMUM DAILY TEMPERATURES (FAHRENHEIT) Fort Bayard, New Mexico (1897-1993)			
Month	**Maximum**	**Average**	**Minimum**
January	52	38	25
February	55	41	27
March	60	46	31
April	69	51	37
May	77	61	44
June	87	70	54
July	87	72	58
August	84	71	57
September	80	66	52
October	71	56	42
November	60	46	31
December	52	39	26
Annual Average	70	55	40
Annual Extremes	73 (1989)	—	37 (1964)
Source: EarthInfo, Inc. 1994			

3.9.2 Ambient Air Quality

The attainment status for pollutants within the project area is determined by monitoring levels of criteria pollutants for which National Ambient Air Quality Standards (NAAQS) and New Mexico Ambient Air Quality Standards (NMAAQS) exist. The criteria pollutants for which federal standards exist are carbon monoxide, lead, sulfur dioxide, particulate matter less than 10 micrometers in size (PM_{10}), ozone, and nitrogen dioxide. At a minimum, state standards must incorporate these pollutants, but the state may also establish additional ambient air quality standards for other pollutants. Potential air pollutant emission sources (including the Little Rock Mine) are subject to additional control requirements, including obtaining permits, paying fees, Prevention of Significant Deterioration (PSD) review, limited emissions of Hazardous Air Pollutants, etc. The applicable national and state standards are presented in Table 3-20.

TABLE 3-20 AIR QUALITY STANDARDS				
			National Standards	
Pollutant	Averaging Period	New Mexico Standards	Primary	Secondary
carbon monoxide	1-hour	13.1 ppm	40,000 μg/m³ (35 ppm)	-----
	8-hour	8.7 ppm	10,000 μg/m³ (9 ppm)	-----
lead	Calendar quarter	-----	1.5 μg/m³	1.5 μg/m³
sulfur dioxide	3-hour	-----	-----	1300 μg/m³ (0.5 ppm)
	24-hour	0.1 ppm	365 μg/m³ (0.14 ppm)	-----
	Annual	0.02 ppm	80 μg/m³ (0.03 ppm)	-----
PM_{10}	24-hour	-----	150 μg/m³	150 μg/m³
	Annual	-----	50 μg/m³	50 μg/m³
TSP	24-hour	150 μg/m³	-----	-----
	7-day	110 μg/m³	-----	-----
	30-day	90 μg/m³	-----	-----
	Annual	60 μg/m³	-----	-----
ozone	1-hour	0.06 ppm	235 μg/m³ (0.12 ppm)	235 μg/m³ (0.12 ppm)
nitrogen dioxide	24-hour	0.10 ppm	-----	-----
	Annual	0.05 ppm	100 μg/m³ (0.05 ppm)	100 μg/m³ (0.05 ppm)
Source: Bureau of National Affairs, Inc. 1995				

Air quality data have been used by the EPA to formally designate all areas of the United States with regard to the NAAQS. The areas that record air pollutant concentration levels lower than the NAAQS are classified as attainment. The areas that record air pollutant concentration levels higher than the NAAQS are classified as non-attainment. Regions unclassified with respect to the standards are considered to be attainment areas by the EPA for regulatory purposes.

New Mexico has attainment/non-attainment designation with regard to five pollutants: total suspended particulate matter (TSP), sulfur dioxide, carbon monoxide, nitrogen dioxide, and ozone. The region around the Little Rock Mine has been designated as unclassified for all five pollutants with one exception. This exception is a non-attainment classification for sulfur dioxide in a 3.5-mile-radius around the Chino smelter located in Hurley, New Mexico, approximately 15 miles east of the proposed site. State regulations also include separate standards for TSP containing beryllium, asbestos, or heavy metals; hydrogen sulfide; total resolved sulfur; known or suspected carcinogens; and toxic air pollutants.

As shown in the impact analysis modeling, inhalable particulate, or PM_{10}, is the criteria pollutant of greatest concern for the proposed action. For this pollutant, the accepted background level relative to the NAAQS is 48 μg/m^3 for a 24-hour average, and 22 μg/m^3 on an annual average.

The NMED has reported PM_{10} monitoring data for the region near Tyrone, New Mexico (NMED 1994). Monitoring data are provided in Table 3-21, Monitored PM_{10} Data, for the nearby towns of Hurley, Bayard, and Silver City for 1990 through 1993.

To obtain a representative background particulate matter concentration, the average of the monitored data recorded at Hurley from 1991 to 1993 are used in this analysis. The NMED (1995) has indicated that these data are acceptable because all permitted sources in the area were operating during the period of ambient particulate monitoring.

The data from Hurley are assumed to be representative of the Little Rock Mine area based on the proximity of the monitoring station to the proposed Little Rock Mine. Furthermore, the monitoring station is in close proximity to a similar mining operation in the vicinity of Hurley, New Mexico. The background 24-hour PM_{10} value used in this analysis is 45 μg/m^3 and the annual value is 22 μg/m^3.

TABLE 3-21
MONITORED PM_{10} DATA (μg/m^3)

Station	Year	Samples	1st Maximum 24-hour	2nd Maximum 24-hour	Annual Mean
Bayard	1990	64	70	67	28
	1991	63	44	40	22
	1992	65	51	46	23
	1993	63	43	41	21
Hurley	1990	52	42	39	22
	1991	60	74	36	18
	1992	59	42	27	17
	1993	61	33	30	15
Silver City	1991	61	65	63	24
	1992	56	82	70	26
	1993	60	60	42	21

Source: NMED 1994

3.10 NOISE

Noise from the proposed mining activities has the potential to impact off-site receptors, including both humans and wildlife. A noise impact assessment was conducted to quantify the expected impacts. Sources of noise from mining activities include diesel-powered earth-moving equipment and blasting.

These two sources produce characteristically different types of noise and were therefore analyzed separately in the assessment. This section describes the noise level descriptors used in the assessment, applicable regulations and criteria, and the existing noise environment in the vicinity of the proposed project.

3.10.1 Noise Level Descriptors

Noise is often described as "unwanted sound," and is commonly measured in terms of A-weighted decibels (dBA)[2]. Community noise levels are constantly fluctuating, and as a result single-number descriptors have been developed to facilitate their analysis. The level exceeded 90 percent of the time (L_{90}) is the descriptor most commonly used to quantify ambient noise levels in a given area. The equivalent noise level (L_{eq}) is an energy-average level commonly used to quantify noise from sources such as diesel-powered equipment. The day-night noise level (L_{dn}) is a 24-hour average of L_{eq} levels, with 10 dBA added to the levels between 10:00 p.m. and 7:00 a.m. to account for heightened noise sensitivity at night. For this project, where predicted L_{eq} levels are assumed constant over a 24-hour period, the L_{dn} is equal to the L_{eq} plus 6 dBA. These three descriptors were used in this assessment to quantify noise impact from earth-moving equipment.

Blasting produces impulse noise which is distinct in character and human annoyance response. Therefore, different descriptors apply. The acoustic pressure wave that is emitted from a blast is referred to as an airblast or an overpressure. While different descriptors have been developed for impulse noise, the descriptor most applicable to an airblast, and that used in this assessment, is the peak linear level (dBL).

Impact Criteria

There are no federal, state, or local noise control regulations that apply to the off-site noise produced by this project. To assess impact, noise level criteria were developed based on published recommendations from the EPA (1974), and on standard engineering practices regarding the annoyance of an intruding noise. To date, research on noise impact to wildlife has not been conclusive enough to provide any criteria levels. Therefore, impact to wildlife will only be discussed qualitatively.

Noise levels predicted to be generated by this project were compared with the EPA criteria of 70 dBA (L_{eq}), which has been determined to adequately protect public health and welfare, and 55 dBA (L_{dn}), below which the potential for annoyance is minimized. A noise level of 55 dBA, however, will likely not provide an accurate measure of annoyance from this project because it was developed based on annoyance data of large populations. Most of the receptors in the vicinity of the proposed project are residents living in remote areas, who presumably cherish their quiet environment. A level of 55 dBA would be very intruding and even audibility of noise from the project could be considered an impact.

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[2] The basic unit of noise measurement is the decibel (dB), which is equal to 20 times the logarithm (base 10) of sound pressure divided by the reference pressure of 0.00002 N/m^2. A-weighted decibels have been frequency weighted in a manner representative of human hearing.

Therefore, a second criteria shown in Table 3-22 was applied to project noise levels that is based on the audibility of an intruding noise versus the ambient noise level. For the purposes of this assessment, noise from the project will be considered distinctly audible, and therefore constituting an impact, if the predicted noise level is more than 5 dBA above the ambient noise level.

TABLE 3-22
AUDIBILITY OF AN INTRUDING NOISE

Level of Intruding Noise Relative to Background Noise (dBA)	Audibility/Human Response
0	inaudible
+3	potentially audible
+5	distinctly audible
+10	potentially annoying

As airblasts from mine blasting generally occur only once per day for about one second, their impact is not the result of interference with activities such as speech, but from the rattling of houses, startling residents, and promoting fear of structural damage. The U.S. Bureau of Mines has developed both damage and annoyance criteria which were applied to the airblast levels predicted at receptors near the proposed mine (Bureau of Mines 1980). The Bureau of Mines criteria state that to minimize the possibility of damage, airblast levels should be limited to 134 dBL at receptor locations. To minimize the potential for annoyance, airblast levels should be limited to 129 dBL.

Ambient Noise Levels

Ambient noise levels in the vicinity of the proposed project were estimated based on levels measured in areas with similar characteristics. In urban and suburban areas, ambient noise levels typically depend on proximity to traffic and industrial facilities, the presence of aircraft overflights, etc. In the remote areas surrounding the proposed project, however, ambient noise levels are controlled by sources such as wind rustling vegetation, birds, and crickets. Table 3-23 shows the ambient noise levels measured near a mine, in a remote field, and at the north rim of the Grand Canyon in northern Arizona. The level of 16 dBA measured at the Grand Canyon is one of the quietest on record. The ambient noise level of 30 dBA measured at the other two locations is considered representative of the ambient noise level in the project area. This is because both locations are remote, and the measured level was reported to be dependent on natural noise sources as is the expected case in the vicinity of the proposed project.

TABLE 3-23 REPRESENTATIVE AMBIENT NOISE LEVELS	
Location Description	**Ambient Noise Level (L_{90} dBA)**
near remote mine, California	30
rural agricultural field	30
north rim of Grand Canyon	16

Chapter 4.0

ENVIRONMENTAL CONSEQUENCES

CHAPTER 4.0 - ENVIRONMENTAL CONSEQUENCES

4.1 IMPACT ASSESSMENT METHODS

This analysis is based on the inventory results and standard practices combined with professional judgment of the principal investigator for the particular environmental component. Each of the impact levels as a part of the assessment model is defined below. Potential impacts are discussed as being either high, moderate, low, or having no identifiable impact.

- High Impact - A high level of impact would result if the establishment, operation, reclamation, and abandonment of the proposed project would potentially cause a substantial adverse change or stress to an environmental resource.

- Moderate Impact - A moderate impact would result if the establishment, operation, reclamation, and abandonment of the proposed project would potentially cause some adverse change or stress to an environmental resource(s).

- Low Impact - A low impact would result if the establishment, operation, reclamation, and abandonment of the proposed project would potentially cause a small adverse change or stress to an environmental resource(s).

- No Identifiable Impact - No identifiable impact would be indicated where no measurable impact would occur to the specific resource(s) under investigation.

Direct impacts are those which would be caused by the action and would occur at the same time and place as that action. Impacts were determined by assessing the initial effects of construction activities anticipated for the proposed action or alternative, and the long-term effects of project operation and maintenance (see Chapter 2). Potential conflicts with the objectives of federal, state, and local plans, policies and controls were also identified. Short-term impacts could be caused by constructing individual components of the project, such as the fueling facility, dewatering station, power substation, and office trailer. Long-term impacts could result from operating and maintaining these facilities, as well as from the long-term effects of covering land, potentially altering drainage patterns or recharge of ground waters.

Secondary (or indirect) impacts are caused by development or other activities that are not a direct part of the project, but occur either later in time or outside the study area. Indirect effects must be reasonably foreseeable. Indirect effects may include changes in land use patterns; population density or growth rates; and related effects on air, water, and other natural systems. Beneficial impacts related to the project may include increased employment and tax revenues to the local government.

Cumulative impacts are the impacts on the environment resulting from the incremental effects of the project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal of non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

No impacts are anticipated to areas of critical environmental concern, prime or unique farmlands, floodplains, wild and scenic rivers, wilderness, wetlands, climate, and minority or low-income populations or communities. No activities are proposed that would create any hazardous waste within the permit area.

4.2 EARTH RESOURCES

4.2.1 Soils

Existing mining activity-related disturbance in the project area consists primarily of the old mine pit, graded and ungraded roads, waste rock and leach stockpiles, shafts and drifts, drill holes, and several old buildings and mining-related facilities. Most of these features are from previous exploration and mining at the site. Active mining at this site ended in 1972.

The soils in the areas that would be disturbed as a result of proposed operations and related activities vary in quality as well as their erosion potential. Some of the physical/chemical properties of these soils are presented in Tables 3-1 and 3-2 of Chapter 3. Table 4-1 shows the soil units affected by and the areas of potential disturbance for each of the haul road and pit alternatives. Table 4-2 presents criteria for determining soil suitability for reclamation purposes based on some of these physical/chemical characteristics. Figure 3-1 shows the soil map units and the areas of disturbance for the proposed action. Figures 2-1a, 2-1b, and 2-1c show the various haul road and pit alternatives. The areas designated as Pits-Leach Stockpiles-Disturbed Lands have already been disturbed; however, the remaining units are generally undisturbed except for some unpaved roadways in the area.

Results

Alternative 1—No Action

Under the no-action alternative there would be no changes to soils from the existing condition. Where the soils have already been disturbed, soil could be subject to accelerated erosion. In undisturbed areas, natural erosion rates will continue.

Alternative 2—Proposed Action

The proposed action includes Alternative B for the haul road and pit. Within the pit area boundary, a total of about 186 surface acres would be disturbed. Of that total, approximately 63 surface acres have already been disturbed and consist of pits-leach stockpiles and other disturbed lands from previous mining operations. The remaining 123 acres have been mapped as Santa Fe-Rock outcrop complex. These soils and underlying rock will be completely removed to an elevation of 5,600 feet. In the areas of the pit with exposed rock, there would be no soil erosion.

TABLE 4-1 AREAS OF DISTURBANCE BY SOIL MAP UNIT (all numbers are in acres)						
				Outside Pit Area		
Soils	**Within Pit A***	**Within Pit B***	**Within Pit C***	**Haul Road A**	**Haul Road B**	**Haul Road C**
Santa Fe-Rock outcrop	127.00	122.91	125.59	29.14	39.75	27.03
Pits - Leach Stockpiles - Disturbed Lands	63.49	63.49	63.49	0.00	0.00	0.00
Gaddes-Santa Fe-Rock outcrop	0.00	0.00	0.00	5.52	0.00	0.00
Lonti gravelly clay loam	0.00	0.00	0.00	7.79	0.00	0.00
Lonti gravelly loam	0.00	0.00	0.00	10.99	0.00	0.00
Manzano loam	0.00	0.00	0.00	0.32	0.00	0.00
Paymaster gravelly sandy	0.00	0.00	0.00	4.60	0.00	0.00
Total Soils	**190.49**	**186.40**	**189.08**	**58.36**	**39.75**	**27.03**
***Pit area described with haul road Alternatives A, B, and C.**						

TABLE 4-2 SOIL SUITABILITY FOR RECLAMATION PURPOSES				
	Soil Quality			
Soil Property	**Good**	**Fair**	**Poor**	**Unsuitable**
Texture	sandy loam loam silt loam	sandy clay loam silty clay loam clay loam	sandy clay loamy sand silty clay	clay >60%
Rock & Gravel (% by volume)	0 to 10	10 to 20	20 to 40	>40
pH	6 to 8	5 to 6 8 to 8.5*	4.5 to 5 8.5 to 9*	>4.5 >9
Na absorption ratio (SAR)	4	4 to 8	8 to 16	>16
Electrical Conductivity (millimhos/cm)	5	3 to 7	7 to 15	>15
*Check for heavy concentrations of Boron or Lime. Source: BLM Solid Minerals Reclamation Handbook 1992				

Disturbance along the haul road would total approximately 40 surface acres outside of the pit. The haul road crosses the Santa Fe-Rock outcrop complex which is subject to increased erosion. Erosion hazard potentials for the soils in this map unit are generally moderate to high for wind and/or water.

Potential impacts to soils as a result of mining and mining-related activities include increased rates of soil erosion by wind or water, loss of topsoil, and decrease in soil productivity due to soil mixing. Indirect impacts include increased sedimentation in streams due to runoff following rainfall or snow melt. Increased sedimentation may affect aquatic habitats, domestic drinking water supplies, and the aesthetics of the stream itself. Loss of topsoil and decrease in soil mixing affects the vegetation supported in the area which in turn affects the animal life in the area if there is loss of forage or habitat. However, with adherence to the proposed reclamation plan, adverse impacts would be reduced.

Long-term soil productivity would be reduced for the project area since soils in the proposed pit would be removed and soils would be disturbed and compacted along the haul road. However, some of these impacts could be successfully mitigated by Phelps Dodge's commitment to test and amend plant growth media (including replaced topsoil if suitable) as discussed in the Reclamation and Closure Plan. Sediment control along the haul road will greatly reduce the potential for increased gully and rill erosion in the cut and fill material. Reclamation of the haul road by regrading and replacing local soils capped by either stockpiled topsoil or adding soil amendments to promote native vegetation would return those portions reclaimed to productivity. Revegetation is not planned for the pit area, along vertical cliffs and areas that would remain underwater. However, natural revegetation by native plants is likely along portions of the pit walls.

Therefore, revegetation is not expected in the pit area, a total of 186 surface acres, including the previously disturbed 63 acres. However, revegetation along major portions of the haul road is expected. A total of approximately 188,026 cubic yards of salvageable soil from the pit and haul road would be stockpiled at a designated site, segregated from waste rock, and later available as topsoil for revegetation. Reclamation and revegetation with native plant seed will occur during the June or early July following completion of mining activities.

Haul Road/Pit Alternatives

Alternative A

Soils in the pit area (127 surface acres plus 63 surface acres of existing mine workings) would be removed. Soils along the haul road (58 surface acres) could be disturbed. The area of the haul road will be reclaimed and revegetated. The area of the pit, 190 surface acres, will not be revegetated and reclamation of the pit would be limited to methods and techniques which promote revegetation, decrease potential erosion, and limit impacts to water resources.

Table 4-3 shows the reclamation potential of the soils for Alternative A. Those soils with poor or fair soil quality ratings will require some soil amendments to aid in successful revegetation and reclamation. A total of approximately 250,137 cubic yards of salvageable soils will be stockpiled at a designated site, segregated from waste rock, and later available as topsoil for revegetation.

TABLE 4-3
RECLAMATION POTENTIAL OF SOILS

Location	Soil Unit	Soil Quality	Potential Salvage Depth (inches)	Surface Area (acres)	Salvage Limitations	Approximate % of Unit Salvageable	Estimated Soil for Salvage as Topsoil for Reclamation (yd^3)
HAUL ROAD ALTERNATIVE A							
Pit area	Santa Fe-Rock outcrop	fair	16	127.0	shallow bedrock, gravels	55	146,499
Within haul road area	Graddes-Santa Fe-Rock outcrop	fair to poor	18	5.5	shallow bedrock, gravels	85	11,313
	Lonti gravelly clay loam	poor	23	7.8	—	100	23,909
	Lonti gravelly loam	poor	23	11.0	—	100	28,395
	Paymaster gravelly sandy loam	fair to good	10	5.0	—	100	6,453
	Santa Fe-Rock outcrop	fair	16	29.1	—	55	33,568
TOTAL							**250,137**
HAUL ROAD ALTERNATIVE B							
Pit area	Santa Fe-Rock outcrop	fair	16	123.0	shallow bedrock, gravels	55	141,885
Within haul road area	Santa Fe-Rock outcrop	fair	16	40.0	shallow bedrock, gravels	35	46,141
TOTAL							**188,026**
HAUL ROAD ALTERNATIVE C							
Pit area	Santa Fe-Rock outcrop	fair	16	126.0	shallow bedrock, gravels	55	145,345
Within haul road area	Santa Fe-Rock outcrop	fair	16	27.0	shallow bedrock, gravels	55	31,145
TOTAL							**176,490**

Source: BLM Solid Minerals Reclamation Handbook 1992; SCS 1993

Alternative C

Soils in the pit area (126 surface acres plus 63 surface acres of existing mine workings) would be removed. Soils along the haul road (27 surface acres) could be disturbed. Portions of the area of the haul road will be reclaimed and revegetated with the exception of the canyon fill. The area of the pit, 189 surface acres, will not be revegetated and reclamation of the pit would be limited to methods and techniques which promote revegetation, decrease potential erosion, and limit impacts to water resources.

Table 4-3 shows the reclamation potential of the soils for Alternative C. Those soils with poor or fair soil quality ratings will require some soil amendments to aid in successful revegetation and reclamation. A total of approximately 176,490 cubic yards of salvageable soils will be stockpiled at a designated site within the waste stockpile area, segregated from waste rock, and later available as topsoil for revegetation.

Partial Backfill Alternative

With this alternative, a total of 123 to 127 surface acres of soil and 63 surface acres of existing mine workings (varies with pit/haul road alternatives) could be removed from the pit area. Construction of the haul road could result in the disturbance of 27 to 40 surface acres (varies with haul road alternatives). As part of reclamation and mine closure, the pit would be partially backfilled and the haul road would be reclaimed. The difference with this alternative is the temporary or permanent stream diversion option. With the temporary diversion of California Gulch to Deadman Canyon, the previously diverted stream area would also be reclaimed. The pit will be backfilled to about 5,820 feet. It is assumed that with some soil amendments and placement of topsoil from the stockpile, natural revegetation would occur. The exposed rock slopes of the pit will generally not be subject to revegetation.

Table 4-3 shows the reclamation potential of the soils for each of the pit/haul road alternatives. Those soils with poor or fair soil quality ratings will require some soil amendments to aid in successful revegetation and reclamation. With a permanent diversion, no reclamation would occur along the diversion.

California Gulch - Stream Diversion Alternatives

With the Whitewater Canyon SD-1 Alternative, a channel and pipe would be constructed, affecting an area about 2,200 feet long and 40 feet wide. Approximately two surface acres would be disturbed. Reclamation and revegetation of the area would limit the extent and duration of the increased soil erosion so impacts are expected to be minimal. The soils crossed by the channel and pipe are mapped as Santa Fe-Rock outcrop. The physical/chemical properties are shown in Table 3-1 and the reclamation potential is given in Table 4-2.

With the Tributary to Whitewater Canyon SD-2 alternative and the Diversion to Open Pit SD-3 alternative, there are no additional disturbances beyond the pit boundary as a result of construction of diversion systems. No additional impacts to soils is anticipated by construction of the SD-2 or SD-3 alternatives.

4.2.2 Geology and Minerals

Results

The proposed action would affect the geology and mineral resources by removing 160 million tons of total mine rock including 100 million tons of leachable ore. The leachable ore will be removed from the site and processed at an existing permitted leach stockpile at Tyrone. Overburden, or waste rock that does not contain copper, will be removed and stockpiled during the operation to access the mineralized area. Phelps Dodge plans to remove 1.6 million tons of mineable ore that was left as waste in the form of a leach stockpile by USNR.

4.3 WATER RESOURCES

This section describes the effects implementation of the proposed project would have on:

- surface water quality and quantity
- channel morphology of surface water drainages
- ground water quality and quantity

4.3.1 Removal of Existing Mine Structures

The removal of the leach stockpile containing approximately 1.6 million tons would have a beneficial impact on surface water quality within California Gulch and adjacent ground water quality. During their unsuccessful attempt at recovering copper at this facility, USNR applied over 30 million pounds of sulfuric acid of unknown concentration to the leach stockpile. This effort provided the acidic environment necessary to mobilize naturally occurring metals and other ions, producing the apparent impacts identified in seeps, surface water, and ground water (see Chapter 3).

Evidence of impacts has been identified in seep CLDS (see Section 3.3.2) which flows out of the leach stockpile and sometimes discharges to California Gulch. The seep exceeds NMWQCC standards for surface water for aluminum, cobalt, and copper. Surface water quality downgradient of this feature also is impacted. Sample CG-1, located upgradient of the leach stockpile, exceeds no standards, while sample CG-2, located downgradient of both the seep and leach stockpile, exceeds standards for both aluminum and copper.

Evidence of ground water impacts is found in monitor well LRW-4, located adjacent to the leach stockpile, where NMWQCC standards are exceeded for TDS, fluoride, sulfate, several different metals, and pH. It is possible that the ground water quality found in LRW-1, which also exceeds standards for several constituents, may be partially due to this feature.

The removal of the leach stockpile, considered a primary source of acid rock drainage, would result in an improvement in the surface water and ground water quality in the area. The seep, whose surface expression position will change with the alteration in the terrain after removal activities, should have an almost instantaneous improvement in quality. The same is true for the quality of California Gulch. This is true due to the short resident times for surface water to move through the system. The ground water quality would also improve, as metals precipitate, mixing and dilution occurs, and a cone of depression is created and impacted water is removed during the life of the mine by pit dewatering.

4.3.2 Pit Construction and Dewatering Impacts

Pit dewatering will be necessary to pump out ground water that enters the pit once the pit bottom reaches the present ground water table located at an elevation of about 5,800 feet. The bottom of the pit is estimated to be at the 5,550-foot elevation level. A ground water model was developed to predict what effects dewatering of the pit would have on the watershed. Details of the models used, assumptions made, input data files, and file descriptions are located in the *Ground Water Model Technical Report.* A summary description and results of the models are presented here.

An accurate prediction of the dewatering rate and the area and magnitude of influence on ground water levels at the Little Rock site is a function of correctly estimating aquifer parameters such as porosity, hydraulic conductivity and thickness of the aquifer, and the amount of recharge to the system through infiltration from precipitation events. A range for these parameters was identified through literature and from direct field measurements (see Section 3.3.3). A ground water model used to predict future conditions is calibrated by comparing aquifer parameters to past and present conditions. This allows for the best estimate of input parameters to simulate future conditions. Table 4-4 presents the range of values reported in the literature and identified in the field.

A numerical, two-dimensional, steady-state ground water flow model, FLOWPATH, was selected to model flow patterns and pit inflows for premining and current ground water conditions. FLOWPATH was developed by Franz and Guiger (1990) and is widely used. The model was calibrated by matching observations of past and present ground water elevations, and effects from dewatering at the nearby Tyrone Mine, to aquifer properties and recharge that will then be used to predict drawdowns due to dewatering at the Little Rock Mine.

The model was calibrated for premining conditions by varying hydraulic conductivities of the various geologic units within reported ranges and comparing the resultant ground water elevations to observed 1950s conditions (Trauger 1972). Several assumptions were made, which include:

- aquifer is unconfined and has a thickness of 1,000 feet
- aquifer is composed of several hydrogeologic units and each has a uniform hydraulic conductivity

TABLE 4-4 GROUND WATER FLOW MODEL INPUT DATA			
Parameter	**Reported Range**	**Value Used**	**Source of Reported Range**
Regional ground water elevations	N/A	(see source)	Trauger (1972)
Local ground water elevations	N/A	(see source)	Investigation Technical Report
Geometry of Tyrone Pit	N/A	(see source)	PDMC (1995a)
Hydraulic conductivity (ft/day)			
Precambrian rocks	0.00013 0.028 - 2.8 0.01	0.23	Trauger (1972) Dieulin (1981) Aquifer Pumping Test (Investigation Technical Report)
Triassic intrusives	0.01 - 500	0.70	Trauger (1972),
Conglomerates	0.0013 - 1.3	1.5	Trauger (1972)
Alluvium	0 - 10,000	25.0	Trauger (1972)
Pit Backfill	5.29 - 345	23.0	Science Application (1981)
Effective porosity (%)			
Precambrian rocks	0 - 0.05 2 - 8	5	Trauger (1972) Dieulin (1980)
Triassic intrusives	0 - 9	5	Trauger (1972)
Conglomerates	0.1 - 15	10	Trauger (1972)
Alluvium	0 - 53	20	Trauger (1972)
Aquifer thickness (feet)	—	1,000	
Return flows (gpm)			
No. 1X Tailings Pond	452	226	Shomaker (1994)
No. 1 Tailings Pond	491	245.5	Shomaker (1994)
No. 1A Tailings Pond	491	245.5	Shomaker (1994)
No. 2 Tailings Pond	348	174	Shomaker (1994)
No. 3 Tailings Pond	0	0	Shomaker (1994)
No. 3X Tailings Pond	348	174	Shomaker (1994)
Fortuna Well withdrawal (gpm)	141	141	Shomaker (1994)
Inflow rate to Tyrone Mine pit (gpm)	1,200 - 2,000	1,837*	PDMC (1995b)
*Value Predicted			

- bedrock units are significantly fractured and act as porous media
- ground water elevations are stable at the model boundaries and are not affected by dewatering events
- net recharge is assumed to occur only at the model boundary
- evapotranspiration of ground water is negligible

Once the steady-state model was calibrated to pre-mining conditions (within 10 percent of observed ground water elevations), current conditions which include dewatering of the Tyrone Mine, occasional discharge to tailing ponds, and pumping of the Fortuna well were simulated. Calibration was achieved by varying the hydraulic conductivities within the hydrogeologic units. The resultant hydraulic conductivities that achieved the best results (residual standard deviation of less than 10 percent of the observed range of heads) are shown in Table 4-4.

Once these input parameters were established through model calibration, a transient model was used to predict ground water conditions during mining. The model selected was TARGET2DH, developed by Dames & Moore. This model was used for predicting the effects dewatering would have on the hydrogeology of the site because a transient-state model is best for ground water systems which are not in equilibrium, such as predicting conditions during pit water recovery.

The assumptions made for use of this model were:

- mining would occur for 3 years
- ground water levels at the base of the pit would be maintained at the 5,550-foot elevation level

Within 6 months of pumping ground water to maintain a dry pit, ground water inflows are predicted to be 450 gpm, and decrease to less than 300 gpm at the end of three years. Ground water drawdowns of up to 10 feet are predicted at distances of up to 7,000 feet from the pit during mining. The maximum predicted transient drawdown after 3 years is presented in the *Ground Water Model Technical Report*.

Pit Water Recovery Impacts

Once mining is completed and pit dewatering ceases, the pit would begin to infill with ground water, and water from California Gulch. The proposed action is to allow the pit to fill with ground water and surface water, creating a lake, with no outlet.

The ground water model TARGET2DH was selected for evaluating the final elevation of the lake in the pit once mining ends. The assumptions made in developing the model are the same as outlined in Pit Dewatering Impacts. In addition, it is assumed there is no surface water drainage from the lake. The *Hydrogeologic Ground Water Model Technical Report* includes the input data used in the model and results that show how the lake levels change over time relative to inflows and outflows with and without input from California Gulch.

The model predicts that the final elevation of the pit lake would be 5,730 feet without inflow from California Gulch, and 5,733 feet with inflow from California Gulch.

It is predicted it would take at least 50 years to reach equilibrium. (The calculated values have an error rate of approximately 11 feet. Thus, there is no statistical difference between the estimated 5,730 and 5,733 lake level elevation.) At the predicted lake levels, there would be approximately 70 feet of freeboard between the lake level and the nearest overflow point at Deadman Canyon (approximately 5,800 feet). Thus, there is no anticipated discharge outflow under this scenario.

Impacts on Wells

Based on results reported in the *Hydrogeologic Ground Water Model Technical Report*, and the locations of residences within the study area, well drawdowns are predicted as follows.

The well located at the Burro Mountain Homestead and the well at the residence northwest of the proposed pit would have ground water drawdowns of 1 to 5 feet at the end of mining. This should be a temporary effect, and will most likely rebound to premining levels after mining is completed.

The well located at the residence southeast of the proposed pit would have a drawdown of 10 to 20 feet at the end of mining. The time for the ground water to rebound to premining levels is greater than 50 years.

Impacts on Seeps and Springs

Most of the springs located within the study area are outside the cone of depression from pit dewatering. There is an unnamed spring, which has been called Sugarloaf Spring for purposes of this study, which does lie within the zone of influence. Due to hydrologic complexities of the site, such as the extent of communication between near surface waters and the regional ground water system, it is unclear if dewatering would affect this spring.

There are several seeps along Deadman Canyon and California Gulch which lie within the zone of influence from pit dewatering. However, as in the case of Sugarloaf Spring, due to the hydrologic uncertainties, it is not clear whether pit dewatering will have a direct influence on the seeps.

Impacts on Alluvial Ground Water and Surface Water Flows

The effect of pit construction would be to reduce the area contributing to streamflow in each of the three affected watersheds. With an estimated pit area of 0.27 square mile, 0.06 square mile would be removed from the Whitewater Canyon drainage, 0.09 square mile would be removed from the Deadman Canyon drainage, and 0.12 square mile would be removed from the California Gulch drainage. Of the unmined area in California Gulch, 0.79 square mile is upstream of the pit and 0.09 square mile is downstream of the pit. For evaluation purposes, the 0.09 square mile downstream of the pit is treated as being part of the future Deadman Canyon watershed, contributing to the total flow of Deadman Canyon at the haul road crossing.

Reduced areas in each watershed would result in slightly lesser flood flows and total runoff than for existing conditions. Table 4-5 compares modeled flood flows for existing and projected conditions. Revised peak flows from a 100-year, 24-hour storm are 1425 cfs to 1461 cfs for Deadman Canyon at the haul road alternatives, 856 cfs for Whitewater Canyon, and 275 cfs for California Gulch upstream of the proposed pit. Modeled flows in Deadman Canyon for Haul Road Alternative A are the same as for existing conditions. This is because the drainage area lost from Deadman Canyon is offset by the area of California Gulch north of the pit; future flow downstream of the convergence of the two streams would be approximately the same as existing flow upstream of the convergence. In effect, the portion of California Gulch north of the proposed pit becomes part of the Deadman Canyon drainage.

It is predicted that ground water inflows to the pit will initially be approximately 1.0 cfs (450 gpm), decreasing to less than 0.7 cfs (300 gpm) after three years. If Phelps Dodge elects to discharge this water to Deadman Canyon or California Gulch during pit dewatering, the volume of this flow would be added to that estimated in Table 4-5.

The alluvial ground water system within the zone of influence is severely restricted in areal extent. Although there is believed to be hydraulic communication between seasonal perched alluvial water zones and the regional aquifer, it is not known what the extent of the potential impacts will be.

TABLE 4-5
ESTIMATES OF EXTREME FLOOD AND AVERAGE ANNUAL FLOWS OF LITTLE ROCK MINE WATERSHEDS

Watershed	Modeled Peak Flood Flow (cfs)			Projected Annual Average Stormwater Flow (gpm)	
	Flood Return Frequency (years)	Existing Conditions	Projected Conditions	Existing Conditions	Projected Conditions
Whitewater Canyon, above junction with Deadman Canyon	10 25 100	269 474 889	265 467 856	36	35
Whitewater Canyon, above junction with SD-1 diversion channel	10 25 100	238 420 788	238 420 788	32	32
California Gulch[1]	10 25 100	88 158 293	79 144 275	9	7

TABLE 4-5 ESTIMATES OF EXTREME FLOOD AND AVERAGE ANNUAL FLOWS OF LITTLE ROCK MINE WATERSHEDS					
	Modeled Peak Flood Flow (cfs)			Projected Annual Average Stormwater Flow (gpm)	
Watershed	Flood Return Frequency (years)	Existing Conditions	Projected Conditions	Existing Conditions	Projected Conditions
Deadman Canyon[2]					
Haul Road A	10	481	481	55	55
	25	812	812		
	100	1,461	1,461		
Haul Road B	10	473	469	53.8	53.7
	25	798	792		
	100	1,436	1,425		
Haul Road C	10	473	470	54.1	54.2
	25	799	793		
	100	1,438	1,427		

[1]Watershed outlet to Deadman Creek junction for existing conditions, pit entrance for projected conditions.
[2]Watershed outlet is at site of proposed haul road crossing for existing and future conditions

4.3.4 Stream Diversion Impacts

There are three stream diversion alternatives for the flows in California Gulch above the proposed pit: SD-1, SD-2, and SD-3.

For SD-1, during operation of the mine, flows would be diverted in a constructed channel around the southwest portion of the pit, and discharged into Whitewater Canyon. Low (base) flows would be carried in a pipeline, placed within an engineered channel designed to carry the regulatory stormwater flow. This channel could be either permanent or temporary. If temporary, once mining ceases the flows will be discharged to the pit. The SD-1 diversion flow enters Whitewater Canyon at a point about 3300 feet above the point where the flows originating from the SD-2 diversion enter the canyon. The basin area for Whitewater canyon above the junction with SD-1 is 3.58 square miles, 0.41 square miles less than the area above the junction of the canyon with the unnamed tributary that would carry SD-2 flows.

For SD-2, flows would be diverted to an unnamed tributary of Whitewater Canyon during operation of the mine. As in SD-1, the diverted low (base) flows would be carried in a pipeline, placed within an engineered channel designed to carry the regulatory stormwater flow. This channel could be either permanent or temporary. If temporary, once mining ceases the flows will be discharged to the pit.

For SD-3, flows would be diverted directly to the pit bottom both during operation of the mine and after mining ceases. As in the other alternatives, the diverted low (base) flows would be carried in a pipeline, placed within an engineered channel designed to carry the regulatory stormwater flow. The flows collected in the pit bottom during mine operation would be pumped to one of three destinations: California Gulch north of the pit; Deadman Canyon downstream of the open pit, or to No 1A/1X Tailing Dam.

Changes in flows at the haul road crossing (Deadman Creek), Whitewater Canyon, and the junction of the Deadman and Whitewater streams are presented in Table 4-6. Modeled peak flows and calculated average flows in Table 4-5 were added or subtracted based on routing scenarios to construct Table 4-6. Although peak flows are not directly proportional to drainage area and tend to attenuate (decrease) downstream of watershed outlets, this summation provides conservative estimates.

Diversions of California Gulch flows to Whitewater Canyon would have two main impacts on the canyon's flow regime. First, each channel to which the diversion is proposed to discharge would carry the entire flow of California Gulch upstream of the pit (base flow 10 gpm or less, storm flows as in Table 4-5). Each of the two potential drainages (for SD-1 or SD-2) currently conveys little or no flow due to its small drainage area. Flow in the diversion to Whitewater Canyon for either SD-1 or SD-2 is estimated as 275 cfs for the 100-year 24-hour storm. Second, Whitewater Canyon downstream of the junction with either SD-1 or SD-2 would carry its existing flows in addition to all diverted flows. As an estimate of the maximum flow below the convergence of the diverted flow with Whitewater Creek, the sum of the post-construction 100-year 24-hour storm peak flows for both drainages is 1063 cfs for SD-1 and 1,131 cfs for SD-2. This is 35 percent and 27 percent, respectively, above the estimated peak for Whitewater Canyon in its current state at the respective junctions. Average stormwater flows at the junction increase from 32 gpm to 38 gpm for SD-1, and 36 gpm to 42 gpm for SD-2.

For SD-3, which flows into the pit, the volume of water inflow is more of interest than the peak flow. Runoff modeling indicates 45 acre-feet would flow into the pit as a result of the 100-year 24-hour storm. The relationship of this volume to available capacity is discussed in the following paragraph. Table 4-5 shows the peak 100-year, 24-hour flow for the SD-3 diversion channel. The effect of SD-3 on the flow below the junction of Whitewater Creek, Deadman Canyon, and California Gulch is uncertain, due to the uncertainty in the amount of flows to be pumped to the Tailings Pond and retained within the mining operation. The maximum reduction in peak and average flows are if the full flows from California Gulch, presented in Table 4-5, are retained.

If a lake is allowed to form in the pit following closure, water from California Gulch allowed to drain into the pit is expected to recharge the ground water (possibly discharging farther downstream) or be lost to evaporation. As noted above, runoff modeling indicates 45 acre-feet would flow into the pit as a result of the 100-year 24-hour storm. With an estimated pit capacity of over 11,500 acre-feet between the long-term lake level (elevation 5,730 feet) and the estimated pit rim elevation (5,800 feet), any floods from California Gulch are expected to be captured completely by the pit; no overflow of the pit is expected. A 15-inch runoff event (on the order of a probable maximum flood), from the portion of California Gulch draining to the pit, would result in a total runoff of only 630 acre-feet to the pit, well within the pit's capacity. Since water entering the pit does not contribute to downstream stormwater flows, peak storm flows and average annual flows would both be less (17 percent and 14 percent, respectively, at the haul road crossing) than flows under existing conditions.

TABLE 4-6 COMPARISON OF FLOWS FOR CALIFORNIA GULCH DIVERSION SCENARIOS								
	100-year 24-hour Storm Peak Flow (cfs)				Annual Average Stormwater Flow (gpm)			
Scenario	At Haul Road *	White-water Canyon Outlet	Junction of SD-1 and White-water Flows	Junction of Tributary (SD-2) and White-water Flows	At Haul Road*	White-water Canyon Outlet	Junction of SD-1 and White-water Flows	Junction of Tributary (SD-2) and White-water Flows
1. Existing Conditions	1,754	889	788	2,643	64	36	32	100
2. California Gulch Diverted to Whitewater Canyon (SD-1, SD-2 only)	1,461	1,131	1,063 for SD-1, 788 for SD-2	2,592	55	42	38 for SD-1, 32 for SD-2	97
3. California Gulch Drains into Pit	1,461	856	788	2,317	55	35	32	90
4. California Gulch Diverted to Deadman Canyon via Pit	1,787	856	788	2,643	65	35	32	100
*Haul Road Route A Crossing (see Table 4-5).								

If the pit is backfilled to the 5,800-foot level and a channel is constructed to Deadman Canyon, flows from California Gulch may be routed to enter Deadman Canyon. For this case, rainfall incident on the pit would also drain to Deadman Canyon. Summing peak storm flows (100-year 24-hour) for the two watersheds obtained from hydrologic modeling yields a peak flow in Deadman Creek of 1,769 cfs for this routing option, compared to 1,461 cfs estimated for Deadman Canyon in its current condition. This is an increase of 21 percent in the peak flow. Average annual stormwater flows at the haul road would increase from 64 to 65 gpm. Flow to Whitewater Canyon would decrease correspondingly. If flows from California Gulch are not routed to enter Deadman Canyon, only runoff from rain falling directly on the pit would enter Deadman Canyon. With an area of 0.27 square mile, compared to 6.21 square miles for Deadman Canyon, this flow would result in minor flow increases in Deadman Canyon.

Erosion and Sediment Impacts

The major impact of the stream diversion with regard to erosion and sediment deposition would be experienced where the constructed channel intersects with the natural drainage: for SD-1 where the constructed channel discharges directly into Whitewater Canyon , and for SD-2, where the constructed channel discharges to the unnamed tributary leading to Whitewater Canyon. Riprap or other protection would be placed at either discharge location of the diversion channel, but further improvements to the intersection are not planned.

According to the Soil Survey of Grant County, New Mexico (SCS 1983), Santa Fe soils comprise the drainage of the unnamed tributary, with a depth to bedrock of 6 to 20 inches. With a permanent diversion of California Gulch to this tributary, it is likely that the channel would eventually be eroded down to the bedrock. Eroded sediments would be deposited in the area of gentle gradient below the canyon mouth, decreasing the downstream channel capacity.

Limiting diversion of California Gulch to the life of the mine (approximately three years) would result in much less erosion than a permanent diversion. It is unlikely that extreme flood events would occur during this period, so only gradual erosion would be expected.

Due to the removal of California Gulch flows from their existing drainage, average flows below the existing confluence of the gulch and Deadman Creek would be somewhat less than current. However, since the Deadman Canyon drainage covers more than six times the area of the California Gulch drainage and therefore contributes the majority of sediment, deposition downstream of the confluence is not expected to change significantly as a result of the stream diversion.

If flows are routed to Deadman Creek at the 5,800-foot level following mine closure, it is unlikely that much additional erosion would occur. A channel would be constructed through the pit wall leading directly to Deadman Creek. This channel would be constructed in rock, and will not erode appreciably. Thus, the only increased erosion would be in Deadman Canyon itself. With extreme flood flows increasing by only 21 percent (see previous section) due to the addition of California Gulch runoff for the 100-year storm, increased erosion would be minor.

Floodplain Impacts

Areas of floodplain impact can be divided into three sections: Whitewater Creek between the canyon outlet and the junction of Whitewater and Deadman creeks; Deadman Creek between the various haul road alternatives and the junction of Whitewater and Deadman creeks; and the channel downstream of the junction of the two creeks.

For diversion alternatives SD-1 and SD-2, Whitewater Creek upstream of its junction with Deadman Creek would experience increased flows due to the addition of flow from the California Gulch diversion. Channel capacity of the creek is not currently known, so a quantitative assessment of floodplain impacts cannot be performed. However, with an approximate 18 percent increase in drainage area (current drainage area is 4.05 square miles), it is likely that most floods contained within the channel under current conditions would also be contained within the channel with the California Gulch diversion in place. Flows overtopping the channel would result in more flooding with the diversion than without. Additional inundation has not been quantified, but would likely be in the range of 18 percent more inundated area.

Deadman Creek prior to the junction of Whitewater and Deadman creeks would receive less flow for all action alternatives except the Partial Backfill option of routing California Gulch and pit flows to Deadman Canyon, for which its flow may increase slightly. Thus with mining in California Gulch, channel overtopping in the event of extreme floods will cause less inundation than under present conditions in all cases but one, for which additional flooding would be minor since only 0.06 square mile is added to the present drainage area.

The channel downstream of the junction of Whitewater and Deadman creeks, leading to Mangas Creek, would receive the same or slightly less flow for the action alternatives than for existing conditions. The flow regime for this channel would be similar for all alternatives, since the channel conveys the cumulative flow of all three watersheds. This cumulative flow would be largely unaffected by the proposed mine, so impacts to the channel and its floodplain are negligible. This channel and downstream are beyond the effective hydrologic influence of the proposed mine.

4.3.5 Haul Road Impacts

Haul road impacts would be negligible because the road is being constructed above surface water drainages. Where it is necessary to cross a drainage, proper engineering controls would be placed to allow for flows during stormwater events. The haul road would not have an impact on ground water.

4.3.6 Results

Alternative 1 - No Action

The no-action alternative would continue to have a negative impact on ground water quality due to the continued source of leachate from existing stockpiles. Currently, there are adverse impacts to the California Gulch watershed, as expressed by the CLDS seep, by existing leach stockpiles. In addition, there is a ground water contaminant plume, as documented in ground water samples collected from monitor well I,RW-4, adjacent to the leach stockpiles. The removal of the leach stockpile, as outlined in the Proposed Action, would remove the source of contamination that has been identified in I,RW-4 and the CLDS seep. In addition, mine dewatering during the life of the Little Rock Mine would contain the existing ground water contaminant plume from the existing leach stockpiles, and based on the ground water model, remove all or a substantial part of constituents of concern within the ground water plume.

The no-action alternative would have no effect on existing surface water flow conditions.

Alternative 2 - Proposed Action

During mine operations, the diversion of California Gulch to the open pit would cause decreased flows at the California Gulch/Deadman Canyon discharge at the proposed haul road and below. Rainfall directly on the pit area would no longer contribute to natural flows to Mangas Creek. If water is discharged to Deadman Canyon or California Gulch during pit dewatering, increased flow would occur in that drainage.

Following mine closure, flows from California Gulch entering the pit would either evaporate or recharge the ground water. Due to the large pit capacity relative to potential runoff, flows entering the pit are not expected to overtop the pit sides. The net result would be a decrease in flows ultimately entering Mangas Creek, with a decrease of 1.06 square miles from an original 11.26 square miles of contributing drainage area.

As in all action alternatives, rainfall directly on the pit area would no longer contribute to natural flows to Mangas Creek. The additional flow into the pit lake would raise the elevation from 5,730 feet to 5,733 feet.

If water from California Gulch is allowed to flow into the pit, it would have a small but positive effect on pit lake water quality. The *Geochemical Evaluation Technical Report* presents lake water chemistry for both best and worst case scenarios with the addition of flow from California Gulch (10 gpm). Under the worst case scenario, copper would still slightly exceed the NMWQCC surface water standard (0.55 mg/l), and the ground water standard for fluoride would be exceeded for both best case (2.5 mg/l) and worst case (5.9 mg/l) scenarios.

The removal of the leach stockpile, believed to be the source of the poor ground water quality in LRW-4, and the pit dewatering, which would likely remove elevated anions such as sulfates during the mine life, would have a positive effect on ground water quality. It does not appear pit dewatering will be effective in removing cations such as metals during the life of the mine.

Diversion Alternative SD-1

During mine operations, the diversion of California Gulch would cause increased flow in Whitewater Canyon and decreased flows at the California Gulch/Deadman Canyon discharge at the proposed haul road and below. Some erosion could potentially occur in Whitewater Canyon, below the point where the diversion discharges would occur, with eroded sediment being deposited in the streambed below the mouth of Whitewater Canyon.

Diversion Alternative SD-2

Impacts to water resources from Alternative SD-2 are similar to those described with Alternative SD-1, with the exception that potential erosion would occur on the unnamed tributary to which the diversion discharges would occur, rather than directly within Whitewater Canyon. As with Alternative SD-1, eroded sediment would likely be deposited in the streambed below the mouth of Whitewater Canyon.

Diversion Alternative SD-3

The potential channel and watershed erosion and deposition associated with Alternative SD-1 and Alternative SD-2 are not associated with SD-3. Peak and average flows below the junction of Whitewater Canyon, California Gulch, and Deadman Canyon could potentially be reduced by a full cutoff of inflows from California Gulch, if all pit inflows were diverted to the Tailings Pond.

Haul Road Alternatives A, B, and C

Haul alternatives vary slightly in the watershed area of Deadman Canyon upstream of the drainage structure designed to carry flows underneath the haul road. The variance in flows through the structure due to this variance in watershed area is not significant. Sizing of this structure should allow for minimal impacts on Deadman Canyon flood flows or channel morphology upstream and downstream of the structure.

Partial Backfill Alternative

Following mine closure, flows from California Gulch would be routed to Deadman Canyon via a drainage system constructed through the pit wall. In addition, runoff from precipitation incident on the pit would flow to Deadman Canyon. Peak flow in Deadman Canyon for the 100-year 24-hour storm would increase by 21 percent as a result, and average annual flows would increase slightly due to the minor increase in drainage area (the part of the Whitewater Canyon drainage that is incorporated within the pit). Minor additional erosion between the pit outlet and the junction with California Gulch may result. Flow below the confluence of the original California Gulch and Deadman Canyon would be similar to current conditions. This alternative retains the total flow and most nearly retains the flow distribution of the no-action alternative.

The construction of a temporary diversion of California Gulch, coupled with backfilling the pit and allowing drainage to Deadman Canyon, would not result in a positive effect on surface or ground water quality. This is because there would not be the mineral precipitation effects as found in the pit lake, which improves water quality by removing metals species. However, this alternative would not result in a degradation of water quality relative to that found in the *Geochemical Evaluation Technical Report* before mineral precipitation effects occur. Partially backfilling the pit would result in the predicted average water level stabilizing to 5,750 feet (AMSL) after 25 years. Drawdowns of up to 10 feet are estimated at distances of up to 6,000 feet from the pit after the end of mining.

A permanent drainage system into Deadman Canyon would increase Deadman Canyon flows by a small percentage due to the small area of the pit in relation to the drainage area of Deadman Canyon. This alternative retains the total flow of the no-action alternative. The construction of a permanent diversion to Whitewater Canyon, with backfilling of the pit and positive drainage to Deadman Canyon, would result in a similar water quality and pit lake level as a diversion to Whitewater Canyon.

4.4 BIOLOGICAL RESOURCES

Potential impacts of the proposed project to biological resources are associated with activities likely to occur during construction, operation, and closure of the mine. The following section provides an explanation of the methods used and the results of the impact assessment and mitigation planning process. The process utilized for the biological resources impact assessment included assessing the potential impacts to the resources by comparing the proposed activities with the existing conditions, developing measures designed to reduce or eliminate impacts, and determining the impacts that would remain following the implementation of mitigation.

The following analysis addresses the no-action and proposed action alternatives. It also provides a comparison of alternatives for various components of the project including haul road partial backfill stream diversion and stockpile location alternatives.

Reactivation and expansion of the mine would result in both adverse and beneficial impacts to biological resources, including vegetation, wildlife, and special status plant and wildlife species. Ground disturbance, occurring as a result of expansion of the pit and construction of the haul road and ancillary facilities, would impact resources to varying degrees depending on several factors including sensitivity of the resource, duration of the disturbance, and the level of disturbance. These impacts are either direct or indirect, and long term or short term. Impact types potentially associated with the proposed project may include:

- direct loss of vegetation resulting in the loss or degradation of potential habitat for wildlife species
- direct mortality of wildlife due to increased traffic at the mine site and along the haul road
- loss of potential habitat or food sources for special status species or other wildlife
- indirect effects to wildlife, which may avoid habitat adjacent to the mine site due to increased activity at the site

4.4.1 Vegetation

Results

Alternative 1 - No Action

Under the no-action alternative, the permit area and proposed mine site would remain in their present condition. There would be no additional loss of vegetation as a result of this alternative. However, water quality in the vicinity of the existing leach pile is poor and may continue to degrade as it flows into California Gulch and farther downstream. This could be detrimental to vegetation associated with this drainage as well as to wildlife that may drink the water.

Impacts Common to All Action Alternatives

The project area is approximately 600 acres in size, much of which is disturbed due to previous mining activities. The proposed pit and associated facilities are located adjacent to existing mining operations in the northern section of the project area. The vegetation within the study area consists of ponderosa pine forests, piñon-juniper woodlands, and intergradations of these main types. Riparian vegetation does not occur in the project area, although small stands or individual cottonwoods and ash occur in isolated pockets along Deadman Gulch, Whitewater Canyon, and California Gulch.

The proposed pit would cover an estimated 186 to 190 acres. The actual acres disturbed would be dependent on the haul road alternative selected. Of this acreage, approximately 63 acres are currently disturbed, 13 acres are grasslands/juniper grasslands, 110 to 112 acres are juniper grasslands/piñon-juniper woodlands, and 2 acres are ponderosa pine forest. Ponderosa pine forests and piñon-juniper woodlands are extensive in the cumulative study area, particularly to the south on Forest Service lands. The loss of 114 acres of such habitat in the vicinity of the mine would have minimal impact on the integrity of the area. A few cottonwood trees along California Gulch south of the existing pit may be removed as a result of pit expansion or during the clean-up operation of the leach pile.

Alternative 2 - Proposed Action

Under the proposed action, the pit would cover an estimated 186 acres. A permanent diversion of California Gulch would be created which would allow for the discharge of seasonal flow into the pit. This diversion would not result in loss of vegetation as the channel is located on previously disturbed land. The water would be pumped from the pit and discharged to either Deadman Canyon or tailing dams. If water is discharged to Deadman Canyon, it could enhance opportunities for the development of riparian habitat along this drainage. Haul Road Alternative B and Stream Diversion Alternative SD-3, as described below, are part of the proposed action.

Haul Road Alternatives

Haul Road Alternative A. Route A is the longest of the three haul road alternatives and would, therefore, result in the greatest amount of ground disturbance. Approximately 58 acres would be disturbed, including 33 acres of grasslands/juniper grasslands, 24 acres of piñon-juniper woodlands, and approximately 1 acre of area which has been previously disturbed. Also, approximately 136 acres of grasslands/juniper grasslands would be covered by the proposed stockpile.

Haul Road Alternative B. Construction of this route would result in the loss of approximately 40 acres of vegetation, including three acres of grasslands/juniper grasslands and 37 acres of piñon-juniper woodlands. The 150-acre waste stockpile area would cover an area with one-third grasslands/juniper grasslands and two-thirds piñon-juniper woodland/chaparral ecotone.

Haul Road Alternative C. Route C covers the shortest distance of the three alternatives and would result in disturbance to approximately 27 acres, most of which is in piñon-juniper woodlands or juniper grasslands. However, this route would require a fill and culvert structure at the crossing of Deadman Canyon and could result in a greater disturbance to vegetation in that area. The stockpile area would be similar to Haul Road Alternative B.

Stream Diversion Alternatives

Whitewater Canyon (SD-1). Alternative SD-1 would require completion of a channel and pipe to carry water from the pit area to Whitewater Canyon. If permanent, the additional water could enhance opportunities for the development of more extensive riparian habitats along this drainage.

Whitewater Canyon-Tributary (SD-2). Alternative SD-2 would result in the diversion of flows from California Gulch to a tributary of Whitewater Canyon. Opportunities for enhanced riparian habitats along these drainages could be as described for SD-1.

Discharge to Pit (SD-3). For Alternative SD-3, the proposed action, water would be diverted from California Gulch to the pit, where it would subsequently be pumped along with ground water to Deadman Canyon, California Gulch downstream from the pit, or to the tailing dams. The location of the discharge would be determined by the water quality. If water is pumped to other drainages, benefits to riparian habitats could result.

Partial Backfill Alternatives

There are two alternatives which would involve partially backfilling the pit following mining operations. The pit would be backfilled to the 5,820-foot elevation mark and a system to drain water from the pit to Deadman Canyon would be developed. This would provide opportunities to increase habitat for terrestrial wildlife by revegetating the former pit area. However, there would be disturbance to the area from which the backfill material is obtained.

The difference between the Partial Backfill Alternative would be the creation of a temporary or permanent diversion of California Gulch, respectively. Water from California Gulch would be diverted into the pit area, or into Whitewater Canyon directly or to one of its tributaries. A permanent diversion to Whitewater Canyon would increase seasonal flow and may enhance riparian habitat along the drainage. The combination of maintaining a permanent diversion and backfilling the mine pit would be the optimum combination for biological resources.

4.4.2 Wildlife and Fisheries

Results

Alternative 1 - No Action

Under the no-action alternative, there would be no additional loss of wildlife habitat and the current seasonal drainage systems would continue. There could be continued degradation of water quality, particularly in California Gulch, which runs adjacent to an existing leach pile and then drains into Deadman Creek. Water quality standards for copper and aluminum are exceeded at this point, which could be detrimental to wildlife dependent on the water in this area.

Impacts Common to All Action Alternatives

Wildlife in the vicinity of the existing mine include big game species, small mammals, diverse avifauna on a seasonal and residential basis, and reptiles and amphibians. All of the action alternatives would result in the loss of habitat for wildlife as described under the section on impacts to vegetation. The sites for the proposed haul road alternatives are adjacent to the existing mine facilities and it is unlikely that this habitat is utilized by wildlife due to current mining activities. Big game and avian species would likely avoid the area during construction of the road and during times of high human activity. There may be some short-term loss of ground dwelling mammals and reptiles. Increased vehicle traffic in the area may result in direct mortality of wildlife due to collisions with haul vehicles. Avoidance of the area would be a short-term effect occurring during the life of the project (two to four years).

Expansion of the existing pit would result in the loss of approximately 13 acres of grasslands-juniper grasslands, 112 acres of piñon-juniper woodlands, and 2 acres of ponderosa pine forest. No riparian habitat would be lost as a result of the expansion, with the possible exception of a few individual cottonwood trees along California Gulch near the old mine facilities. Increased activity at the pit site and along the road would most likely result in wildlife avoiding the area. One spring that is utilized by wildlife is located west of the existing pit and would likely be adversely effected by dewatering activities of the pit. However, there are other water sources nearby which can be utilized by big game. It is not anticipated that the displacement of big game into adjacent habitat would be detrimental to the populations due to the existence of higher quality habitat south and west of the site. No critical seasonal habitat or birthing areas for big game are known to occur in the vicinity; therefore, effects from the mine would not have long-term adverse effects on population dynamics or recruitment numbers.

No fisheries resources exist in the drainages which traverse the site. Therefore, water quality would not be an issue for fish populations. However, past activities in some areas have resulted in levels of copper and aluminum which exceed state water quality standards. These elements are not generally considered as critical in water sources for wildlife (unlike selenium, cadmium, lead, and mercury, for example); however, when the existing leach piles are mitigated, water quality would improve in the area. This would be a benefit to all biological resources. Another potential benefit would be the opportunity to revegetate the pit site and haul road which would provide additional habitat for terrestrial wildlife.

Alternative 2—Proposed Action

The proposed action would result in some loss of habitat for wildlife. Following closure of the mine, no drainage system would be developed and the mine pit would fill with surface runoff and ground water. This would, in essence, become a manmade lake which would likely be utilized by wildlife, where accessible, and migratory birds passing through the area. Given that the water quality meets standards for wildlife, it could potentially constitute a beneficial effect for wildlife habitat.

Partial Backfill Alternatives

Partially backfilling the pit would provide an opportunity to increase wildlife habitat by revegetating the pit area following mining operations. The Partial Backfill Alternative, that involves a permanent diversion of California Gulch, could increase the development of riparian habitat along Whitewater Canyon. This would be beneficial to all wildlife, particularly mammals and birds which utilize the area for food and shelter.

Haul Road Alternatives

Habitat types likely to be lost due to the construction of each of the three haul road alternatives are described under the section on impacts to vegetation. Increased mining traffic along any of these roads could cause wildlife to avoid the area and alter current movement patterns. Wildlife continuing to utilize the area could be subject to increased collision hazards from vehicles hauling the mined material from the pit area. These impacts are likely to minimal, as the roads are located adjacent to mining activity and are not heavily utilized by wildlife. Additionally, these impacts would be short term, occurring during the life of the project.

Stream Diversion Alternatives

As previously described under the section on impacts to vegetation, there are three stream diversion alternatives. If these diversions are permanent, then there could be an improvement in riparian habitat along the drainages receiving the flow. This may benefit wildlife in the area.

4.4.3 Special Status Species

A draft Biological Assessment was prepared for the Little Rock Mine Project with a determination of no effect for all federally listed species potentially occurring in the project area (Dames & Moore 1996).

Results

Alternative 1 - No Action

The no-action alternative would not result in the loss of potential habitat for special status species which may occur in the vicinity of the mine.

Impacts Common to All Action Alternatives

No significant unavoidable adverse effects would result to special status species as a result of the action alternatives. Several special status species have the potential to occur in the vicinity of Little Rock Mine, although known locations of such species do not exist on the proposed expansion site or haul road. Occult little brown bat and spotted bat have the potential to inhabit ponderosa pine trees, of which approximately two acres would be lost. They generally occur in close proximity to water and it is unlikely that loss of this habitat would have an adverse effect on bat populations. Peregrine falcon and northern goshawk may forage over the grassland areas during the winter months. Approximately 63 acres of grasslands, which support prey species for the raptors, would be lost temporarily. The affected grasslands constitute approximately one percent of the project area. Ferruginous hawks inhabit piñon-juniper woodlands during the winter months, although no occurrences are known in the project area. Approximately 200 acres of piñon-juniper woodlands would be lost, which constitutes 33 percent of the project area or 10 percent of the study area.

The green-flowered pincushion, a BLM sensitive species, is known to occur on the Tyrone Mine and may occur within the arid grasslands at the Little Rock Mine site. If populations of this plant are located on the proposed expansion site or along the haul road, they could be transplanted to adjacent suitable habitat, or otherwise salvaged. There is low to moderate potential for occurrences of two additional Federal candidate C2 species, Pringle's hawkweed, and grama grass cactus. Both of these species inhabit piñon-juniper woodlands and grasslands and there would be a short-term loss of potential habitat as a result of expansion of Little Rock Mine.

Alternative 2 - Proposed Action

Under the proposed action, there would be permanent diversion of California Gulch to the pit. Because no drainage system would be developed, the mine pit would fill with surface runoff and ground water following mining operations. This would, in essence, become a manmade lake which would likely be utilized by wildlife and migratory birds passing through the area. Spotted and occult little brown bats are insectivorous and generally forage over open water which acts as breeding grounds for insects; therefore, the presence of the ponded water may increase the foraging opportunities for bats. There would also be increased habitat available to amphibians, such as Arizona toad and narrow-headed garter snakes. These are federal candidate species which inhabit water sources in arid to semi-arid habitats.

Partial Backfill Alternatives

The pit would be partially backfilled to the 5,820-foot elevation mark and a system would be developed to drain water from the pit to Deadman Canyon. There would be an opportunity to revegetate the pit site and haul road which would provide additional habitat for terrestrial wildlife. Over time, small mammals may begin to inhabit the area providing a prey base for raptors, such as gray hawks, peregrine falcons, and northern goshawk. A permanent diversion of water to Whitewater Canyon could enhance riparian habitat which could support prey and provide nesting and perching sites for such species.

Haul Road Alternatives

Impacts to special status species associated with the haul road alternatives are as described under "Impacts Common to All Action Alternatives."

Stream Diversion Alternatives

Impacts to special status species associated with the stream diversion alternatives would be similar to those described under the "Partial Backfill Alternatives." If permanent diversion occurs and riparian habitat increases, this would be beneficial to several special status species as previously listed.

4.5 LAND USE AND ACCESS

Potential impacts to land uses that could be caused by the proposed project would result from a number of activities during construction, operation, and maintenance of the Little Rock Mine. The primary concern is the potential conflict with existing or future land uses resulting from construction, operation, and reclamation of the proposed mine site. This process includes (1) assessing potential impacts to land uses by comparing the proposed action (i.e., construction, operation, and maintenance activities) with the condition of the existing environment (i.e., prior to construction); (2) determining measures that would mitigate or eliminate the impacts; and (3) identifying the impacts that remain after mitigation (or residual impacts).

4.5.1 Method

Implementation of the proposed action or any of the alternatives would have similar impacts to all existing land use, range, transportation, and recreation resources. Impacts to land use and access resources are characteristically similar in nature regardless of which action alternative is selected. The types of impacts related to land use and access are described below.

Impact Types

Once the inventory of land uses was compiled and analyzed, and the proposed project activities were reviewed, the types of impacts were identified and characterized. The types of impacts to land uses are characteristically direct and long term, and generally include any impact that physically affects, alters, or displaces any use of the land. Impacts can result from:

- Ground disturbance - Ground disturbance, mainly associated with construction, causes physical disturbance of the surface and subsurface resulting in short- or long-term disruption and/or losses of land uses (e.g., grazing, wildland, recreation).

- Presence of the mine - Generally, limited uses may be allowed within the mine area, as long as the uses are compatible with the primary purpose of the mine and do not jeopardize the operation of the mine, or the health and safety of people. Activities that may not be allowed could include grazing, recreation, residential, and public uses.

- Indirect Impacts - Cumulative impacts affecting water resources, air quality, vegetation, wildlife and fisheries, visual resources, and noise.

More specific examples of impact types for each of the land use themes are provided below.

4.5.2 Results

Existing Land Use

Potential impacts with existing land uses, resulting from the construction and/or presence of the mine, would be low or negligible. The effects of these impacts would be low due to the current operations of other mining and industrial activities in the area. No impacts would occur to residences.

Range Resources

Potential impacts that may result from the operation of the Little Rock Mine include reduction of grazing capacity as a result of ground disturbance, and disruption to grazing activities from changes in fence lines. The mine operation would be fenced to restrict livestock. These impacts would be considered low, due to minor modifications of the fence line, and because leach stockpiles currently occupy the 45 acres of Forest Service grazing land. No AUMs would be affected. After mining operations are complete, and reclamation activities such as grading and reseeding with native plants have taken place, the grazing allotment may actually sustain a positive net benefit.

Transportation/Utilities

No transportation routes, transportation plans, or major rights-of way are affected in the study area. The existing Texas-New Mexico Power Company power line traversing the mine area will be re-routed prior to mine construction. Existing service along this line may be interrupted for the short term.

Future Land Use

Impacts to future land use would include adding the Little Rock Mine to already allocated mining and industrial operations in the area. This allocation would be permanent, and no other planned or proposed land uses potentially would occur, unless they are industrial (BLM 1995).

Haul Road Alternative A would cross unpatented mine claims north of the Little Rock Mine site. The mine claimants have proposed exploration and mining operations that would conflict with construction of the Haul Road Alternative A. Alternatives B anc C would not result in any land use conflict.

Recreation

Recreation resources may be affected by the mining operation, reducing quality of experience and restricting both motorized and non-motorized access to some areas. Impacts to recreation are expected to be minor, since recreation is informal and dispersed in the study area. The potential impacts to hunting would be negligible, due in part to the high amount of ground disturbance already existing in the study area.

4.6 SOCIOECONOMICS

No adverse socioeconomic impacts are likely to result from the proposed action—construction and operation of the Little Rock Mine. However, the no-action alternative would result in direct and indirect negative effects resulting from the loss of jobs and associated economic benefits associated with the Tyrone operations. Implementation of the project would sustain and prolong the ongoing level of employment and wages, procurements from suppliers, and payments of taxes to state and local governments that have been generated for many years by Phelps Dodge at its Tyrone Branch operation. The principal variable is timing, i.e., for how long copper ore mining at the site will continue. Current estimates place the life of the Little Rock Mine at two to four years at proposed rates of output, depending on world copper prices.

4.6.1 Phelps Dodge Copper Operations and the Regional Economy

Phelps Dodge accounted for about one-fifth of the jobs in Grant County in 1993—approximately 2,300 out of 12,200—divided among the Tyrone Branch (including both the Tyrone Mining Operations and Burro Chief Copper Company subsidiaries), the Chino Mine, and the Hurley smelter. Tyrone Branch's work force of approximately 380 thus accounted for about 17 percent of the company's total staffing in Grant County and, by extension, about 3 percent of total countywide employment.[1] As another indicator, the total value of payroll, procurements and local taxes paid directly by Phelps Dodge to Grant County residents, businesses and governments in 1993 amounted to $104 million, according to a report prepared by the Western Economic Analysis Center, Arizona (Phelps Dodge 1994). The Tyrone Branch's share of these outlays was estimated at $26.43 million, according to another study (Phelps Dodge 1995b), thus indicating that the Tyrone operation represents about 25 percent of the company's direct economic impact on Grant County. Secondary (indirect and induced) multiplier effects within Grant County generated by Phelps Dodge's direct payments are estimated at the equivalent of 80 percent of the direct effects.[2] Thus, the sum of direct, indirect, and induced economic activity in Grant County in 1993 from all Phelps Dodge operations there was estimated at $185 million, of which the Tyrone operation contributed approximately $47.5 million (Phelps Dodge 1994, 1995b).

The total value of goods and services produced by all economic entities—businesses, governments and households—in Grant County in 1993 was estimated at approximately $1.48 billion (IMPLAN 1994), of which Phelps Dodge's Grant County operations directly or secondarily generated about one-eighth.[3] The Tyrone Branch's operations contributed about one-fourth of the value of the company's output in Grant County, or about three percent of total county output of goods and services.

Phelps Dodge has copper operations in other counties in New Mexico, and in 1993 their direct impact amounted to over $180 million statewide, divided among Grant County ($104 million), Luna and Hidalgo counties ($36 million), Bernalillo ($12 million), Santa Fe ($9 million), Doña Ana ($2 million), and others ($18 million) (Phelps Dodge 1994). Secondary multiplier effects due to the recycling of income and spending added another $400 million in indirect and induced output, earnings and taxes to the statewide total.

Breakdowns of the economic contributions of the Phelps Dodge's Tyrone Branch to the Grant County and New Mexico economies are presented in Tables 4-7 and 4-8.[4]

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[1]As of February 1995, the Tyrone Branch work force numbered 459 persons (103 salaried and 356 per diem), of whom 429 resided in Grant County, 23 in Hidalgo County, 6 in Luna County, and 1 in Catron County (Phelps Dodge 1995).

[2]Regional economic analysis divides impacts into three categories. Direct impacts are the value of payments for factors of production by the entity (i.e., Phelps Dodge) to meet the demand for its products. Indirect impacts are the payments made by the suppliers of inputs to the direct entity in order to pay employees and replace inventory. Induced impacts result from the spending of wages and other income earned by the households supplying labor to the direct and indirect entities.

[3]The $185 million direct, indirect and induced output attributable to Phelps Dodge equals 12.5 percent of countywide total industry output of $1.48 billion. The company's $104 million of direct payments equals 7.0 percent of $1.48 billion, while the secondary component of $81 million equals another 5.5 percent.

[4]Data provided by Phelps Dodge from a confidential report also prepared by the Western Economic Analysis Center (WEAC). Data inputs and assumptions for allocating expenditures by category and estimating multiplier effects were not made available to Dames & Moore. A number of sensitivity tests of the implied multiplier effects presented in the

TABLE 4-7 TYRONE BRANCH ECONOMIC IMPACT ON GRANT COUNTY, 1993 ($'000)			
Category	**Direct Impact**	**Secondary Impact**	**Total Impact**
Personal Income (1)	12,590	6,840	19,430
Business Income (2)	12,768	13,294	26,032
Local Governments (3)	1,101	895	1,996
Total	26,429	21,029	47,458

TABLE 4-8 TYRONE BRANCH STATEWIDE ECONOMIC IMPACTS, 1993 ($'000)			
Category	**Direct Impact**	**Secondary Impact**	**Total Impact**
Personal Income (1)	12,590	20,922	33,512
Business Income (2)	14,130	47,279	61,409
State/Local Governments (3)	4,673	7,242	11,915
Total	31,393	75,443	106,836

Source: Phelps Dodge 1995b.
Notes: (1) Includes employee wages, salaries and supplemental unemployment benefits.
(2) Includes procurements from public utilities, construction contractors, wholesale and retail vendors, transportation, manufacturing, services, other mining companies, and miscellaneous.
(3) Includes school districts and county and municipal governments and the State of New Mexico.

Inspection of the two tables reveals considerable differences between the countywide versus statewide secondary impacts on personal and business incomes. The greater values at the statewide level are largely due to outflow of spending to adjacent counties and to the Albuquerque area for procurement of supplies for copper production and for personal consumption. There is also a substantial difference in the levels of government revenues between Grant County and the rest of the state at both the direct and secondary

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Phelps Dodge report were performed using the IMPLAN system of input-output modeling. Models for Grant County and the statewide economy were constructed and tested for the response of county and statewide employment, earnings and output to reductions in the levels of direct impacts cited in Tables 4-7 and 4-8. The magnitudes of the indirect and induced effects were found to be quite close to those in the Phelps Dodge report, leading to the conclusion that WEAC's model was similarly structured to IMPLAN's (which is based on the U.S. Department of Commerce, Bureau of Economic Analysis and the U.S. Department of Labor, Bureau of Labor Statistics input-output models of the national economy).

levels, which is largely due to the remittance of severance taxes and a portion of property taxes to the state government in Santa Fe. These indirect business taxes, which are augmented by sales taxes on the induced retail spending of households, support a significant number of government jobs around the state.

4.6.2 Results

Impacts of Little Rock Mine

The proposed action and other action alternatives for the Little Rock mine would have no appreciable social or economic impacts on the human environment because they would introduce no change in the area's patterns and trends of socioeconomic activity. Accordingly, no mitigating measures would be required. It is the contrary case—the no-action alternative or, ultimately, exhaustion of copper reserves and termination of mining at Tyrone—that would cause low to moderate negative socioeconomic impacts. Timing is the principal variable influencing the socioeconomic impacts of the Tyrone operation. Ultimately the Tyrone area's economically recoverable copper ore deposits will be exhausted, and mining operations will have to be terminated. The Little Rock Mine action will allow two significant activities to occur: (1) maintain current levels of employment, earnings and local tax payments flowing from the Tyrone operation to county residents, businesses, and local government agencies; and (2) allow local institutions and economic entities to have more time to plan for the eventual loss of cash flows stemming from that source of income and spending.

Without the Little Rock Mine, some activities would continue at Tyrone, but a majority of the work force would have to be laid off. Production of copper from SX/EW of stockpiled ore and reclamation and revegetation of existing deposits would provide some employment for several years. Other Phelps Dodge activities in Grant County (which account for the majority of the company's economic impacts on the county) would be unaffected by events at Tyrone. Some Tyrone Branch personnel would be transferred to other Phelps Dodge operations in New Mexico or Arizona, while others would be laid off or take early retirement. It is not presently known how many workers or how much copper production would continue at Tyrone without the Little Rock Mine, but the Tyrone Branch's contributions to the state and local economies would continue at some fraction of the economic values presented in Tables 4-7 and 4-8 and the fiscal values reviewed in Section 3.6.4.

The negative impacts on Grant County from the no-action alternative (i.e., denial of the Little Rock Mine permit) can be inferred from the data in Table 4-7, and on the state from data in Table 4-8. Production of the Little Rock Mine would allow the Tyrone Branch operation to continue at current levels for several more years, thus sustaining the flows of payroll earnings, procurements, and taxes into the local and regional economy. The no-action alternative would precipitate loss of those inflows.

The final column of Table 4-7 indicates that the Tyrone Branch contributed an estimated $19.43 million to Grant County Personal Income (direct plus secondary impact) in 1993. Total employee compensation for the county in 1991 (per the IMPLAN database) was $239.37 million, which corrected for growth and inflation in the two ensuing years would have been around $250 million in 1993. Thus, the Tyrone Branch's personal income contribution represented about 7.8 percent of county wages and salaries. This would be equivalent to the average earnings of approximately 975 workers. Loss of 975 jobs would approximately double the 1993 unemployment rate in the county, although unemployment benefits and workers relocating or taking early retirement would reduce the impact on the economy.

Regarding business income, Table 4-7 estimates that $26.03 million in business income in Grant County was supported by the Tyrone Branch in 1993. The IMPLAN database for Grant County indicates that the procurements of goods and services as intermediate inputs by county-based businesses exclusive of the materials and services the copper mining and refining sectors supplied themselves internally amounted to $123.0 million in 1991 (equivalent to about $130 million in 1993). Thus the $26 million worth of goods and services that the Tyrone Branch purchased from other industries and suppliers in Grant County represented around 20 percent of the latter's business volume. The transportation, public utility, construction, and professional services sectors would experience the bulk of these impacts, according to the IMPLAN model.

Finally, Table 4-7 estimates that county and local governments and school districts received over $1.99 million in revenues directly and indirectly as a result of the Tyrone Branch's operations in 1993. According to the IMPLAN database for Grant County in 1991, revenues from sales and property taxes (designated as indirect business taxes) to local governments aggregated to $32.06 million (or about $34 million in 1993). Thus, the Tyrone Branch's direct property taxes (from the Copper Production Ad Valorem Tax) plus tax revenues derived from the state gross receipts tax on the consumption spending of households directly or secondarily accruing income from the Tyrone operation accounted for about six percent of local tax revenues. The incidence of the property tax revenue losses would be most acute on the county government inasmuch as it relies relatively more on the Copper Production Ad Valorem Tax than the school districts.[5] Silver City would be impacted by the loss of gross receipt taxes if households contracted their spending in the wake of closure of the Tyrone operation.

Because of the absence of changes in employment or population projected to result from the proposed project, any social effects to local communities would be negligible. No issues or concerns have been raised in the public scoping process to indicate that minority or other special populations would be affected by the proposed action or any of the alternatives.

In summary, if Little Rock Mine could not be worked the curtailment of employment and income would definitely be felt in Silver City, and to a lesser extent countywide. Businesses particularly oriented to supplying the copper industry would experience significant reductions in business. The community would perhaps experience low to moderate levels of recession. The overall severity or duration of the downturn would, however, probably not be worse than would occur as a result of a cyclical decline in world copper prices (such as occurred in the 1980s) forcing a temporary reduction in copper production.

[5]Anecdotally, the county manager recounted that when the Tyrone mine was closed in 1982 the county lost about one-half million dollars in property taxes (Cardoza 1995).

4.7 VISUAL RESOURCES

This section provides an evaluation of visual impacts of the proposed Little Rock Mine plan of operations and alternatives, including (1) a description of the study methods, (2) impacts to adjacent scenery and potential viewers, (3) compliance of the project with BLM and Forest Service visual management objectives, and (4) the potential mitigation actions that could reduce visual impacts.

4.7.1 Methods

The purpose of the visual resource assessment is to identify impacts to scenery and views, and address compatibility with the VRM classes of the area. The potential visual contrast of the project was analyzed using several different elements of the project for investigation. The elements of this action which could potentially affect the existing visual conditions consist of the open pit hard rock mine; the haul road route, Alternatives A, B, and C; the California Gulch stream diversion, Alternatives SD-1, SD-2, and SD-3; the addition of a waste stockpile located east of the pit; and the removal of existing tailings located immediately south of the pit. The contrast of these project components was analyzed for impacts to local scenery, potential viewers, and compliance with BLM and Forest Service management objectives.

Both short-term impacts (two to four years) and long-term impacts have been considered. Visual impacts relate directly to changes to the form, line, color, and texture of the landscape as a result of landform and vegetation contrasts from proposed mining activities. The degree of contrast is based on the BLM Contrast Rating System (BLM 1986) as follows:

- Weak — The element contrast can be seen but does not attract attention.
- Moderate — The element contrast begins to attract attention and begins to dominate the characteristic landscape.
- Strong — The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

High visual impacts would result when strong levels of contrast from mining activities conflict with local scenery or sensitive viewpoints, or BLM or Forest Service visual management objectives. Moderate and low levels of visual would be associated with lesser degrees of conflict resulting from visual contrast.

4.7.2 Results

The existing landscape that is within and adjacent to the mining permit area has been extensively modified by the presence of surface extraction from the existing Little Rock excavation. The site was active most recently in the early 1970s producing copper using head leaching methods and, in general, has the appearance characteristic of surface mines throughout the region. The existing remnants of the previous operations, primarily the open pit, have already caused a high level of visual contrast when compared with the surrounding landscape. Additional excavation will be mitigated to the extent possible with appropriate actions detailed in the Reclamation Plan. As a result of these actions and the distance and visibility of potential viewers, the proposed mine construction will not result in any high impacts to scenery or viewers. Descriptions of visual impacts associated with components of the proposed mine and alternatives follow.

Open Pit

The site of the proposed open pit currently is characterized by multiple terraces. The terraces vary in size and are comprised of exposed sub-strata, residual ore, and the remnants of cleared vegetation. The color of the exposed rock is significantly lighter than the surrounding hillsides; the form of the sidewalls and terraces are more angular than the natural terrain; and the surface of the mined areas are smoother than the naturally formed and weathered slopes (see Figure 2-4). The introduction of the new pit would increase the depth of the existing excavation by approximately 300 feet, and would exceed the perimeter of the original mine in several places. It would expose a larger surface area of sub-strata and result in the clearing of all existing native vegetation within the immediate area.

The level of visual contrast resulting from the proposed open pit would typically result in a strong contrast rating; however, due to the pre-existing conditions, the visual contrast would be perceived as moderate. Because of the limited success of visual mitigation and reclamation with large scale open pit excavation, moderate contrast levels would result for both the short and long term. The scenery in the area has already been modified and the additional contrast from the proposed pit would result in low impacts to scenic quality, in both the short or long term. Impacts to viewers would also be low and are limited to Mangas Creek Road, where from two miles away, any visibility of the open pit would be evident but subordinate to the surrounding landscape which is dominated by existing mining. The area is designated as VRM Class IV by the BLM, and a VQO of modification by the Forest Service. Moderate contrast levels associated with the open pit would be compatible with these objectives.

Haul Road Alternatives

The proposed haul road would extend no more than one mile from the proposed Little Rock pit generally to the east, between the proposed pit and the Tyrone excavation. Each of the three alternatives described in this section would cross Deadman Canyon between the elevations of 5,600 feet and 5,900 feet (see Figures 2-1a, 2-1b, and 2-1c). Each of the alignments will, in general, pass through unmodified terrain that is vegetated with cedar and juniper, which is typical to this region of New Mexico, but unique to the adjacency of the project. The difference between each of the alternatives is the location of the alignment relative to potential viewers and the appropriate cut and fill required. Each of the alternatives will require road construction consisting of substantial grading and vegetative clearing to maintain a slope of less than 10 percent maximum grade.

- Haul Road Alternative A (Figure 2-1a) - This is the northernmost of the alternatives, and is probably more exposed to distant views from the north and west than the others. It is also the longest, starting on the northwest edge of the pit at elevation 5,900 feet, following the entire north face of the permit area crossing the base of Deadman Canyon at elevation contour 5,660 feet.

It then extends to the far east edge of the study area ending at an elevation of 6,200 feet. Though it is the most visible of the alternatives and its length will require more vegetative clearing, it tends to follow ridge lines along most of its route and thus, will require less cut and fill.

- Haul Road Alternative B—Proposed Action (Figure 2-1b) - This alternative is the most southern and is well contained within Deadman Canyon for half of its length. However, the eastern two thirds of the alignment are above the 6,000-foot elevation line and will most likely be seen from the north and west. The alignment crosses Deadman Canyon at the 5,900-foot elevation, and straddles the east side of the canyon before following a ridge line to the base of the Tyrone site. The portion along the side of the canyon will require a significant amount of cut and fill, and subsequent vegetative clearing, though its length is relatively short. The crossing of Deadman Creek will most likely consist of an at-grade crossing and relatively small culvert, resulting in a visually insignificant segment along the alignment. Associated with this alternative would be an additional waste stockpile located northeast of the open pit and adjacent to the haul road alignment. The proposed stockpile would be within the visual context of the Tyrone Mine. Though it would be a dominant feature in the landscape, it would not be perceived as a significant change, due to the existing waste stockpiles that are prevalent throughout the area.

- Haul Road Alternative C (Figure 2-1c) - This alternative is significantly shorter than the others, resulting from a due east alignment perpendicular to Deadman Canyon. The alignment then follows a ridge line the remaining short distance to the Tyrone site. A fill and culvert structure 250 feet in height would be needed to span Deadman Canyon and would result in visually dominating the immediate area and changing the characteristics of the canyon. Though there is major changes to the landscape resulting from this alternative, it is nevertheless a relatively short distance, and its position within the canyon conceals most of the changes from potential viewers. The proposed stockpile associated with this alternative would be within the visual context of Tyrone Mine, as described for Alternative B, above.

After closure of the mine, major portions of the haul road would be reclaimed to the general condition of the original and surrounding landform, and some native vegetation will be reestablished. These mitigation measures will reduce the long-term contrast rating of the haul road to weak.

Long-term impacts to scenery after reclamation would be low. Potential views of the haul road would be limited to Mangas Creek Road, where visual impacts would be low due to the adjacent mines and existing tailing ponds along Mangas Creek. Both short- and long-term visual impacts to the haul road would be compatible with management objectives for the BLM and Forest Service.

<u>Stream Diversion Alternatives</u>

Sections of the California Gulch have been substantially altered due to previous activities at the Little Rock site in the early 1970s. The creek to the south of the existing excavation, however, is still in pre-mining conditions, with riparian areas, and limited stands of pine and cedar (see Figure 3-6). Alternative diversions of California Gulch, SD-2 and SD-3, are both within the immediate vicinity of the open pit or haul road, or contained completely within. These alternatives will either be unseen or associated with impacts from either the haul road or the open pit. Therefore, there will be no visual impact associated with these actions.

Alternative SD-1, however, will transmit flow direct to Whitewater Canyon and will require that a channel be cut through an existing ridge along the western edge of the open pit. This channel would run approximately 2,200 feet from the pit to Whitewater Canyon and be exposed to foreground and middleground views from the north and northwest. The channel would require an extensive amount of cut and vegetation removal and would alter the character of the eastern slope of Whitewater Canyon at that location. Impacts of the diversions to viewers would be low and are limited to a short stretch of travel along Mangas Creek Road. The visual contrast associated with the alternative is compatible with BLM and Forest Service management objectives.

Existing Leach Stockpiles

A large area of leach stockpiles remain from the previous excavations that occurred at the existing Little Rock Mine (see Figure 3-6). They are several hundred feet high and consist of native ore extracted from the mine. The piles are adjacent to the existing excavation, in the southern portion of the permit area on the BLM and Forest Service boundary. The color of the ore is both lighter and slightly reddish, and differs from the native topsoil. The piles are heaped to a steep gradient and are usually flat on top, creating a strong visual with the area. This ore will be removed and processed, and the site will be graded to its natural form and revegetated.

With the removal of the existing tailing piles and restoration activities, the landscape would revert to a character similar to pre-mining conditions. The impacts to the local scenery and viewers would be positive and compatible with BLM and Forest Service visual management objectives.

Night Lighting

The Little Rock Mine may be lit at night to allow for nighttime operations. This lighting may produce illumination that is seen as a glow in the sky above the mine facilities. Lights would only be used on equipment and at the water fill-up and office area. No general pit lighting would be employed. This light source would be eliminated with closure of the mine, anticipated to occur up to four years after initial startup. While night lighting would not result in a physical change to the landscape, night lighting would be visible. Visibility would obviously be restricted to nighttime hours, and would be limited to the few viewers that would be affected at that time.

4.8 CULTURAL RESOURCES

Cultural resources tie contemporary cultures to their heritage. Therefore, cultural resources are not merely remnants of the dead past, but have an important role in contemporary societies. Once deteriorated, damaged, or destroyed, the tangible evidence of the past may be restorable or reconstructible, but these cultural resources are essentially nonrenewable. This section of the EIS describes the impact analysis methods and the impacts associated with each of the alternative project components.

4.8.1 Methods

In assessing the potential impacts of the Little Rock Mine three specific "impact issues" were considered:

- loss or degradation of prehistoric and historic archaeological sites
- loss or degradation of special status cultural resources
- loss or degradation of traditional cultural places

For each of the defined "impact issues" two types of impacts were identified as potentially affecting cultural resources. The most damaging types of impact would be due to direct construction impacts. Activities such as excavation of the ore, construction and maintenance of the haul road, and construction of temporary or permanent stream diversions all could result in permanent destruction of cultural resources.

A second, less severe type of impact could result from visual and auditory intrusions into the settings of cultural resources that might be located in the vicinity of direct impact zones. Modification of the landscape could change the setting of cultural resources, and the noises associated with mining could also be intrusive. The landscape modifications, such as the excavation of the mine pit or permanent stream diversions, would essentially be a permanent alterations. The impacts of the haul road on the landscape would be more temporary because it would be reclaimed at the termination of the mining operation, which is expected to last two to four years. Auditory intrusions also would be limited to the term of the operation of the mine.

Most of the significant cultural resources recorded within and in the immediate vicinity of the mine are important for their information potential. Such information potential is subject to adverse impacts from direct ground disturbance, but would not be affected by the indirect visual or auditory intrusions. If the site of the historic Ohio Mine, or other historic sites were determined to be significant because of associations with important historic events, indirect visual and auditory intrusions would adversely affect the historic qualities of such sites.

4.8.2 Results

The impacts of the no-action alternative, the proposed action, and the various alternative components to the proposed action are described in the following sections.

Alternative 1 - No Action

The no action alternative would eliminate the ground disturbing activities associated with the proposed development of the Little Rock Mine. Prehistoric and historic archaeological sites would not be threatened, nor would they be further investigated through mitigative data recovery studies. Those sites on public lands would continue to be managed in accordance with relevant federal regulations. Those sites on private lands are unlikely to be actively managed for protection.

Alternative 2 - Proposed Action

Proposed Action

Six prehistoric and historic archaeological sites are located within the direct impact zones of the proposed action (Table 4-9). The Ohio Mine (LA 102,140), a historic copper mine dating to the early 1900s, is located within the proposed mine pit. This site would be destroyed by the proposed mining activity, but its setting has been considerably altered by mining and processing activities pursued between 1970 and 1972. The Ohio Mine appears to lack historic significance, but consultation with the State Historic Preservation Office is still ongoing.

The other five archaeological sites are within the proposed waste rock stockpile associated with use of the Haul Road B alternative. These sites are likely to be disturbed and buried with rock. Two of the sites in the stockpile area are large but low density scatters of prehistoric chipped stone artifacts (LA 102,138 and LA 102,139). Approximately 400 to 600 artifacts are estimated to be present on the surfaces of each these sites, and additional artifacts may be buried at both sites. Both of these prehistoric sites are important because they have potential to yield important information.

Three historic sites within the stockpile area reflect historic prospecting on two mining claims: the Morrill Lode (LA 109,238 and LA 112.579), and the Zona Lode (LA 112,577). The remnants of each consist primarily of small mine pits or trenches, waste rock, claim markers, and very few artifacts. These sites appear to lack historic significance, but consultation with the State Historic Preservation Officer is still ongoing.

The proposed action also includes construction of a pipeline and channel to divert California Gulch into the bottom of the mine pit. Diverted stream water, along with ground water pumped to dewater the pit, would be pumped for discharge into Deadman Gulch, if of good quality, or otherwise piped to the No. 1X Tailing Dam. Virtually all of the ground disturbance associated with this diversion and pumping would be confined to the footprint of the mine pit. The one exception is the surface pipe for discharging to the tailing dam. This pipe would be adjacent to parts of Haul Road B and then extend approximately one-half mile or more to the north. The line would be routed to avoid archaeological sites.

The proposed action also would involve installation of a 46kV and 4.1kV power lines, electric substation, and temporary operations and maintenance facilities. Most of these facilities also would be within the mine pit footprint or immediately adjacent areas, where no archaeological sites are present. The 46kV transmission line would extend approximately two miles to the northeast of the pit area to the existing Tyrone Mine along this corridor. The line would be routed to avoid archaeological sites.

TABLE 4-9 SUMMARY OF IMPACTS ON ARCHAEOLOGICAL SITES		
	Haul Road and Associated Stockpile Alternatives	
Proposed Action	**Route A**	**Route C**
Mine Pit Ohio Mine (LA 102,140)	***Mine Pit*** Ohio Mine (LA 102,140)	***Mine Pit*** Ohio Mine (LA 102,140)
Route B Haul Road and Stockpile prehistoric lithic scatters (LA102,138) (LA102,139) Morrill Lode Claim (LA109,238) and (LA 112,579) Zona Lode Claim (LA112,577)	***Route A Haul Road and Stockpile**** prehistoric lithic scatters (LA 102, 134) (LA 102, 136) prehistoric Mimbres pueblo (LA 102, 132) possible small prehistoric Mimbres pueblo and historic spring development (LA 102, 133) prehistoric Mimbres camp (LA 102, 135) historic mining camp (LA 112, 576) Morrill Lode Claim (LA 109, 238) and (LA 112, 579)	***Route C Haul Road and Stockpile*** prehistoric lithic scatters (LA102,138) (LA102,139) Morrill Lode Claim (LA109,238) and (LA 112,579) Zona Lode Claim (LA112,577)
* inventory not complete		

In sum, four of the six archaeological sites within the direct impact zones of the proposed action appear to lack significant historical values. Another two sites are significant for their potential to yield important information about the prehistoric occupation of the region.

Haul Road Alternatives

The Haul Road A alternative would use a considerably different alignment than Haul Road B, which is a component of the proposed action, and a different area for stockpiling waste rock. Two of the five sites that would be affected by Haul Road B also would be affected by Haul Road A, plus six other archaeological sites located within the alignment of Haul Road A or the associated adjacent stockpile area (see Table 4-9).

The sites within the impact zone of the Haul Road A and associated stockpile area include a prehistoric Mimbres habitation site (LA 102,132), another possible Mimbres habitation with a historically developed spring (LA 102,133), plus a Mimbres campsite (LA 102,135). Two other prehistoric scatters of lithic artifacts, similar to the toolstone collection area noted in the Haul Road B stockpile area, also would be affected (LA 102,134 and LA 102,136). All of these prehistoric sites are significant for their potential to yield important information about the prehistory of the region. In addition, a historic site that appears to be the remnant of a small temporary mining camp is located within the Haul Road A stockpile area (LA 112,576). The Morrill Lode claim sites (LA 109,238 and LA 112,579) also are within the alignment of Haul Road A. These historic sites appear to lack significant historic values.

The sites in the Haul Road A impact zone are not only more numerous, but also considerably more complex than those within the impact zone of the proposed action. Accordingly, mitigative studies for the Haul Road A alternative would require substantially more effort and time than for the proposed action. Approximately 30 percent of the stockpile area for Haul Road A has not been inventoried for cultural resources, and other archaeological sites may be present.

The alignment of the Haul Road C alternative is in the vicinity of Haul Road B and both of these alternatives would involve use of the same stockpile area. The impacts of the Haul Road C alternative on archaeological sites are identical to those of Haul Road B of the proposed action.

<u>California Gulch Diversion to Whitewater Canyon Alternatives</u>

Two options were considered as alternatives to the component of the proposed action that involves diverting California Gulch into the mine pit (SD-3). Both options involve diverting California Gulch into Whitewater Canyon, but at different locations.

The Whitewater Canyon Alternative SD-1 would require excavating through a ridge and excavating a channel on the western margin of the mine pit. No archaeological sites have been identified in this area, although the entire direct impact zone of this alternative has not been intensively surveyed for archaeological sites. If this alternative were to be selected, additional survey would be required.

The Whitewater Canyon Alternative SD-2 would divert California Gulch into a tributary of Whitewater Canyon on the northwestern margin of the mine pit. No archaeological sites are present within the area that would be disturbed by excavation of the diversion channel. The entire downstream length of the tributary has not been surveyed for archaeological sites, but the potential for indirect impacts on downstream sites is small. The drainage basin of California Gulch upstream of the diversion point is small, encompassing only about one square mile. Therefore the diversion is not expected to substantially alter erosional patterns that could affect any sites that might be present along the wash.

<u>Partial Backfill Alternative</u>

Two options involving partial backfilling of the mine pit also were considered as alternatives to the proposed action. The first option would involve temporarily diverting California Gulch during mining operations. After mining and partial backfilling is completed, California Gulch would be allowed to flow into the pit. A channel would be excavated to empty flows out of the pit into Deadman Gulch. In contrast, the proposed action would allow flows of California Gulch and groundwater to collect forming a pit lake.

The second option would be similar insofar at it involves partial backfilling of the mine pit, and excavation of a channel to empty any water collecting in the pit into Deadman Gulch. The difference would be a permanent diversion of California Gulch into Whitewater Canyon to reduce flows through the pit. No archaeological sites in addition to those identified within the mine pit or stream diversion alternatives would be affected by either backfill alternative.

Status of Agency Consultation

Consultation between the BLM and SHPO regarding the significance of the archaeological sites within the project area is ongoing. These consultations also are addressing potential effects and mitigation measures. The potential is high for mitigating impacts to the information values of the prehistoric sites through mitigative data recovery studies. If the consultations conclude that the historic sites lack significance, a determination of "no adverse effect, as defined by *Regulations for Protection of Historic Places* (36 CFR Part 600), would be appropriate. If the consultations should determine that any of the historic sites to be affected have associational values that warrant preservation in place, the loss of these sites would warrant a finding of "adverse effect." That finding would require consultations with the Advisory Council on Historic Preservation and other interested parties to seek ways to avoid or lessen those impacts.

A mitigation plan to collect additional information about the archaeological sites that would be affected by the proposed action is being prepared by the project proponent. This plan would involve recovery and analysis of archaeological data from the significant prehistoric sites. If any historic sites were determined to be significant, measures to mitigate impacts to those resources also would be developed.

4.9 AIR QUALITY

The proposed action will involve activities known or suspected to cause air pollution, including construction of the haul road, preparation of the mine site, and operations of the mine. The mine operations will include drilling and blasting, material transfer, and loading using shovels and material transport (to the Tyrone facility) utilizing haul trucks. Actual mining operations will be approximately 4 years duration. A detailed description of the air quality impact analysis (including process description, emissions inventory, modeling methodologies, and modeling results) is provided in the *Air Quality Technical Report* (Dames & Moore 1996).

Gaseous pollutant emissions were shown to be of insignificant magnitude to warrant modeling. Therefore, the primary pollutant of concern for this project is airborne particulate matter. Although the state of New Mexico has statutory limits for Total Suspended Particulate matter (TSP) and gaseous pollutants, the NMED has indicated that, due to the nature of air pollutant sources at the proposed Little Rock Mine, they have no mechanism to enforce the New Mexico Ambient Air Quality Standards (NMAAQS). Specifically, since the proposed sources are either mobile, area or fugitive sources (i.e., no stationary point sources are proposed), the mine is not subject to state air quality permitting requirements. Consequently, the NMED cannot impose restrictions or operating practice requirements (such as pollutant monitoring or control measures) to enforce the NMAAQS (NMED 1995). For this reason, potential air pollutant impacts were compared only to National Ambient Air Quality Standards (NAAQS) for PM_{10} and gaseous pollutants. Sources of fugitive dust include unpaved roads, blasting, material transport, and land cleared for mining activity. In addition, nitrogen oxides, carbon monoxide, hydrocarbons, and sulfur oxides are emitted by blasting and fuel burning activity. As required under New Mexico Air Quality Regulations, vegetation cleared for the haul road construction will not be disposed by open burning.

In general, open pits associated with mines do not experience significant mixing of ambient air below the pit rim with the air flow above the rim. Consequently, control of fugitive dust generating activity below the rim will not be required. However, haul road fugitive emissions above the pit rim can contribute to off-site impacts. This proposed action will include one of three alternative haul roads. For the selected alternative, the haul road will be surfaced with gravel and watered during haul operations to achieve an average silt loading of either 2 percent (Alternative Route "A") or 5 percent (Alternative Routes "B" and "C"). Continual watering or chemical suppressants will be applied, providing minimum dust control efficiencies of 95 percent. Haulage speeds will average approximately 15 mph over the life of the project. Truck speeds will not exceed 33 mph. The maximum would only be attained when trucks are empty and on a flat road; speeds will be lower than average on other portions of the route (i.e., downhill empty, uphill empty, downhill loaded, and uphill loaded).

4.9.1 Methods

A dispersion modeling analysis of direct air quality impacts (mining-related emissions) of the proposed project was performed using the Fugitive Dust Model (FDM; U.S. EPA 1988). The FDM is a multiple line source model, accepted by the EPA, and designed to calculate particulate matter impacts from fugitive dust sources (such as open pit mining operations). The FDM was used to estimate PM_{10} concentrations off-property at receptor sites along and outside of the study area boundary generally to the west of the pit, along the Phelps Dodge property boundary generally to the east, at two populated locations within the study area, and at the nearest Class I area. The emission inventory and modeling meteorologies may be reviewed in the *Air Quality Technical Report* (Dames & Moore 1996).

4.9.2 Results

Based on the conservative estimates of the FDM model, receptor points along or outside the combined study area and PDMC property boundary could experience PM_{10} concentrations above the 24 hour or annual NAAQS limits of 150 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively. The predicated PM_{10} concentrations provided in this analysis, unless otherwise noted, include estimated background concentrations of 48 $\mu g/m^3$ (24 hour) and 22 $\mu g/m^3$ (annual) reported for Hurley, New Mexico. It should be noted that any potential worst-case exceedances are highly localized, just "off-property." The predicted locations of elevated off-site PM_{10} concentrations vary depending on the selected haul road alternative.

The highest applicable modeled 24-hour PM_{10} concentrations, including background, at the inhabited Burro Mountain Homestead to the southwest of the pit are estimated to be 58 $\mu g/m^3$ while the highest applicable modeled 24-hour concentrations at the dwelling to the northwest is estimated to be 98 $\mu g/m^3$. The highest PM_{10} concentrations resulting from the proposed mining activity at the nearest Class I area, the Gila Wilderness Area approximately 20 miles to the north, are estimated to be near zero; representing essentially no significant increase above background conditions.

Haul Road Alternative A

The predicted highest second-high off-property 24-hour PM_{10} concentration attributed to the proposed facility alone is 278 $\mu g/m^3$ at one location immediately north of the proposed facility. Therefore, including the background concentration of 48 $\mu g/m^3$, total predicted highest second-high 24-hour off-property concentration at this location is 326 $\mu g/m^3$. The predicted highest off-property annual concentration from the proposed facility alone is 147 $\mu g/m^3$ at one location immediately south of the proposed facility. Therefore, including the background PM_{10} concentration of 22 $\mu g/m^3$, total predicted highest annual off-property concentration at this location is 169 $\mu g/m^3$. The predicted violation of the 24-hour PM_{10} NAAQS is attributed to emissions from the haul road that is proposed to be located approximately 300 meters east of the receptor.

Haul Road Alternative B

The predicted highest second-high off-property 24-hour PM_{10} concentration attributed to the proposed facility alone is 456 $\mu g/m^3$ at one location southeast of the proposed facility. Therefore, including the background concentration of 48 $\mu g/m^3$, total predicted highest second-high 24-hour off-property concentration at this location is 504 $\mu g/m^3$. The predicted highest off-property annual concentration from the proposed facility alone is 277 $\mu g/m^3$ at one location immediately southeast of the proposed facility. Therefore, including the background PM_{10} concentration of 22 $\mu g/m^3$, total predicted highest annual off-property concentration at this location is 299 $\mu g/m^3$. The predicted violation of the 24-hour PM_{10} NAAQS is attributed to the combined impacts of emissions from the haul road, blasting, and loading operations.

Haul Road Alternative C

The predicted highest second-high off-property 24-hour PM_{10} concentration attributed to the proposed facility alone is 418 $\mu g/m^3$ at one location immediately east of the proposed facility. Therefore, including the background concentration of 48 $\mu g/m^3$, total predicted highest second-high 24-hour off-property concentration is 466 $\mu g/m^3$. The predicted highest off-property annual concentration from the proposed facility alone is 161 $\mu g/m^3$ at one location immediately south of the proposed facility. Therefore, including the background PM_{10} concentration of 22 $\mu g/m^3$, total predicted highest annual off-property concentration at this location is 183 $\mu g/m^3$. The predicted violation of the 24-hour PM_{10} NAAQS is attributed to the combined impacts of emissions from the haul road, blasting, and loading operations.

There is another area (under all three alternative haul road alternatives), which includes several receptors, south of the mine pit that is also predicted to violate the 24-hour PM_{10} NAAQS. The predicted PM_{10} concentrations are primarily attributed to the loading operations that would occur near the pit boundary and wind erosion from the mine pit. The predicted PM_{10} concentrations are below the NAAQS approximately 400 meters south of the permit area boundary.

Table 4-10 summarizes the predicted off-site particulate concentrations in comparison with the National 24-hour and annual PM_{10} standards. To identify violations of the 24-hour NAAQS, the maximum of the second-highest predicted values (highest-second high) for all applicable receptors is used, because it is the second occurrence of a concentration in excess of the short-term NAAQS values which constitutes an actual violation. For a complete review of the predicted pollutant concentrations at each modeled receptor site, see the *Air Quality Technical Report* (Dames & Moore 1996).

Based on a comprehensive analysis conducted by Dames & Moore (1996), the air quality impacts associated with the proposed Little Rock mine have been predicted to violate both the short-term and long-term NAAQS. As shown in Table 4-10, localized violations of the PM_{10} NAAQS were predicted for worst-case conditions, for each of the proposed haul road alternatives.

TABLE 4-10
SUMMARY OF PM_{10} MODELING RESULTS ($\mu g/m^3$)

Haul Road Alternative	Averaging Period	Predicted Off-Property Impacts			NAAQS
		Direct[1]	Background[2]	Total	
A	24-hour[3]	278	48	326	150
	Annual	147	22	169	50
B	24-hour[3]	456	48	504	150
	Annual	277	22	299	50
C	24-hour[3]	418	48	466	150
	Annual	161	22	183	50

[1] Contribution due to proposed sources alone (without background).
[2] As reported for Hurley, New Mexico (1990-1993).
[3] Based on maximum, second-highest modeled impact (applicable for short-term NAAQS).
Source: Dames & Moore 1996

These violations are predicted to occur primarily because of the limited distance between the lease boundary and the proposed mining activity (e.g., blasting, loading, and truck transport) along the north and south sides. PM_{10} violations are predicted to occur (based on conservative model results) under "worst-case" meteorological conditions in areas immediately adjacent to, but outside, the lease boundary. The modeling results indicate that predicted PM_{10} concentrations diminish rapidly (i.e., within a few hundred meters) away from the lease boundary. Although the areas affected are not currently inhabited or used as public recreation areas, ambient air quality standards are applicable.

In practical terms, the likelihood that a PM_{10} violation will actually occur is quite low. The conservative modeling analysis was based on an assumption that the pollutant generating activities occur continuously throughout each operational day and across the entire pit area. In fact, such activities will be relatively localized as mine development progresses. This would result in impacts less than those predicted in the modeling analysis. For an exceedance to actually occur, mining activity would have to be conducted at a location within 400 meters from the lease boundary at or near grade level, during worst-case meteorological conditions.

4.10 NOISE

The impact of noise from this project on off-site receptors was assessed by comparing predicted mining activity noise levels to the impact criteria discussed in Chapter 3. This section describes the prediction methodology, the location of noise-sensitive receptors, and the expected noise impact to both humans and wildlife.

4.10.1 Methods

The noise level (L_{eq}) from earth moving equipment was predicted at each receptor location by extrapolating the L_{eq} of each piece of equipment (measured by the manufacturer at a distance of 50 feet) to the distance of each receptor. The extrapolation included the effects of sound energy spreading and absorption of sound energy by the atmosphere with distance. The noise levels from each piece of equipment were then summed to obtain the total noise level expected at the receptor. The predictions were based on the maximum number of pieces of equipment to be used at any one time, did not include intermittent atmospheric effects on sound propagation (i.e., winds, atmospheric stability, etc.), and distances were calculated from the nearest mining activity. Therefore, the predicted noise levels are worst case estimates and actual levels will be equal or lower.

Airblast levels were predicted using data provided by the U.S. Bureau of Mines (1980). Data measured at other hardrock mines were normalized to the weight of charge per delay of explosives expected to be employed on the proposed project (1,500 pounds.). The expected level at each receptor location was then calculated using propagation information also provided by the Bureau of Mines.

Seven noise-sensitive receptors were identified within approximately five miles of the project. These include a ranch residence 3,000 feet northwest of the pit; an isolated residence located approximately 4,700 feet southeast of the pit in Section 21 of T19S R15W; the Burro Mountain Homestead trailer park approximately two miles south-southwest of the project; residences located in Sections 1, 10, and 21 of T20S R15W approximately five miles southwest of the project; and the community of Tyrone approximately five miles northeast of the project.

4.10.2 Results

Predicted earth-moving equipment noise levels are shown in Table 4-11. Noise levels were predicted at each of the receptors identified above for each of the three haul road alternatives. For the Ranch Residence, the predicted noise level of 61 dBA (L_{dn}) for Haul Road Alternative A would be distinctly audible and potentially annoying. This level exceeds the EPA's 55 dBA annoyance criterion and is greater than 10 dBA noise increase above the assumed background of 30 dBA (EPA 1974). Under Haul Road Alternatives B and C, the predicted noise levels at the Ranch Residence are 8 to 9 dBA less than under Haul Road Alternative A.

TABLE 4-11
PREDICTED NOISE LEVELS, EPA CRITERIA, AND AUDIBILITY (dBA)

Receptor Location	Equivalent Noise Level (Leq)				Day-Night Noise Level (Ldn)				
	Predicted Level			EPA Criteria[1]	Predicted Level			EPA Criteria[1]	
Haul Road	A	B	C		A	B	C		Audibility[2]
Ranch Residence	55	46	47	70	61	52	53	55	potentially annoying
Residence Sec 21, T19S R15W	42	44	43	70	48	50	49	55	potentially annoying
Burro Mountain Homestead	20	21	20	70	26	27	26	55	inaudible
Residence Sec 1, T20S R15W	<10	<10	<10	70	13	13	13	55	inaudible
Residence Sec 10, T20S R15W	<10	<10	<10	70	<10	<10	<10	55	inaudible
Community of Tyrone	<10	<10	<10	70	<10	<10	<10	55	inaudible

1 = EPA 1974
2 = Based on exceeding the ambient noise levels presented in Table 3-22 by the values presented in Table 3-21

Predicted noise levels at the residence in Section 21 of T19S R15W range from 48 to 50 dBA (L_{dn}) for all three haul road alternatives. While these levels do not exceed the EPA's 55 dBA annoyance criterion, they would be distinctly audible and potentially annoying.

Noise from earth-moving activities is expected to be inaudible at all other receptor locations for all three haul road alternatives. This includes the Burro Mountain Homestead, the residences in Sections 1, 10, and 21 of T20S R15W, and the Community of Tyrone. None of the predicted levels at any of the seven receptor locations exceed the EPA's criterion of 70 dBA for protecting human health and welfare.

Over large distances, such as those between the receptors and the pit, air blast propagation is strongly dependent on wind, temperature, and terrain conditions. Under ideal propagating conditions (i.e., a receptor located downwind from the blast during a temperature inversion), air blasts could be audible at any of the identified receptors. Under typical conditions, air blasts are expected to be audible (nearly annoying) at the nearby ranch residence, the residences located in Section 21 T19S R15W and in Section 21 of T20S R15W. None of the levels in Table 4-12 exceed either the damage criterion of 134 dBL or the annoyance criterion of 129 dBL.

TABLE 4-12
PREDICTED AIRBLAST LEVELS AND CRITERIA

Receptor Location	Predicted Level	Annoyance Criterion[1]	Damage Criterion[1]
Ranch Residence	128	129	134
Residence (Section 21, T19S R15W	126	129	134
Burro Mountain Homestead	121	129	134
Section 1, T20S R15W	116	129	134
Section 10, T20S R15W	116	129	134
Section 21, T20S R15W	114	129	134
Community of Tyrone	115	129	134

[1] U.S. Bureau of Mines 1980

Wildlife

A substantial amount of research has been conducted on the effects of noise on wildlife. However, few comprehensive studies have been conducted in the natural environment and many lack specific acoustic information that is necessary to predict responses or derive accurate impact criteria (EPA 1980). The following discussion describes the types of noise impacts that can occur and relays some of the effects that have been observed on the species that exist or may exist in the vicinity of the project.

Noise introduced into the natural environment can impact wildlife by rendering inaudible (masking) sounds used by wildlife for communication, locating predators, etc., by causing behavioral changes such as a shift in habitat or interruption of normal activities, and by causing permanent or temporary hearing impairment. The only directly applicable example of masking impacts is provided by research on bats. Bats are dependent on acoustic signals for survival, but have been found to be capable of separating the desired signal from most interference. Relevant behavioral studies include those on rabbits, bears, and wolves and coyotes. A study involving the effect of snowmobile noise on rabbits indicates that rabbits increased the range of their movement while snowmobiles were present. Limited data have shown that repeated aircraft flyovers at 1,000 feet may alter the foraging and breeding patterns in bears. Wolves and coyotes have shown an ability to adapt to manmade noise as long as they do not feel threatened by it (i.e., hunted from aircraft).

Only in the immediate vicinity of the pit and haul road will noise levels be as great as those used in most of the studies cited above. Therefore, it is expected that wildlife such as rabbits and deer would shift their habitat away from these areas. A few hundred feet away from the pit and haul road noise levels would be significantly less than those used in the studies, and impacts are expected to be minimal.

4.11 POTENTIAL MITIGATION AND MONITORING

Measure A-1: Additional haul road watering (and chemical stabilizers, as necessary) would be implemented to mitigate exceedances of the PM_{10} NAAQS.

Effectiveness: This measure would help to minimize fugitive dust emissions.

Application: This measure would apply to the proposed action and all alternatives except the no-action alternative.

Measure A-2: Relocate a portion of the haul road to increase the distance between the haul road and the permit area boundary.

Effectiveness: This measure would help to avoid fugitive dust impacts off-site.

Application: This measure would apply to the proposed action and all alternatives except the no-action alternative.

Measure A-3: Implement a meteorological monitoring-based control strategy. This measure would require periodic modification of blasting or loading operations during certain wind events.

Effectiveness: This measure would help to avoid fugitive dust impacts off-site.

Application: This measure would apply to the proposed action and all alternatives except the no-action alternative.

4.12 CUMULATIVE IMPACTS

Definition

Cumulative impact as defined by Council on Environmental Quality (40 CFR 1508.7) is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). These reasonably foreseeable future actions refer to future action projections, or estimates, of what is likely to take place when a given proposed action is implemented. They are not a part of the proposed action but are projections being made so that future impacts, cumulative and otherwise, can be estimated as required by NEPA. Cumulative impacts are interdisciplinary, multi-jurisdictional and usually do not conform to political boundaries.

The resulting effects have been defined by Council on Environmental Quality as direct and indirect. Direct effects are caused by the project action and occur at the same time and place while indirect effects are also caused by the project action but are later in time or further removed in distance, but are still reasonably foreseeable (40 CFR 1508.8). Cumulative impacts are the total effect on a given resource or ecosystem of all actions taken or proposed.

Description of Actions Within the Cumulative Analysis Area

The geographic area considered for the analysis of cumulative impacts of the proposed Little Rock Mine project is delineated as the 20,564 surface acres that includes the California Gulch, Deadman Canyon, Whitewater Canyon, and portions of the Upper Mangas Creek watersheds. Two exceptions include the areas for socioeconomic analysis (Grant County and communities within a 100-mile radius) and special status species (all potential species' habitat locations). The reasonable foreseeable future action is a five year time period, beginning in 1995 (the base year and start of EIS process) and extending to 2000. The estimated potential future mine life of the Little Rock Mine is up to four years.

Existing activities in the area of cumulative analysis include a portion of the tailings pond and waste rock from on-going mining operations at the adjacent Tyrone Mine and processing facilities. The first recorded mining at the project site was in the 1890s and consisted of underground copper mining at the Ohio, Two-Best-in-Three, Little Rock, and Nellie Bly mines. This early mining led to patenting of some claims. The unpatented Southern Star claims, located to the north, were mined in the early 1900s and again in the 1960s. Fluorspar was mined from California Gulch in the 1940s, resulting in several patented claims. The existing Tyrone Mine was developed by Phelps Dodge in the late 1960s.

During the 1960s, the Little Rock property underwent several periods of limited exploration and leach testing. In 1970, the property was leased and underwent an extensive drilling program. From 1970 to 1972, approximately 1,000,000 tons of leach material and 660,000 tons of waste were removed and stockpiled at various locations in the project area. An open pit was created within the California Gulch drainage. The leachable material was stockpiled along California Gulch south of the pit and leached with over 30 million pounds of sulfuric acid solution over the two year period. During 1993 and 1995, PDMC conducted exploration drilling and baseline environmental data collection (including hydrogeologic, surface water, archaeological, and biological surveys) in the area. Approximately 120 surface acres have been disturbed by these previous mining activities; about 60 acres of this total within the proposed Little Rock Mine pit area.

Other land uses in the cumulative analysis area include one rural ranch with associated facilities; a recreational vehicle park with 12 to 15 trailers, 3 permanent residences and outbuildings; a number of individual mining claims scattered throughout the area; permitted grazing on two allotment areas; and several unimproved dirt roads, improved dirt roads, and a paved two-lane road. Recreational land uses in the area are hunting and dispersed recreation such as hiking, exploring, rockhounding, horseback riding, picnicking, camping, and off-road vehicle use. The closest potentially affected water users (other than Phelps Dodge) in the study area are the trailer park, Burro Mountain Homestead, located more than two miles upgradient of the proposed pit area, and two private residences.

The proposed project will be a conventional open-pit mining operation with a production rate of as high as 160,000 tons of ore per day for a period of 2 to 4 years. All leachable ore from Little Rock will be processed at the existing permitted processing sites at the Tyrone Mine. Previously, approximately 580 million tons of material have been leached for copper and processed at the SX/EW and precipitation plants at the Phelps Dodge Tyrone facility, as of January 1, 1995. All solid wastes generated at the Little Rock Mine will be transported to and disposed of at existing permitted facilities at the Tyrone Mine. Overburden or other inert, non-mineralized materials will either be transported to the existing Tyrone tailing dams, for use as cover material for tailing dam closure, or stockpiled on site for use in reclamation. No processing or waste disposal facilities are planned for the project area. Depending on the alternative selected, surface water from California Gulch will be diverted into the Whitewater Canyon watershed, to the pit, or to Deadman Creek.

Planned and proposed land use of the cumulative analysis area is based on resource management plans for the BLM Mimbres Resource Area and the Gila National Forest. On Gila National Forest lands, future land use management includes a long-term increase of herbaceous forage for wildlife, maintaining species population levels, and establishment of livestock grazing numbers through updated standard range analysis procedures. On BLM lands, only the proposed Little Rock Mine is anticipated within the project area. No other new development is expected. Grazing, wildlife habitat, and recreational land uses are expected to continue in the cumulative analysis area.

Three other open-pit copper mine operations are planned in the area that would also influence the local and regional economy. The Continental Mine Expansion, located about 15 miles from Silver City, is proposed by the Cobre Mining Company. If permitted, the Continental operation would produce and process 10 million tons of ore per year and employ a full-time workforce of about 160 people for several years.

The Copper Flat Project, as proposed by the Alta Gold Company, will re-establish an open-pit copper mine near Hillsboro, located about 40 miles from Silver City in Sierra County. The Copper Flat Project would produce and process about 6 million tons of ore per year and employ approximately 150 people for at least 10 years.

The Chino Mines Company has submitted an amendment to the 1981 Plan of Operations. The amendment includes plans to mine between 114.1 and 138.7 million tons of material annually between 1996 and 1998 at the Chino Mine.

Exploration and mining have been proposed less than one mile north of the Little Rock Mine site on unpatented mine claims. No other information is available on the size or type of operation proposed.

There is one underground copper mine operating in Grant County, but it is scheduled to close within the year. The Cyprus Pinos Altos Mine, located near Silver City, currently employs only 22 people and produces 600 to 800 tons of ore daily.

Environmental consequences of the proposed Little Rock Mine were evaluated in Chapter 4 for each environmental resource. Direct and indirect impacts were identified and evaluated. Cumulative impacts are discussed below for various affected resources.

Physiography

As a result of mining operations there would be a permanent change to the physiography of the area. The areas and type of disturbance are discussed in Chapter 2. A total of 230 surface acres would be disturbed for the pit and haul road, of which approximately 190 surface acres are within the pit boundary. The proposed waste stockpile of 136 to 150 acres would be located outside of the permit area on the Tyrone Mine site. The majority of approximately 40 acres along the haul road would be reclaimed to minimize the impact to physiography. Since the cumulative impact area includes 20,564 acres, the change to physiography that would occur from the proposed action represents less than two percent of the cumulative analysis area.

Soils

In the area of the pit boundary, the soils would be totally removed, portions of which may be stockpiled for use during reclamation. Of the 190 surface acres within the pit boundary, about 60 acres are existing tailings and waste rock which would be removed and hauled to the Tyrone Mine facility for processing. The remaining 130 surface acres of soil resources would be disturbed and removed although a portion may be stockpiled for use during reclamation. There would be an increase in soil erosion in the areas of disturbance until reclamation is successfully completed.

Potential impacts to soils as a result of mining and related activities include increased rates of soil erosion by wind or water, loss of topsoil, and decrease in soil productivity due to soil mixing. Indirect impacts include increased sedimentation in streams due to runoff following rainfall or snowmelt. Increased sedimentation may affect aquatic habitats, fisheries, domestic drinking water supplies, and the aesthetics of the stream itself. Loss of topsoil and decrease in productivity due to soil mixing affects the vegetation supported in the area which in turn affects the animal life in the area if there is loss of forage or habitat. However, with adherence to the proposed reclamation plan, adverse impacts would be reduced.

Long-term soil productivity would be reduced for the project area since soils in the proposed pit would be removed and soils will be disturbed and compacted along the haul road. However, some of these impacts could be successfully mitigated by implementing the Reclamation and Closure Plan.

Geology and Minerals

The proposed action would affect the geology and mineral resources by removing up to 160 million tons of mine rock including 100 million tons of leachable ore. The copper ore would be removed from the site and processed at an existing permitted leach stockpile at Tyrone.

Historical mining at the site has disturbed approximately 120 acres of land; about half of this area is included within the proposed mine pit boundary. Since monitoring of activities will be conducted from Tyrone, and excavated rock will be taken off site, there would be no other disturbances such as leach stockpiles or permanent structures. Phelps Dodge plans to remove the mineable ore that was left as waste in the form of a leach stockpile by USNR. This would result in the removal of approximately 3 million pounds of potentially mineable copper and could serve to partially restore that portion of the area to its pre-mining landscape. Slope stability of the mine pit would be necessary to protect human health and the environment. The final approach to stabilize the slopes would be implemented in accordance with the BLM Reclamation Plan guidelines and New Mexico Mining Act Rules for closure.

Water Resources

Pit construction would bisect California Gulch, effectively removing surface water flow in California Gulch between the south rim of the proposed pit and its confluence with Deadman Creek. The terminus of the surface water flow, estimated to have a mean annual rate of approximately 10 gpm, would be either Whitewater Canyon or directly into the pit. The effect of pit construction would reduce the area contributing to streamflow in each of the three watersheds in the cumulative analysis area by a total of 0.27 square mile.

During the life of the mine it is estimated approximately 2,200 acre-feet of ground water would be removed during pit dewatering activities. The pumping of ground water and resultant drawdown would have a temporary effect on ground water levels in the area. The well located at the Burro Mountain Homestead is predicted to have a drawdown of 1 to 5 feet during mining. However, after mining, the ground water levels are expected to rebound to current or pre-mining conditions.

There are several seeps and springs along Deadman Canyon and California Gulch which lie within the zone of influence from pit dewatering. These springs and seeps may be influenced by the project but the extent of the effect is uncertain due to hydrologic uncertainties.

The overall surface water quality in California Gulch, where it remains intact, would improve due to the removal of the existing leach stockpile left by USNR. The removal of this source, which is believed to have impacted ground water, along with pit dewatering, would also improve the overall ground water quality at the site. Evidence from laboratory and modeling analyses show that ARD will not develop, and that the overall water quality within the pit lake, if developed (proposed action) would be of relatively good quality. It is estimated that dissolved copper in the pit lake water would slightly exceed the NMWQCC surface water standard of 0.5 mg/l under the worst-case scenario, and water from the lake that recharges ground water would exceed the NMWQCC ground water standard for fluoride. Several wells in the area currently exceed state or federal ground water standards for copper and fluoride due to naturally occurring mineral content.

Processing ore at the existing Tyrone operation would not add a substantial increment of cumulative impacts on water resources.

Biological Resources

Potential impacts to biological resources that could be caused by the proposed project are associated with activities likely to occur during construction, operation, and closure of the mine. Biological impacts may be both adverse and beneficial to vegetation, wildlife, and special status plant and wildlife species. Ground disturbance, occurring as a result of expansion of the pit and construction of the haul road and ancillary facilities, would impact resources to varying degrees depending on several factors including sensitivity of the resource, duration of the disturbance, and the level of disturbance. These impacts are either direct or indirect, long-term and short-term, and include direct loss of vegetation resulting in the loss or degradation of potential habitat for wildlife species, direct mortality of wildlife due to increased traffic at the mine site and along the haul road, loss of potential habitat or food sources for special status species, and habitat avoidance by wildlife adjacent to the mine site due to increased activity and noise at the site.

The cumulative increment of vegetation and wildlife impacts resulting from processing ore at the existing Tyrone operation would be negligible. Overall, the proposed pit expansion and construction of the haul road would result in additional loss of vegetation and potential habitat for wildlife species. There would also be the likely loss of one spring utilized by wildlife. The quality of habitat at the proposed site is marginal and adjacent lands provide much better habitat for most species. The mine would only be in operation for two to four years, after which it would either provide a water source or provide terrestrial habitat for wildlife. Diversion of water into Whitewater Canyon may have beneficial effects on vegetation along that drainage, eventually creating some higher quality riparian habitat. More detailed descriptions of cumulative biological resource impacts follows.

Vegetation

The vegetation in the study area consists of ponderosa pine forests, piñon-juniper woodlands, grasslands, and intergradations of these main types. Small riparian stands or individual cottonwoods and ash occur in isolated pockets along Deadman Gulch, Whitewater Canyon, and California Gulch in the cumulative analysis area.

The proposed pit would cover an estimated 190 acres. The loss of this amount (including 60 acres disturbed by previous mining) of vegetation habitat in the vicinity of the mine represents less than one percent of the cumulative analysis area and would have a minimal impact on the integrity of the area. No riparian habitat exists, with the exception of a few cottonwood trees along California Gulch south of the existing pit, which may be removed as a result of pit expansion or during the clean-up operation of the leach pile.

If the pit is partially backfilled to the 5,800-foot elevation mark and a channel to drain water from the pit to Deadman Canyon is developed, there would be opportunities to increase habitat for terrestrial wildlife as the area is revegetated. Deadman Canyon would experience a temporary increase in flow.

Wildlife and Fisheries

Wildlife in the vicinity of the existing mine includes big game species, small mammals, diverse avifauna on a seasonal and residential basis, and reptiles and amphibians. Any of the action alternatives would result in the loss of about 110 acres of habitat for wildlife. The site for the proposed haul road is adjacent to the existing mine facilities and it is unlikely that this habitat is currently utilized by wildlife due to current activities. Big game and avian species would likely avoid the area during construction of the road and during times of high human activity. There may be some loss of ground dwelling mammals and reptiles and increased vehicle traffic in the area may result in direct mortality of wildlife due to collisions with haul vehicles. Avoidance of the area would be a short-term effect occurring during the life of the project (two to four years).

Increased activity at the pit site and along the road would most likely result in wildlife avoiding the area. One spring that is utilized by wildlife is located west of the existing pit and will likely be adversely effected by dewatering activities of the pit. There are other water sources nearby which can be utilized by big game. It is not anticipated that the displacement of big game into adjacent habitat would be detrimental to the populations due to the existence of higher quality habitat south and west of the site. No critical seasonal habitat or birthing areas are known to occur in the vicinity for big game; therefore, effects from the mine would not have long-term adverse effects on population dynamics or recruitment numbers.

No fisheries resources exist in the drainages which traverse the site. Water quality would not be likely to affect fish populations. However, past activities in some areas have resulted in levels of copper and aluminum which currently exceed state water quality standards. These elements are not generally considered as critical in water sources for wildlife (unlike selenium, cadmium, lead, and mercury, for example); however, when the existing leach piles are removed, water quality would improve in the area. This would be a benefit to biological resources and the ecosystems within the cumulative analysis area.

With a temporary or permanent diversion of California Gulch to Whitewater Canyon seasonal flow in California Gulch would be channeled to Whitewater Canyon. For Alternatives 2A and 2B, the pit lake would likely be utilized by wildlife and migratory birds passing through the area. Given that the water quality would meet standards for wildlife, it could potentially result in a beneficial effect for wildlife habitat.

Special Status Species

No significant unavoidable adverse effects would result to special status species as a result of the action alternatives. Several special status species have the potential to occur in the vicinity of Little Rock Mine, although known locations of such species do not exist on the proposed mine pit site or haul road.

If populations of a state-listed plant species are located on the proposed expansion site or along the haul road, they could be transplanted to adjacent suitable habitat, or otherwise salvaged. There is a low to moderate potential for occurrences of two additional Federal candidate C2 species that inhabit piñon-juniper woodlands and grasslands. There would be a loss of potential habitat as a result of expansion of Little Rock Mine.

Spotted and occult little brown bats are insectivorous and generally forage over open water, which acts as breeding grounds for insects; therefore, the presence of the ponded water may increase the foraging opportunities for bats. There would also be increased opportunities for amphibians, such as Arizona toad and narrow-headed garter snakes. These are federal candidate species which inhabit water sources in arid to semi-arid habitats.

If the pit is partially backfilled to the 5,800-foot elevation mark and water drains from the pit to Deadman Canyon, the pit site and haul road may revegetate over a longer period of time and these areas would provide additional habitat for terrestrial wildlife. Over time, small mammals may begin to inhabit the area providing a prey base for raptors, such as gray hawks, peregrine falcons, and northern goshawk.

Land Use

The cumulative impacts to land use and transportation are negligible due to the lack of impacts on these resources. Previous mining activities since the late 1800s, combined with current mining operations in the vicinity of the study area, contribute to the current status of ground disturbance and limited land uses. Future activities in the area would likely be of the same nature and would potentially have negligible impacts as well.

Socioeconomics

Development and operation of the Little Rock Mine would have the effect of sustaining the existing level of mining activity in the study region for several years. Continuation of the Tyrone operation's output will sustain current levels of employment and income deriving from copper production, not add to them. Absent other projects or changes in local agriculture, mining or tourism, the Little Rock Mine would preserve the area's economic equilibrium for a few more years.

If the two other proposed copper mine projects (Continental and Copper Flat Mine) are permitted and operate at the same time as the Little Rock Mine, an increment of 16 million tons of ore would be mined annually in addition to the Little Rock Mine's total production of 100 million tons over a two- to four-year period. The two other proposed mine operations may add a combined total of 310 jobs to the 2,300 existing jobs directly associated with copper production (employed by Phelps Dodge in 1993—see Section 4.7.1) in the cumulative analysis area. The Continental and Copper Flat operations would therefore result in about a 12 percent increase in direct copper industry employment, based on these estimates.

As reported previously the operation at Little Rock Mine would result in continued employment and income, contributing in part to the $185 million generated annually by Phelps Dodge in Grant County. After mining activity ends at Little Rock, operations at the Chino Mine, Hurley Smelter and potentially, other new mines, would continue into the foreseeable future, assuming that copper prices are sustained at acceptable levels. Therefore, cumulative economic impacts resulting from the proposed Little Rock Mine Project would be greatest during the operating phase of the mine with respect to the regional economy. Relative to past, present, and longer-term future economic trends, the effect would be negligible.

Visual Resources

Cumulative visual impacts would be long-term modifications to the local setting caused by reestablishing the pit and related mining activities. However, because of the isolated nature of the setting and the presence of past and current mining in the region, cumulative impacts would not extend to surrounding viewers.

Recreation

Recreation resources may be affected by the mining operation by reducing the quality of the experience, and by restricting access to some areas. However, since recreation in the area is dispersed and informal, impacts are expected to be minor. Impacts to hunting are also expected to be minimal due to the current extensive mining operations adjacent to the cumulative analysis area.

Cultural Resources

No major cumulative impacts of the proposed Little Rock Mine on the local and regional cultural resource base are expected. Although it is difficult to quantify the level of cumulative impacts, estimates can be made. A recent archaeological overview of southwestern New Mexico (Lekson 1992) documented that more than 5,000 archaeological sites have been recorded within the southwestern part of the state, and this probably reflects inventory of less than 5 percent of the region (Lekson 1992:48-52). Although the region has "gained a reputation for catastrophic pothunting" (Lekson 1992:41), the regional cultural resource base is substantial.

At the smaller scale of the USGS 7.5 minute Wind Mountain quadrangle, within which the Little Rock Mine is located, fewer than 40 sites had been recorded and only three archaeological sites have been excavated—CF Springs, Willow Creek, and Wind Mountain (Fitting 1973; Gilman 1987). However, this inventory reflects survey of less than probably 2 percent of the quadrangle (Lekson 1992: Figures 3.10 and 3.14).

The results of archaeological survey for the Little Rock Mine suggest an average density of about 10 to 15 sites per square mile in the local area. On this basis, it can be estimated that there may be approximately 300 to 500 archaeological sites within the 32-square-mile study area defined for the Little Rock Mine impact analysis, which encompasses the drainage basins of Whitewater Canyon, California Gulch, and Deadman Canyon, all minor tributaries of Mangas Creek. Accordingly, the six archaeological sites that would be destroyed may represent one or two percent of the local cultural resource base, and a tiny fraction of the regional cultural resource base. The information gained from the cultural resource surveys and mitigation studies will offset this loss to some degree by contributing to the cumulative knowledge of the local archaeological record.

Air Quality

The primary concern is airborne particulate matter. Sources of fugitive dust would be limited to areas disturbed during mining activities. Pollutants emitted by fuel-burning trucks and equipment are expected to be minimal and limited to the life of the mine and during operation hours. Cumulative air quality impacts are not predicted to occur.

Noise

Noise from earth moving equipment is expected to be below estimated ambient noise levels and inaudible to all receptor locations except the two, nearby residential units. Cumulative noise impacts at these receptors are not predicted. A few hundred feet away from the pit and haul road, noise levels would be significantly less than those shown to have potentially adverse effects on some wildlife, and impacts are expected to be minimal and short term.

4.13 UNAVOIDABLE ADVERSE EFFECTS

Unavoidable adverse impacts are impacts that remain following the implementation of mitigation measures, or impacts for which there are no applicable mitigation measures. Implementing any of the action alternatives would have some adverse environmental effects. The majority of the effects are temporary, construction and operation related impacts. The no-action alternative would also result in adverse impacts to water quality because of discharges from the leach stockpiles that remain from previous mining in the permit area. These leach stockpiles will be removed as a source of contaminants by implementation of the proposed action. The Reclamation Plan and associated mitigation measures will reduce anticipated impacts and potentially eliminate some unavoidable adverse effects.

Unavoidable adverse impacts that may occur from the proposed action, and would remain following mitigation, are summarized below for the affected resources.

No unavoidable adverse impacts are anticipated for air, noise, socioeconomic, recreation, land use, transportation, and visual resources.

Earth Resources

The removal of up to 160 million tons of material, including approximately 100 million tons of leachable mineral ore, would disturb approximately 230 acres of ground surface including the pit, haul road, slopes and previously disturbed areas. Implementation of the proposed action would result in the permanent establishment of an open pit of considerable size.

During the mine construction and operation phase, the temporary or permanent diversion of California Gulch would increase soil erosion above the natural levels and soil would be deposited downstream when rain storms occur.

Water Resources

The proposed action would divert California Gulch, comprising one square mile of contributing watershed.

Ground water levels would decline due to dewatering by one to five feet at wells in the area (i.e., Phelps Dodge and Burro Mountain Homestead), but would eventually return to premining levels after mining ceases. The ground water levels would be approximately 100 feet lower than premining levels in the immediate area of the pit.

Sediment deposition downstream of the confluence of California Gulch and Deadman Canyon is not likely to occur.

Removal of existing leach stockpiles and pit dewatering would not result in adverse water quality effects; a positive effect on surface water and ground water may occur.

Biological Resources

Potential loss of approximately 15 acres of grassland/juniper grasslands, 150 acres of juniper grassland/piñon-juniper woodland and 2 acres of ponderosa pine forest would occur.

Potential loss of wildlife habitat would occur in the vegetation types listed above, to the extent undisturbed habitat is affected by mining.

Visual Resources

Visual quality would change as a result of the re-establishment of the Little Rock Mine. The creation of an open mine pit would cause minor impacts to the landscape, primarily due to cumulative effects with disturbance from previous mining at the site and existing mine operations in the study.

Cultural Resources

Six archaeological sites will be destroyed. These include five sites within the proposed waste rock stockpile area: the Morrill Lode claim (LA 109,238 and LA 112,579), and the Zona Lode claim (LA 112,577), and two scatters of prehistoric lithic artifacts (LA 102,138 and LA 102,139). In addition, the Ohio Mine site (LA 102,140) within the proposed mine pit will be destroyed. Consultations with the SHPO regarding these impacts are ongoing. The consultations may conclude that this loss will result in "no adverse effect," or an "adverse effect," as defined by regulations for Protection of Historic Properties (36 CFR Part 800). Under either outcome, the effects will be mitigated through compilations of additional documentation and recovery of significant information prior to disturbance of the sites.

Air Quality

Violations of the short- and long-term PM_{10} NAAQS are predicted to occur "off property," where such standards apply. Predicted concentrations of PM_{10} diminish rapidly within 400 meters or less from the permit area boundary. The analysis assumed a minimal buffer spacing between the proposed mine pit and permit area boundary, worst-case meteorological conditions, and continuous mining at or near grade level. Therefore, the likelihood that a violation will occur is quite low.

4.14 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Impacts resulting from the re-establishment of mining operations at the proposed Little Rock Mine site would include short and long-term impacts relative to the existing resources within the study areas. Short term is defined as the life of the Little Rock Mine Project through closure and reclamation. Long term is defined as the future after reclamation is completed. Many of the impacts associated with the Little Rock Mine Project would be short term and would no longer be adverse after mitigation and reclamation activities have been implemented.

Earth Resources

Potential impacts to earth resources would be primarily short term and concentrated within the permit area during the construction, operation, and reclamation phase of the project. Soil erosion levels would increase above natural levels as a result of the diversion of California Gulch, construction of the haul road, and removal and hauling of material from the mine pit. Implementation of an erosion control plan during operation and through reclamation of the mine area would decrease long-term impacts.

Surface Water

Surface water quality and quantity would potentially be impacted during the construction and operation of the mine. Long-term impacts are related to the possible creation of a lake within the mine pit and the permanent diversion of California Gulch.

Ground Water

Ground water quality has been affected by previous mining activities and changes resulting from natural processes. Removal of the existing leach stockpiles would improve the ground water quality in the long term. Ground water levels will decrease by one to five feet at wells in the area due to dewatering of the pit during mining (short term), and then return to pre-mining levels after mining activity is complete (long term). Ground water levels would drop about 100 feet in the immediate area of the pit over the longer term.

Wildlife Resources

The re-establishment of mining operations at the proposed site would have minimal impacts to wildlife habitat and special status species. Disturbance from previous mining activities at the site has already had a long-term impact relative to the establishment of critical habitat for wildlife species which could potentially occur in the area.

Special Status Species

Impacts related to special status species are considered both short and long term. Construction of the pit and haul road would avoid potential disturbance to critical habitat for special status species.

Land Use, Recreation, Grazing, and Access

Each of the action alternatives would have minimal short-term impacts and negligible long-term impacts to land use, recreation, grazing, and access within and surrounding the proposed mining operation. Post-mining land uses could include grazing and wildlife habitat during and after reclamation of the mine site.

Socioeconomics

Selection of any action alternative would provide short-term benefits to local and regional economies and could potentially provide long-term benefits in the form of improved infrastructure, schools, and other public facilities constructed and maintained through tax dollars.

Visual Resources

Potential impacts related to the re-establishment of mining activities at the proposed site are long-term in nature and associated with the continued and permanent modification of the existing landscape. However, due to the proximity of existing mining operations, previously disturbed areas within the project area, and implementation of mitigation measures, these impacts are considered negligible.

Cultural Resources

Cultural resources would be destroyed with the selection of any alternative, thus foregoing long-term use of these resources. The recovery of archaeological information prior to re-establishment of the mine would be a beneficial short-term use insofar as the results enhance understanding of the cultural history of the region. The collected information would be preserved and available for reanalysis over the longer term, but the sites themselves, of course, would not be available for study in the future when archaeological data recovery techniques might have improved.

Air Quality

Potential impacts to air quality are short term in nature and directly associated with the construction and operation of the proposed mine pit. No long-term impacts are anticipated as a result of any of the alternative actions, based on final reclamation of the mine area and haul roads.

Noise

Projected noise levels associated with mining activities at the proposed site are considered short term and directly related to the construction and operation of the mine pit. Anticipated noise levels are well within standards set to protect public health. No long-term impacts are anticipated.

4.15 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The irreversible commitment of resources is defined as the use of nonrenewable resources which once committed to the proposed project would continue to be committed throughout the life of the proposed project and thereafter. Irretrievable commitment of resources is interpreted to mean that those resources used, consumed, destroyed, or degraded during construction, operation, and reclamation of the proposed project could not be retrieved or replaced for the life of the project, or beyond. However, irretrievable commitments may be reversed in some cases. This is due in part to the use of mitigation measures outlined in the Reclamation Plan or natural restoration of the site.

The proposed action for the Little Rock Mine Project would result in some irreversible and irretrievable commitments of minerals, soils, ground water, biological, and cultural resources. Any of the action alternatives would result in comparable levels of resource commitments. The major commitment is the removal of up to 160 million tons of material including 100 million tons of ore from the open pit resulting in both an irreversible and irretrievable commitment of geologic and mineral resources.

The commitments of ground water, surface water, soils, vegetation, wildlife habitat, grazing land, and recreation resources are considered irretrievable. These resources would be disturbed or displaced during the project life of the mining operation, but the commitment is reversible to the extent that successful reclamation of the mine site would allow for the long-term replacement of these resources to some extent.

Consumption of ground water used for dewatering of the mine would be irretrievable during mine operation. The ground water elevation levels measured at wells in the cumulative analysis area would decrease by one to five feet, but are expected to return to pre-mining levels after mining is completed.

The diversion of California Gulch would alter approximately one square mile of the affected watershed and associated surface water flow. This effect would be irreversible for the alternatives where a permanent diversion is established either into Whitewater Canyon or into a pit lake. If the diversion is temporary, the commitment would be considered irretrievable for the life of the project only.

Approximately 230 acres of total surface area would be required for the proposed mine pit and haul road. This includes approximately 167 acres of undisturbed to partially disturbed lands and about 63 acres of previously disturbed area. This acreage represents an irretrievable commitment of soils and vegetation resources during the life of the project. After mining operations cease, reclamation efforts will take place as part of the proposed action to increase the revegetation potential of the haul road area and the land where existing leach stockpiles will be removed.

Post-mining land uses, including grazing and wildlife habitat, would resume following closure and reclamation of the mine site. The commitment of these resources, as well as wildlife habitat and dispersed recreation that are supported by them, are therefore not irreversible. Although considered minor, visual resource impacts would represent irretrievable and irreversible commitments.

Socioeconomic resource effects are described as the economic benefits to the community and state. These are irretrievable commitments for the life of the project and beyond, to the extent that tax revenues are invested in enduring public facilities or programs.

Commitments of cultural resources include the potential destruction of two prehistoric sites and four historic sites. The commitment of these resources is irreversible, although the information content of the sites would be recovered as part of the mitigation plan.

4.16 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

The Little Rock Mine construction and operations would require mainly two types of energy. Diesel fuel would be used primarily for hauling material from the pit to the waste stockpile area and the Tyrone site. Electricity would be used to power equipment for excavation of the mine pit and material removal. The following are estimates of energy requirements for the proposed action (Phelps Dodge 1996).

Energy Consumption	Electricity	Diesel Fuel
Annual	24 kilowatt-hours	3.9 million gallons
Project Life (4 years)	96 kilowatt-hours	15.6 million gallons

Conservation potential would be limited, although the amount of energy used for the proposed action would differ from that used for the alternatives, depending on which haul route is used. Over the life of the project, Haul Road Alternative A would require about 2.0 million gallons more than the proposed action (with Alternative B). Haul Road Alternative C would require approximately 2.3 million gallons less fuel than the proposed action.

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[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Chapter 5.0

Consultation and Coordination

CHAPTER 5.0 - CONSULTATION AND COORDINATION

5.1 PUBLIC SCOPING

Public Meetings and Announcements

A public scoping meeting was held to discuss and collect public and agency comments on the potential Little Rock Mine project alternatives. The meeting was held at 7:00 pm on January 5, 1995 at Western New Mexico University, Silver City, New Mexico.

Notices of the meetings appeared in the *Federal Register* on December 16, 1994, in the newspaper (The Courier), and also on the local radio station (Silver City Radio).

In addition, the BLM scoping packet was mailed to approximately 375 individuals, groups, and agencies appearing on the mailing list supplied by the BLM, PDMC, and Forest Service. In addition, the scoping packet was distributed to 26 local and regional newspapers, radio stations, and television stations. Handouts provided at the meetings included additional fact sheets, comment forms, and the agenda.

Two fact sheets were mailed to parties on the mailing list in January and March 1995. The fact sheets provided information on the project in general, described the purpose and need and proposed action, and identified the location of the proposed project. Both fact sheets provided a mailing address and point of contact (Juan Padilla, BLM) for the public to send comments to.

Several graphic displays were presented at the meetings including a slide presentation prepared by PDMC representatives. Additional maps of the detailed project area, a process/schedule flow chart, and aerial photographs of the mine site were also displayed.

Twenty-five people were in attendance at the public scoping meeting at Western New Mexico University not including members of the BLM, PDMC, and Dames & Moore.

Throughout the scoping process, comments were received and recorded to provide guidance in the issues and concerns to be studied through the EIS process. A total of 67 comments were recorded—47 were noted on comment forms returned from the BLM scoping packet, 6 letters from public and private sectors were recorded, and 14 separate comments were noted during the scoping meeting.

A second mailing was conducted in March 1995 which consisted of an update on the EIS and previous public comments. The update included an announcement of a public open house to be held on April 12, 1995 from 4:00 to 7:00 pm in Silver City. Graphic displays of the project site and resource studies were available for public review. Nine people were in attendance at the open house not including representatives of the BLM, PDMC, and Dames & Moore. One comment was received at the meeting.

Public Involvement and Input

Prior to initiating the public scoping process for the Little Rock Mine Project, the BLM identified a range of issues that would require additional analysis in the EIS. In general, comments received from the public and agencies at the public meeting, and by written response during the scoping period, have reflected concerns for the same specific issues as well as some additional concerns. A scoping report is available for public review at the BLM Las Cruces District office, located at 1800 Marquess Street, Las Cruces, New Mexico.

The following potentially significant issues were identified by the BLM in the scoping letter of December 1994, and were included in many of the public and agency responses:

- quality and quantity of post-mining water generated by the open pit

- effect on surface water and riparian areas of the proposed haul road to the Little Rock site

- effect on surface water quality and riparian areas of the proposed diversion of California Gulch around the Little Rock site

Various other descriptions of these and related issues and concerns were offered by comments and questions, although in different words. For example, one comment that is related to the water quality/quantity issue included a concern for "pollution of the water table," and another mentioned "withdrawal of water from the Gila River."

Several comments were received regarding reclamation of the pit after mining operations are complete. These included:

- appearance of the pit after mining
- restoration and revegetation
- potential for backfilling of the pit
- post-mining land use

Other concerns included the following:

- cumulative effects to the environment
- other future mining activities
- impacts to the Silver City water supply
- impacts to wildlife from withdrawal of water
- disposal of existing wastes from former mining activity
- socioeconomic impacts of employment (hiring and termination)
- use of county roads and New Mexico Highway 90
- downstream erosion due to the diversion of California Gulch
- impacts of haul road on wildlife migration patterns, wildlife mortality, and erosion
- impacts of the existing leach stockpiles on underlying ground and surface water quality
- effects of pit dewatering on local ground and surface water and nearby springs

- effect on cultural and historical resources (2 comments)
- effect on nearby State Trust lands
- above-ground storage of heavy-metal-bearing mine tailings
- special status plants and animals (3 comments)
- noise levels
- impacts to upland forest and shrub habitats
- water table under the existing mine and the processing area and contamination of the water
- water quantity/utilization (2 comments)
- requirements, including bonding, for reclamation and spills
- reclamation of the haul road (2 comments)

5.2 CONSULTATION AND COORDINATION

Formal Consultation

The BLM, PDMC, and Dames & Moore staff consulted with the SHPO to initiate Section 106 compliance. Consultation with SHPO will be completed prior to issuance of a special use permit and subsequent project construction and operation.

In addition, Section 7 consultation with the USFWS has been conducted as is documented in Chapters 3 and 4 of this report. The NMDFG was also contacted for input and comment on the proposed project, and is documented in Chapter 3 and 4 of this report.

List of Agency Contacts

The following agencies were consulted during preparation of the DEIS.

Federal Agencies
U.S. Bureau of Land Management
U.S. Forest Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Natural Resources Conservation Service
U.S. Army Corps of Engineers

State Agencies
New Mexico Environment Department
New Mexico Department of Game and Fish
New Mexico Bureau of Mines and Mineral Resources
New Mexico State Historic Preservation Office
New Mexico State Land Office
Energy and Minerals Department Mining and Minerals Division

Local Agencies
Southwest Regional Planning Office
Southwest New Mexico Council of Governments
Silver City Planning Office
Grant County Commission
Grant County Assessors Office

Tribal Government
San Carlos Apache Tribe
White Mountain Apache Tribe
Mescalero Apache Tribe
Fort Sill Apache Tribe
Zuni Pueblo

Informal Public Coordination

Informal coordination with the public has taken place throughout the planning process through personal contacts, telephone calls, letters, and will continue throughout the remainder of the planning process.

5.3 LIST OF AGENCIES AND ORGANIZATIONS RECEIVING THE EIS

The following is a partial list of various federal, state, and local agencies, and tribal governments, to which the Draft EIS is being sent for review and comment. In addition, approximately 30 individuals requested copies of this document.

Federal

- Environmental Protection Agency
  - Region 6
- Department of Agriculture
  - Animal Damage Control
  - Environmental Quality
  - Forest Service
    - Gila National Forest
      - Black Range Ranger District
  - Soil Conservation Service
- Department of the Air Force
- Department of the Army
  - Corps of Engineers
    - Albuquerque District
    - Southwestern Division
- Department of Energy
  - Office of Environmental Compliance
  - Office of NEPA Oversight
- Department of Interior
  - Natural Resource Library
  - Office of Environmental Affairs
  - Bureau of Indian Affairs
  - Bureau of Land Management
    - Albuquerque District
    - Farmington District
    - Roswell District
    - Safford District
  - Bureau of Mines
    - Branch of Mineral Assessment
    - Inter-Mountain Field Operations Center
  - Bureau of Reclamation
    - Division of Environmental Affairs
  - Minerals Management Service
    - Environmental Policy and Protection Div
    - Offshore Environmental Assessment Div
  - National Park Service
    - Environmental Quality Division
    - Southwest Regional Office
  - U.S. Fish & Wildlife Service
    - Central Mineral Resources
    - Water Resources Division
    - Division of Environmental Containment
  - United States Geological Survey
    - Environmental Affairs Program
- Department of Transportation
  - Federal Highway Administration
  - Environmental Division
- Federal Officials
  - Jeff Bingaman
  - Pete Domenici
  - Bill Richardson
  - Steve Shiff
  - Joe Skeen
  - John Arthur Smith
- International Boundary and Water Commission

State

- State of New Mexico
  - Office of the Governor
  - Office of Indian Affairs
  - Office of Cultural Affairs
    - State Historic Preservation Office
  - Budget Division
  - Department of Commerce and Industry

State of New Mexico (continued)

Energy Minerals & Natural Resources Div
Engineering Department
Environment Department
Air Quality
Ground Water
Health Program
Office of the Secretary
Surface Water
Environmental Improvement Division Lab
Health Department
Highway Department
Game & Fish Department
Interstate Stream Commission
Library
Mining and Minerals Division
Museum of New Mexico
Parks and Recreation
Public Land Commission
State Land Office
State Game Commission

State Officials
Ben D. Altamirano
Thomas P. Foy
G.X. McSherry
Murray Ryan

University of New Mexico

Local

Village of Bayard
Village of Central
City of Deming
Deming Public Library
Grant County
Hidalgo County
Town of Hurley
City of Lordsburg
Lordsburg Hidalgo Library
Luna County
New Mexico Association of Counties
Town of Silver City
Silver City Public Library
Silver City Grant Chamber of Commerce
Silver City Council-Districts 1-4
Southwest New Mexico Council of Governments

Tribal Government

Isleta Del Sur Pueblo
Mescalero Tribe
Pueblo de Acoma
San Carlos Apache Tribe
White Mountain Apache Tribe
Zuni Pueblo

Special Interest Groups

Amerind Foundation Research Library

Coalition of AZ/NM Counties
Committee of Wilderness Supporters

Doña Ana County Association of Sportsmen

Earth First!
Friends of the Gila River

Gila Conservation Coalition
Gila Native Plant Society
Gila Watch
Greater Gila Biodiversity Project

Hidalgo County Cattlegrowers Association

The Nature Conservancy
New Mexico Land Use Alliance
New Mexico Public Land Coord.
New Mexico Environmental Law Center
New Mexico Mining Association
New Mexico Natural Heritage Program
New Mexico Natural History Institute
New Mexico State Livestock Board
New Mexico Wilderness Commission
New Mexico Wilderness Study Committee
NRDC

Public Land Council

Sierra Club
Southwest Environmental Center
Southwest Minerals Exploration Association

Special Interest Groups (continued)

Southern New Mexico Coalition of Conservation
Organizations

Thomas Branigan Library (Las Cruces, NM)

The Wilderness Society
Wildlife Legislative Council
Wildlife Society, New Mexico Chapter

Other

Albuquerque Journal
Albuquerque Tribune
ASARCO Incorporated
Associated Press

Batcho & Kauffman Associates
Ben F. Schaberg Company

Chino Mines Company
Colorado State University
Cyprus Mineral Company

DBS&A
Deming Headlight
Deming SWCD
Desert Winds Publishing Company
Douglas Dispatch

El Paso Herald-Post
El Paso Times
El Reportero

GCSWCD

Jones & Stokes

KCIK
KCOS TV
KDAP Radio
KDBC TV
KGGM TV
KINT
KNFT Radio
KOAT TV
KOB TV
KOTS Radio
KRWG-TV 13
KSIL Radio News Department
KTSM TV
KVIA

Lordsburg Liberal

Mesilla Valley Audubon Society
Missing Link Mining, Inc.,

National Wildlife Federation
New Mexico State Office Audubon Center
New Mexico Stockman
New Mexico Tech
Bureau of Mining and Mineral Resources
New Mexico State University

Phelps Dodge Corporation
Phelps Dodge Mining Company

Rideout Ranch

Silver City Daily Press
Sunwest Bank

Texas-New Mexico Power Company

United Steel Workers of America

Western New Mexico University

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LIST OF PREPARERS AND REVIEWERS

The individuals listed below prepared or contributed to the preparation and review of this EIS.

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Chuck O' Donnell	Geology & Minerals
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New Mexico Department of Game and Fish

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Dames & Moore

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Western New Mexico University (subconsultant)

Alex Thal Socioeconomics	PhD in Law and Economics, MS in Land Use Planning, and BS in Forest Recreation with 21 years of experience in socioeconomic analyses.

SARB Consulting (subconsultant)

Ingar Waldar Geochemistry	PhD in Geochemistry, MS and BS in Geology with 12 years of experience in geochemical analysis and modeling.

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Appendix A

APPENDIX A - SPECIES ACCOUNTS

Codes

Special status species include species that are currently listed, proposed for listing, or are candidates under review for listing as threatened or endangered by USFWS under the Endangered Species Act; species considered special status or rare by New Mexico state wildlife agencies (NMDGF); Forest Service or BLM sensitive; and species of sport, commercial, or aesthetic value as determined by the appropriate agency.

Federal codes are defined as follows:

Endangered (E): Any species that is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the Endangered Species Act would present an overwhelming and overriding risk to man.

Threatened (T): Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Category 1 Candidate Species (C1): Status review taxa for which the USFWS currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list the taxa as an endangered or threatened species.

Category 2 Candidate Species (C2): Status review taxa for which information now in possession of the USFWS indicate that proposing to list the taxa as an endangered or threatened species is possibly appropriate but for which substantial data on biological vulnerability or threat(s) are not currently known or on file to support proposed rules,

Category 3 (C3): Taxa for which the USFWS has persuasive evidence of extinction (Group 3A); taxa does not meet the Endangered Species Act's definition of a species (Group 3B); or taxa that have proven to be more abundant or widespread than previously believed and/or those that are not subject to an identifiable threat (Group 3C).

Forest Service Sensitive (FSS): Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: significant current or predicted downward trends in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

State of New Mexico codes are defined as follows:

Wildlife: Under the Wildlife Conservation Act, an endangered species is defined as one "whose prospects of survival or recruitment within the state are in jeopardy or are likely within the foreseeable future to become so" (Section 17-2-38). The phrase "within the state" means that the department must base its determination of endangerment solely on the basis of a species status inside

New Mexico, regardless of what the status might be beyond the boundaries of the state. Furthermore, the department has chosen to divide species into two categories, based on the two segments in the above definition. These categories are as follows:

- GR1 = Endangered Group 1: Species whose prospects of survival or recruitment within the state are in jeopardy.

- GR2 = Endangered Group 2: Species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.

In applying the concepts of endangerment in New Mexico, the department takes into account many factors, including the biology, population size and trends, extent of range, threats, and vulnerability of a species. In most cases, those species placed in Group 1 are the ones that have suffered notable decline in numbers and/or range, while Group 2 species are more stable but could decline significantly at any time.

Plants

List 1. State Endangered - A plant species must meet one of the following criteria to be included on the state endangered list:

- The taxon is listed as threatened or endangered under the provisions of the Federal Endangered Species Act (16 U.S.C. Sections 1531 et seq.) or is considered proposed under the tenets of the act

- The taxon is a rare plant across its entire range and of such limited distribution and population size that unregulated collection could adversely impact it and jeopardize its survival in New Mexico

- The taxon may be widespread in its distribution and may occur in adjacent states or Mexico, but its numbers are being significantly reduced to such a degree that within the foreseeable future the survival of this species in New Mexico is jeopardized.

List 2. State Sensitive - These taxa are considered to be rare because of restricted distribution or low numerical density. They need not be endemic to New Mexico, but must be regionally endemic or rare throughout their range. Their rarity makes them sensitive to long-term or cumulative land use impacts and are vulnerable to biological or climatic events that could eventually threaten them with extinction or extirpation. These species are monitored by the State. They are not protected by state statute or policy.

List 3. Rare Plant Review List - The species on this list are those for which more information is needed to determine whether or not they should be listed as sensitive or endangered. There is, based on available information, concern for their continued survival in New Mexico.

Plants

Parish's Alkali Grass (*Puccinellia parishii*)

Legal Status: This species is currently proposed for endangered status (59FR 14378, Mar. 28, 1994). The state of New Mexico lists *Puccinellia parishii* as endangered (Sivinski and Lightfoot 1992).

Distribution: This ephemeral annual grass occurs in small disjunct populations in California, Arizona, and New Mexico (USFWS 1994). This species is known from New Mexico in one location in Grant County (Sivinski and Lightfoot 1992).

Background Information: *P. parishii* is a member of the grass family (Poaceae). It resides in very specific desert habitat consisting of open, saline and alkaline seeps and meadows. It occupies low-lying moist areas among the riparian zone saltgrass community. This species is dependent on continuous water flows, but populations fluctuate in response to climatic conditions and precipitation (USFWS 1994). Parish's alkali grass occurs at elevations from 2,300 to 6,000 feet.

The largest known population of this species occurs in Grant County, New Mexico at a privately- owned spring. This population occurs in a low-lying seep and contains 200-5,000 plants in a ten acre area.

Parish's alkali grass is threatened due to its limited distribution and low population numbers. Additional threats include alteration of hydrologic flows by water diversion, impoundments, or groundwater pumping; and loss of habitat from grazing, agricultural, and residential developments.

Populations in Study Area: Due to its limited distribution and the absence of suitable habitat in the study area, this species has low to no potential for occurrence.

Mimbres Figwort (*Scrophulari macrantha*)

Legal Status: The Mimbres figwort is a Category 1 candidate for federal listing as threatened or endangered (58FR 51185, Sept. 30, 1993). This species is considered rare and sensitive (List 2) by the state of New Mexico (Sivinski and Lightfoot 1992).

Distribution: This species is found in Grant and Luna Counties in New Mexico (Fletcher et al. 1984).

Background Information: *Scrophulari macrantha*, in the figwort family (Scrophulariaceae), is a perennial herb that grows to 3 feet tall with opposite triangular leaves and distinguishing long red flowers. It occurs on north-facing steep rocky slopes and canyon bottoms from 7,000 to 8,000 feet elevation (Fletcher et al. 1984).

This plant occurs in widely disjunct populations, but is absent from suitable habitat adjacent to those populations. This species is threatened by its rarity and copper mining activities have decimated at least one known population (Sivinski and Lightfoot 1992). Other threats include road construction and grazing practices (Fletcher et al. 1984).

Populations in Study Area: The study area is within the range of this species but favorable habitat is not present. It is unlikely that this species would occur in the study area. Surveys conducted by the Metric Corporation (1993) on the adjacent Tyrone Mine did not locate any of these plants.

Wright's Dogweed (*Adenophyllum wrightii*)

Legal Status: Wright's dogweed is a Category 2 candidate for federal listing as threatened or endangered (USFWS 1995a). This species is considered rare (List 3) by the state of New Mexico (Sivinski and Lightfoot 1992).

Distribution: The range of this species is not well known and it has been collected from only a few scattered locations near Santa Rita, Grant County, New Mexico; Springerville, Arizona; and Ciudad Guerrero, Mexico (Sivinski and Lightfoot 1992). This species has not been found in New Mexico since 1880.

Background Information: Wright's dogweed belongs in the family Asteraceae (Compositae). The synonym *Dyssodia neomexicana* is also used for this species. It is an annual species up to 12 inches tall, with upright smooth stems and spine-tipped leaves that occurs in depressions where water collects during late summer rains (Sivinski and Lightfoot 1992). It is found on open slopes from 4,500 to 8,000 feet elevation. Due to the limited information on this species, its limited distribution can only be speculated on, but cattle grazing may have affected its distribution (USFWS 1995b).

Populations in Study Area: The range of this species does include the study area, but this plant has not been found in New Mexico since 1880. It is very unlikely that this species is present at the Little Rock Mine. Surveys conducted by the Metric Corporation (1993) on the adjacent Tyrone Mine did not locate any of these plants.

Porsild's Starwort (*Stellaria porsildii*)

Legal Status: Porsild's starwort is a Category 2 candidate for federal listing as threatened or endangered (USFWS 1995a). This species is considered rare and sensitive (List 2) by the state of New Mexico (Sivinski and Lightfoot 1992).

Distribution: This species in known from only two mountain ranges in Arizona and New Mexico; the Chiricahua Mountains of southeastern Arizona; and, from Signal Peak in the Pinos Altos Range in Grant County (Sivinski and Lightfoot 1992).

Background Information: This recently described species is in the pink family (Caryophyllaceae) and is a slender plant with spreading stems, opposite leaves, and white solitary flowers (USFWS 1995a). It is known to occur in association with mixed conifer forests at approximately 8,200 feet elevation (USFWS 1995b).

The distribution of this species is restricted and drought conditions have affected this plant (USFWS 1995b). Threats to this species are presently unknown.

Populations in Study Area: This species occurs in New Mexico only on Signal Peak, and it had not been seen there for three years (1989-1992) (USFWS 1995b). It is not likely to occur in the study area. Surveys conducted by the Metric Corporation (1993) on the adjacent Tyrone Mine did not locate any of these plants.

Dwarf Milkweed (*Asclepias uncialis* var *uncialis*)

Legal Status: The dwarf milkweed is a Category 2 candidate for federal listing as threatened or endangered (58FR 51150, Sept. 30, 1993). This species is considered rare (List 3) by the state of New Mexico (Sivinski and Lightfoot 1992).

Distribution: The range of *Asclepias uncialis* includes Wyoming, southern Colorado, New Mexico, and the White Mountains near Springerville in eastern Arizona (Kearney and Peebles 1960). In New Mexico, this species is known from Colfax, Grant, San Miguel, and Union Counties in New Mexico (USFWS 1995a).

Background Information: Dwarf milkweed is a member of the milkweed family (Asclepiadaceae) and is an herbaceous perennial with several erect stems up to 2.5 inches tall. The leaves are opposite and wedge-shaped, and flowers are rose-purple (USFWS 1995a). Milkweeds contain a substance, asclepain, which can be used for meat tenderizing (Kearney and Peebles 1960).

This plant is widespread, but rare and not readily found (Sivinski and Lightfoot 1992). It is found in grassland habitats, with grama, wheatgrass, galleta, and buffalograss.

Populations in Study Area: The study area is within the known geographic range of this species. This rare and infrequently found species could occur in the study area but it appears unlikely. Surveys conducted by the Metric Corporation (1993) on the adjacent Tyrone Mine did not locate any of these plants.

Night-blooming cereus (*Cereus greggii* var *greggii*)

Legal Status: The night-blooming cereus is a Category 2 candidate for federal listing as threatened or endangered (58FR 51156, Sept. 30, 1993). This species is considered endangered (List 1) by the state of New Mexico (Sivinski and Lightfoot 1992).

Distribution: This variety of night-blooming cereus occurs in the Chihuahuan Desert of eastern Arizona, the southwestern corner of New Mexico south to west Texas, and into northern Mexico (Benson 1982). In New Mexico, this species occurs in Dona Ana, Grant, Hidalgo, and Luna Counties (Fletcher et al. 1984).

Background Information: This species is a member of the cactus family (Cactaceae). Plant taxonomists also refer to this plant using the synonym *Peniocereus greggii.* It is a very inconspicuous plant, appearing like dead sticks or branches of the creosote bush (Benson 1982). The aboveground portions of the plant emanate from a large underground tuber weighing from 1 to 50 pounds. One to several slender, cylindrical, often-branched stems, which arise from the summit of the tuber to a height of 1.5 to 6 feet, characterize the aboveground portions of the plant. As the name implies, this species blooms at night and the fragrant white flowers last only one (Kearney and Peebles 1960), or possibly two nights (Benson 1982). The large nocturnal flowers appear in early to late June (Benson 1982).

Cereus greggii var *greggii* occurs on flats and in gravelly or silty areas in washes. They often grow under creosote bushes or with surrounding woody vegetation concealing their appearance (Benson 1982). This cactus is found from 3,000 to 5,000 feet elevation (Fletcher et al. 1984).

Although this plant is widely distributed, once populations are found they are threatened by collecting (Fletcher et al. 1984). Other perceived threats include habitat alteration and the physical destruction of brittle stems as a result of overgrazing.

Populations in Study Area: The range of this species includes southern Grant County and the plant could occur in the study area on flats and in washes. The floral survey conducted on the adjacent Tyrone Mine by the Metric Corporation (1993) did not locate any plants.

Slender Spider Flower (*Cleome multicaulis*)

Legal Status: The slender spider flower is a Category 2 candidate for federal listing as threatened or endangered (58FR 51158, Sept. 30, 1993). This species is considered endangered (List 1) by the state of New Mexico (Sivinski and Lightfoot 1992).

Distribution: The known distribution of this species is from south-central Colorado to southeastern Arizona, southwestern New Mexico, western Texas, and Mexico (Fletcher et al. 1984). In New Mexico, this species is known from one collection in 1851, in Grant County, and currently is known only from the San Luis Valley in Colorado (Sivinski and Lightfoot 1992).

Background Information: The slender spider flower is in the caper family (Capparidaceae) and the synonym *Cleome sonorae* is commonly used. This slender annual is approximately 24 inches tall with compound leaves. Flowers are pink or white and occur in the axils of the stem leaves. This species flowers in August and September (Fletcher et al. 1984).

C. multicaulis originally was found in saline or alkaline soils in close proximity to alkali sinks or alkaline meadows or lake beds. It occurs from 4,000 to 7,000 feet elevation. Threats to this species are currently unknown but the use and alteration of mesic or alkaline land could have affected its habitat.

Populations in Study Area: This species has not been seen in the state recently and its present range includes only Colorado. It is very unlikely that it would occur in the study area. Surveys conducted by the Metric Corporation (1993) on the adjacent Tyrone Mine did not locate any of these plants.

Pringle Hawkweed (*Hieracium pringlei*)

Legal Status: Pringle hawkweed is a Category 2 candidate for federal listing as threatened or endangered (58FR 51169, Sept. 30, 1993). This species is considered rare (List 3) by the state of New Mexico (Sivinski and Lightfoot 1992).

Distribution: *Hieracium pringlei* is known from Arizona, in the Huachuca and Santa Rita Mountains (Kearney and Peebles 1960), and from southwestern New Mexico and northern Mexico (USFWS 1995a). This species is known from Grant County, New Mexico.

Background Information: Pringle hawkweed is in the sunflower family (Asteraceae). It is a perennial with hairy stems and leaves with 12 to many flowers that are yellow, white, or pink in color (USFWS 1995a). This species occurs in conifer woodlands and forests with piñon pine, junipers, ponderosa pine, fir, and gambel oak trees (Sivinski and Lightfoot 1992). It is found around 6,000 feet elevation (Kearney and Peebles 1960).

Populations in Study Area: This species could occur in conifer woodlands of the project area around 6,000 feet elevation. A floral survey conducted on the adjacent Tyrone Mine by the Metric Corporation (1993) did not locate any plants.

Pinos Altos Flameflower (*Talinum humile*)

Legal Status: The Pinos Altos flameflower is a Category 2 candidate for federal listing as threatened or endangered (58FR 51188, Sept. 30, 1993).

Distribution: This species was originally collected near Pinos Altos in Grant County, New Mexico. It has not been located in the state since the late 1880's (USFWS 1995a).

Background Information: *Talinum humile* is in the Portulacaceae family. It is a perennial plant that grows 2 to 3 inches tall, having succulent cylindrical leaves forming from a basal cluster (Fletcher et al. 1984). Flowers number 5 to 10 in a terminal cluster, and they are pale yellow in color, changing to orange when dry. This plant grows on south facing rocky slopes at approximately 6,000 to 8,000 feet elevation (USFWS 1995a).

Little information exists on this species and threats are unknown. This plant is known from an area with extensive mining activity.

Populations in Study Area: Although the original range of this species includes Grant County, this species has not been found in New Mexico since the 1880's (USFWS 1995a) and it is unlikely that this species would occur in the project area. Surveys conducted by the Metric Corporation (1993) on the adjacent Tyrone Mine did not locate any of these plants.

Grama Grass Cactus (*Pediocactus papyracanthus*)

Legal Status: The grama grass cactus is a Category 2 candidate for federal listing as threatened or endangered (58FR 51183, Sept 30, 1993).

Distribution: This species occurs sporadically from east-central Arizona in southern Navajo County, and from the north-central, south-central, and south-western part of New Mexico, and west Texas (Fletcher and Moir 1993).

Background Information: This species is a member of the cactus family (Cactaceae). Many southwestern botanists prefer placing this cactus in a separate genus *Toumeya*, and using the scientific name *Toumeya papyracantha* (Fletcher et al. 1984). Most species of the genus *Pediocactus* are small and rarely found in the field. Stems of this species are solitary and from 1 to 8 inches tall, with spines resembling dry grass blades (Fletcher et al. 1984). Flowers bloom from April to June and are white but do not open widely.

This cactus is found in red sandy soils on open flats of grama grass and galleta grasslands and piñon-juniper woodlands. The grama grass cactus often occurs in fairy rings of blue grama grass (*Bouteloua gracilis*) where it is concealed among the dry leaves of the grass (Benson 1982). It occurs from 5,000 to 7,200 feet elevation.

The grama grass cactus may have had a larger range and been more abundant, but degradation of rangeland and overgrazing have reduced its abundance (Fletcher et al. 1984). The major threats to this species are overcollection, overgrazing, destruction of habitat by urbanization, and cyclic insect infestations (Fletcher and Moir 1993).

Populations in Study Area: The entire central part of the state of New Mexico is suitable habitat for this species. Individuals or small populations could occur in the study area, especially in close association with blue grama grass. A survey of suitable habitat in close proximity to the study area was surveyed by the Metric Corporation (1993), but no *P. papyracantha* were found.

Green Flowered Pincushion Cactus (*Mammillaria viridiflora*)

Legal Status: The green flowered pincushion cactus is not federally listed. This species is considered sensitive by the BLM.

Distribution: This species is found in Mohave, Pinal, Graham, Cochise, and Santa Cruz counties in Arizona; and from southern New Mexico (Kearney and Peebles 1960).

Background Information: This plant is a member of the cactus family (Cactaceae), further described as fishhook or pincushion cactus. *Mammillaria viridiflora* is also known by the synonym *M. wilcoxii* var *viridiflora* (Kearney and Peebles 1960). This cactus is about 4 inches tall and 2.75 inches in diameter, with reddish brown to light tan spines in clusters of 16 to 25 (Fletcher et al. 1984). Its flowers are greenish-white, pale pink, or streaked with pink, they are a half to one inch wide, and they bloom in June and July. The flower color distinguish this species from *M. wrightii*.

M. viridiflora is found on dry slopes of arid grasslands or along the edges of desert habitat (Fletcher et al. 1984). In Arizona, it is found from 2,500 to 5,000 feet elevation or higher (Kearney and Peebles 1960), while in New Mexico it is found from 4,500 to 6,500 feet (Fletcher et al. 1984).

This species is occasionally common within in its habitat and collection of this species is its primary threat (Sivinski and Lightfoot 1992).

Populations in Study Area: This species could occur in the study area in appropriate habitat. Floral surveys conducted by the Metric Corporation (1993) on the adjacent Tyrone Mine located several individuals of this species at various locations.

Wright's Pincushion Cactus (*Mammillaria wrightii*)

Legal Status: The Wright's pincushion cactus is not federally listed. This species is considered endangered (List 1) by the state of New Mexico (Sivinski and Lightfoot 1992). The BLM considers this species a sensitive plant.

Distribution: This cactus ranges from New Mexico and adjacent Texas and Arizona. In New Mexico it is found from the central and west-central part of the state, from McKinley and Sandoval Counties south to Catron and Socorro Counties, east to Guadalupe and Lincoln Counties, and from southern New Mexico in Dona Ana County (Sivinski and Lightfoot 1992).

Background Information: This species is a member of the cactus family (Cactaceae). It is approximately 4 inches tall and 2 inches wide. Spines are in clusters of 10 to 15, with outer spines being tan or gray, while inner spines are reddish brown (Fletcher et al. 1984). This species flowers from May to August and flowers are pink to purple with a white or yellow tinge.

This pincushion cactus has a wide, sporadic distribution from gravelly or sandy hills, plains, desert grasslands, or in pinyon-juniper areas (Fletcher et al. 1984). It occurs from 3,000 to 7,000 feet elevation.

This species was once considered extinct in New Mexico, but recent discoveries have revealed more widespread populations. This species is not considered to be in immediate danger, but threats include overcollection and habitat alteration (Fletcher et al. 1984).

Populations in Study Area: The known range of this species does not include Grant County and it is unlikely to occur in the study area. However, a population was identified within six miles of the site (NMHNHP 1995).

TABLE A-1
CHARACTERISTIC PLANT SPECIES
Characteristic Plant Species Within the Various Vegetation Types in the Little Rock Mine Study Area.

SPECIES	
Common Name	**Scientific Name**
TREES	
Netleaf Oak	*Quercus rugos*
Shrub Live Oak	*Q. turbinella*
Ash	*Fraxinus sp.*
Alligator Bark Juniper	*Juniperus deppeana*
Pinyon Pine	*Pinus edulis*
Ponderosa Pine	*P. ponderosa*
Cottonwood	*Populus sp.*
SMALL TREES/SHRUBS	
Fourwing Saltbush	*Atriplex canescens*
Fairy Duster	*Calliandra humilis*
Desert Willow	*Chilopsis linearis*
Rubber Rabbitbrush	*Chrysothamnus nauseosus*
Sotol	*Dasylirion wheeleri*
Hedgehog	*Echinocereus triglochidiatus*
Apache Plume	*Fallugia paradoxa*
Broom Snakeweed	*Gutierrezia sarothrae*
Pale Hackberry	*Lycium pallidum*
Beargrass	*Nolina microcarpa*
Cholla	*O. imbricata*
Littleleaf Sumac	*Rhus microphylla*
Prickly Pear	*Opuntia phaecantha*
Mesquite	*Prosopis juliflora*
Squawbush	*Rhus trilobata*

Table A-1 (continued)
Characteristic Plant Species

SPECIES	
Common Name	**Scientific Name**
Banana Yucca	*Yucca baccata*
Soaptree Yucca	*Y. glauca*
GRASSES	
Wheatgrass	*Agropyron sp.*
Cane Bluestem	*Andropogon barbinodis*
Purple Three-awn	*Aristida purpurea*
Blue Grama	*Bouteloua gracilis*
Sideoats grama	*B. curtipendula*
Black Grama	*B. eriopoda*
Hairy Grama	*B. hirsuta*
Tanglehead	*Heteropogon spp.*
Tobosa	*Hilaria mutica*
Green Sprangletop	*Leptochloa dubia*
Muhleys	*Muhlenbergia sp.*
Alkali Sacton	*Sporobolus airoides*
Sand Dropseed	*S. cryptandrus*
Spike Dropseed	*S. contractus*
Needle Grass	*Stipa sp.*
New Mexico Feathergrass	*Stipa neomexicana*
Arizona Cottontop	*Triachne californica*
FORBS	
Milkvetch	*Astragalus spp.*
Indian Paintbrush	*Castilleja spp.*
Wild Buckwheat	*Eriogonum spp.*
Filaree	*Erodium circutarium*
Gaura	*Gaura spp.*
Gilia	*Gilia spp.*

Table A-1 (continued) Characteristic Plant Species	
SPECIES	
Common Name	**Scientific Name**
Sunflower	*Helianthus spp.*
Peppergrass	*Lepidium spp.*
Lupines	*Lupinus spp.*
Penstemon	*Penstemon spp.*
Tumble-mustard	*Sisymbrium spp.*
Silver Nightshade	*Solanum elaeagnifolium*
Verbena	*Verbena bipinnatifida*
Source: Brown 1982; USDA 1988	

Mammals

White-sided Jackrabbit (*Lepus callotis gaillardi*)

Legal Status: The white-sided jackrabbit is a Category 2 candidate for federal listing as threatened or endangered (59 FR 58986, November 15, 1994). This species is also listed by the state of New Mexico as a threatened species.

Distribution: *Lepus callotis gaillardi* are rare in the United States and occur only in the extreme southwest corner of New Mexico in Hidalgo, County southward to Mexico to Jalisco (NMGF 1988), and possibly into the southeastern corner of Arizona (Hoffmeister 1986). Only a few specimens (3) have been examined from the U. S. and they were taken 0.5-mile north of Cloverdale, New Mexico (Findley 1975).

Background Information: This rare, large jackrabbit is distinguished from the abundant black-tailed jackrabbit by its white sides and lack of black ear tips (Hoffmeister 1986). In New Mexico this species inhabits grasslands not invaded by shrubs and forbs and has been found around 4,600 feet elevation in close association with tobosa grass (*Hilaria mutica*) (Findley 1975).

This species is active only at night and feeds primarily on sedge (*Cyperus rotundus*) and grasses including buffalo-grass (*Buchloe dactyloides*) (NMGF 1988). It appears that this species is monogomous and several litters are produced each year with the average litter size being 2.2 young (Bednarz *in* NMGF 1988).

Threats to *L. c. gaillardi* include destruction of grasslands from overgrazing and conversion to agricultural uses (NMGF 1988). Other potential habitat threats include oil, gas, and mineral exploration, and other anthropogenic developments.

Populations in Study Area: Few records of occurrence in the U. S. exist and it is unlikely that this species occurs in New Mexico outside of Hildago, County (Bogan, Personal Communication, 199?). It is very unlikely to occur in the study area.

Greater Western Mastiff Bat (*Eumops perotis californicus*)

Legal Status: The greater western mastiff bat is a Category 2 candidate for federal listing as threatened or endangered (59 FR 58985, November 15, 1994). This species is not listed by the state of New Mexico.

Distribution: *Eumops perotis* ranges from the southwestern United States and northern Mexico south through most of South America (Nowak and Paradiso 1983). The only record of this species in New Mexico was a female taken in the southwest corner of the state in Hidalgo County (Findley et al. 1975).

Background Information: This is the largest bat species found in the United States. Individuals have large overhanging ears which completely hide the head and face from above. These bats are insectivores, feeding largely on members of the order Hymenoptera and usually foraging between ground level and the treetops (Nowak 1991). They may, however, feed 100-200 feet above the substrate and have been estimated to forage as much as 2000 feet above the ground (Williams 1986).

This species appears to be nonmigratory, but they do shift roosting sites as the seasons change. Some individuals become inactive for short periods in winter (Nowak 1991).

Bats of this genus usually roost in crevices in rocks, trees, tunnels, and buildings. Roosts are generally two to six meters or more above ground. The bats emerge at late dusk and feed throughout the night, returning to the roost before dawn (Hoffmeister 1986). These large bats have narrow wings and require considerable space to launch themselves, and cannot take flight from the ground. Instead, they will crawl up a post or a tree in order to get enough height and then drop.

Usually a single offspring is produced from each successful pregnancy. In the United States, births take place in June, July, and August. Colonies of *Eumops* may contain as many as 70 bats, although groups of 10-20 are more usual, and some individuals may roost alone. Population trends and winter habits of this species are poorly known but information on some roost sites in Arizona show they are no longer being used (AGFD 1993). Declines in California populations have been attributed to habitat loss and pesticides, both directly and through prey base destruction (Williams 1986).

Populations in Study Area: Habitat does exist in the study area where these species could possibly roost, but the range and occurrences of this species is primarily from the southwest corner of the state in Hildago, County. It is unlikely that this species would occur in the study area.

Spotted Bat (*Euderma maculatum*)

Legal Status: The spotted bat is a Category 2 candidate for federal listing as threatened or endangered (59 FR 58985, November 15, 1994). This species is listed by the state of New Mexico as a threatened species.

Distribution: The spotted bat is known from central Canada to the western and southwestern United States, and into northeastern Mexico (Hill and Smith 1984). This species' distribution in New Mexico ranges from the Rio Grande Valley westward, primarily occurring in the Jemez, San Mateo, and Mogollon Mountains (NMGF 1988). Other records of occurrence include Ghost Ranch in Rio Arriba County, Lake Roberts in Grant County, and areas around Aztec, in Doña Ana County, and Mesilla Park in Dona Ana County.

Background Information: This easily identified bat has three distinctive white spots on a dark background and long pinkish-red ears, which are the largest of any North American bat (Noel and Johnson et al. 1993). Very little is known about the habitat requirements and basic biology of this species. The three spots, which are about one-half inch across, are also the reason for the name "Death's Head Bat." Another common name is "Jackass Bat", due to the prominent ears.

The spotted bat is associated with a wide variety of habitats throughout its geographic range, including open ponderosa pine, desert scrub, pinyon-juniper woodlands, and open pastures (Findley et al. 1975, Burt and Grossenheider 1976). They are most common in dry, rough desertscrub (Watkins 1977). It is unclear what the preferred habitat of this species is, although specimen locations in Arizona are all near riparian areas, giving some credence to those who say preferred habitat consists of uneven rocky cliffs within a mile or so of riparian habitat. Records of spotted bats in New Mexico indicate similar habitat requirements. The species has been taken from the lower Rio Grande Valley near Las Cruces at approximately 4,000 feet elevation, to near the summit of Mt Taylor at over 10,000 feet (NMGF 1988).

Like other members of its family (Vespertilionidae), the spotted bat is probably wholly insectivorous, catching insects on the wing or picking them from leaves and other vegetation (Hill and Smith 1984). Moths are thought to be their primary food source. They may also take prey from the ground, including grasshoppers and June bugs (Noel and Johnson et al. 1993). They emerge late in the evening and have a loud, high-pitched call.

Spotted bats appear to be relatively solitary, although they sometimes hibernate in small clusters. They may use caves or mines as hibernacula (Findley et al. 1975). For roosting, they appear to be most at home in remote rock crevices high on limestone or sandstone cliffs (Easterla 1973). This bat has been documented in New Mexico only during the warmer months from April through September, and lactating females have been taken from late June to mid-July indicating that young are born in early summer (NMGF 1988). Limited information suggests the normal litter size is one.

Historic information indicates that the spotted bat is widely distributed but apparently very rare over its range with one possible limiting factor being affects of ingested pesticides by contaminated insects (NMGF 1988). Factors limiting the distribution and abundance of this species may be availability of suitable roost sites or prey items (Spicer 1991). As with other bat species, the spotted bat may be subject to disturbances at roosts, especially maternity roosts.

Populations in Study Area: This species is known from a variety of habitats and locations in relatively close proximity to the study area. Suitable habitat exists in the study area including rocky substrates with forested and open desertscrub but with the absence of riparian habitat. Foraging individuals of this species could occur in the study area, but it is unlikely that this species would roost in the study area.

Occult Little Brown Bat (*Myotis lucifugus occultus*)

Legal Status: The occult little brown bat is a Category 2 candidate species for Federal listing as threatened or endangered (56 FR 58804, November 21, 1991). This species is not listed by the state of New Mexico.

Distribution: The range of this subspecies includes most of Arizona, extreme eastern California, the western half of New Mexico, south into Sonora and Chihuahua, Mexico. Individuals may winter several hundred miles from their summer colonies (Whitaker 1980) or very close to them (Findley et al. 1975).

Background Information: This medium-sized bat has bright glossy fur of tawny color, small ears, and large feet. *Myotis lucifugus occultus* is insectivorous and frequents areas with open water, possibly as much for drinking as for feeding on the associated insects (Hoffmeister 1986).

Like all species of *Myotis*, they roost by day and forage for insects at night, especially mosquitoes, midges, and moths. The insects are caught in flight. This species roosts in attics of buildings, rock crevices, and hollow trees (Williams 1986). They have also been found in crevices between bridge timbers (Noel and Johnson et al. 1993). There is only one report of summertime roosting in caves or mines (Williams 1986), although some winter records are from mines.

During the summer, the sexes separate (Noel and Johnson et al. 1993). Females congregate in maternity colonies, sometimes with other *Myotis* species (Hoffmeister 1986). Maternity colonies number between about 60 and 800 females, often in old buildings, and always near water (Noel and Johnson et al. 1993). Young are born singly in late June. By mid-summer, the colonies disperse to other sites, some previously unoccupied and sometimes to the open (Noel and Johnson et al. 1993).

Reasons for concern include population declines, possibly brought about by pesticide use, and disturbance of roosting bats, especially in maternity colonies (Williams 1986).

Populations in Study Area: Possible roosting habitat does exist in the study area, and this species is known to occur near open water sources, which are found on the study site. This species has moderate potential for occurring in the study area.

TABLE A-2 MAMMALS Mammals known or likely to occur in the vicinity of Little Rock Mine in Grant County, New Mexico. * = Species prèsence was verified by Metric Corporation (1993). # = Species presence was verified by Dames and Moore (1994, 1995).	
Common Name	**Scientific Name**
INSECTIVORA: Insectivores	
Merriam's Shrew	*Sorex merriami*
Desert Shrew	*Notiosorex crawfordi*
CHIROPTERA: Bats	
Yuma Myotis	*Myotis yumanensis*
Little Brown Myotis	*M. lucifugus*
Fringed Myotis	*M. thysanodes*
California Myotis	*M. californicus*
Small-footed Myotis	*M. leibii*
Silver-haired Bat	*Lasionycteris noctivagans*
Western pipistrelle	*Pipistrellus hesperus*
Big Brown Bat	*Eptesicus fuscus*
Red Bat	*Lasirus borealis*
Hoary Bat	*L. cinereus*
Spotted Bat	*Euderma maculatum*
Allen's Lappet-browed Bat	*Idionycteris phyllotis*
Townsend's Big-eared Bat	*Plecotus townsendii*
American Free-tailed Bat	*Tadarida brasiliensis*
Big Free-tailed Bat	*T. macrotis*
LAGOMORPHA: Rabbits, Hares, Pikas	
Eastern Cottontail	*Sylvilagus floridanus*
#* Desert Cottontail	*S. audubonii*
* Black-tailed Jackrabbit	*Lepus californicus*

Table A-2 (continued)
Mammals

Common Name	Scientific Name
RODENTIA: Rodents	
# Cliff Chipmunk	*Eutamias dorsalis*
#* Rock Squirrel	*Spermophilus variegatus*
Botta's Pocket Gopher	*Thomomys bottae*
Apache Pocket Mouse	*Perognathus apache*
Western Harvest Mouse	*Reithrodontomys megalotis*
Deer Mouse	*Peromyscus maniculatus*
Brush Mouse	*P. boylii*
Pinyon Mouse	*P. truei*
Rock Mouse	*P. difficilis*
Northern Grasshopper Mouse	*Onychomys leucogaster*
Hispid Cotton Rat	*Sigmodon hispidus*
# White-throated Wood Rat	*Neotoma albigula*
Stephen's Wood Rat	*N. stephensi*
Mexican Wood Rat	*N. mexicana*
Norway Rat	*Rattus norvegicus*
House Mouse	*Mus musculus*
Porcupine	*Erethizon dorsatum*
CARNIVORA: Carnivores	
#* Coyote	*Canis latrans*
* Gray Fox	*Urocyon cinereoargenteus*
* Black Bear	*Ursus americanus*
Raccoon	*Procyon lotor*
Ringtail	*Bassaricus astutus*
Badger	*Taxidea taxus*
Western Spotted Skunk	*Spilogale gracilis*
Striped Skunk	*Mephitis mephitis*
Hog-nosed Skunk	*Conepatus mesoleucus*
#Mountain Lion	*Felis concolor*
Bobcat	*F. rufus*
ARTIODACTYLA: Even-toed Ungulates	
Collared Peccary	*Tayassu tajacu*
*# Mule Deer	*Odocoileus hemionus*
* White-tailed Deer	*O. virginianus*

Sources: Bernard and Brown 1978; Findley et al. 1975, Whitaker 1980

Birds

Northern Aplomado Falcon (*Falco femoralis septentrionalis*)

Legal Status: The Northern Aplomado Falcon is listed as endangered (51 FR 6690, Feb 25, 1986). It is also listed as endangered (group 1) by the state of New Mexico (NMGF 1988).

Distribution: This falcon ranges from northeastern Mexico, south to Chiapas, throughout Central America and South America (Johnsgard 1990). It was formerly found in southeastern Arizona, southern New Mexico, and west-central and southern Texas. In New Mexico, it formerly occurred in the southwest and farther east to the Tularosa Basin, with occasional reports from the state, but recently there were no verified sightings until a single subadult was sighted in Otero County of south-central New Mexico in 1991 (NMGF 1988 updated in 1991).

Background Information: "Aplomado" in spanish means "lead-colored" referring to this species back color (Clark and Wheeler 1987). The Aplomado falcon is a colorful, narrow-winged, long-tailed, medium-sized bird, found in open grasslands scattered with yuccas (*Yuccas* spp.) and mesquites (*Prosopis* spp.) (Johnsgard 1990). It is also known to inhabit coastal prairie, oak and pine savannas (NMGF 1988). Trees provide observation stations, preening and roosting sites, plucking perches, cache sites, nest sites, and cover from wind and sun (Johnsgard 1990). In the southwestern U. S., this species occurs below 5900 feet elevation.

Aplomado falcons feed primarily on birds. Other species eaten include insects; only one mammalian species, a bat; and reptiles, some of which are pirated from other raptors (Johnsgard 1990). Prey are caught by direct flight from observation stations or on the ground after pursuit on foot (NMGF 1988). Falcon pairs hunt cooperatively in thick cover and breeding pairs remain together throughout the year and are often found perched close together (Clark and Wheeler 1987). Nesting territories are relatively small, and most of the hunting is done close to the nest site. This falcon takes possession of nest platforms built in trees or small shrubs by other raptors (Johnsgard 1990). Clutches consist of 2-4 eggs, which are laid from March to May with most clutches being laid in April.

A great reduction is this species range and number has occurred in the United States. Threats to this species include habitat changes resulting from overgrazing of grasslands (NMGF 1988), supplemented by pesticide contamination in Mexico that have caused egg-thinning effects as great or greater than those observed in peregrines (Johnsgard 1990).

Populations in Study Area: Due to the limited distribution and rarity of this species in the U. S., it is currently unlikely to occur in the study area. If reintroduction efforts continue, the potential for this species to occur in suitable habitat of the study area would increase.

American Peregrine Falcon (*Falco peregrinus anatum*)

Legal Status: The American peregrine falcon is listed as endangered (35 FR 16047, October 13, 1970; 35 FR 8495, June 2, 1970) without determination of critical habitat. The state of New Mexico also lists the American peregrine falcon as endangered (group 1) (NMGF 1988).

Distribution: The peregrine falcon has one of the broadest geographical distribution of all birds, and is found across North America from northern Alaska and Canada south to southern Baja California, the coast of Sonora, and into Central and South America (AOU 1983). In New Mexico, this subspecies breeds locally in mountainous areas, and statewide mainly west of the eastern plains during migration and in winter (Hubbard 1978 *in* NMGF 1988).

Background Information: *Peregrinus* in Latin means "wandering" , and is appropriate for the falcon's long distance migrations and dispersals (Clark and Wheeler 1987). The peregrine falcon is a large dark falcon with a thick dark mustache mark and long pointed wings and a long tail. Habitat features consist of cliffs, that serve as nesting and perching sites, with ledges and caves providing protection from mammalian predators and the weather. A nearby source of water is usually close to the nest site (Johnsgard 1990). In New Mexico this falcon prefers areas from 6,500 to 8,500 feet elevation, but is also found from 3,500 to 9,000 feet (USFWS 1987).

Peregrines feed primarily on birds, which is an important component of their habitat. Formerly called the "duck hawk" in North America for one type of prey (Clark and Wheeler 1987), this species also feeds extensively on passerines and shorebirds (Snow 1972). Prey species are taken almost entirely in flight by aerial stooping or diving at prey from above.

Peregrines form permanent pair bonds and remain mated for life, with breeding territories being reoccupied year after year (Johnsgard 1990). Nest sites are usually on open ledges on cliffs and are usually very inaccessible. Eggs are laid directly on the bare ledge and clutches typically consist of 3-4 eggs (NMGF 1988). Hatching of young occurs in 32-34 days (Johnsgard 1990).

The reason for this species decline in the U.S. was reproductive failure due to pesticide contamination (USFWS 1987). The population started to decline around 1954 and DDT was later determined to be the major cause (Root 1988). A 1980 estimate of breeding pairs in North America of 2,800 to 3,800 included 16 pairs in New Mexico (Cade 1982 *in* Johnsgard 1990). Pesticides have affected populations in New Mexico and peregrine populations reached their lowest levels in the late 1970's. The small breeding population now appears stable (NMGF 1988). Other threats include habitat alteration or destruction, disturbance, and taking. Due to the strong affinity for past breeding territories, those areas need to be protected.

Populations in Study Area: The potential for breeding territories in the study area is low due to the lack of appropriate nesting habitat of cliffs with a proximate water source. Foraging birds could occur in the study area.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

Legal Status: The southwestern willow flycatcher was federally proposed for listing as an endangered species with critical habitat on July 23, 1993 (58 FR 39495). This subspecies is listed by the state of New Mexico as threatened.

Distribution: The species willow flycatcher (*Empidonax traillii*), breeds throughout most of the contiguous United States, portions of southern Canada, and, marginally, in areas of northern Mexico

(AOU 1983, Unitt 1987, Browning 1993). The subspecies (*E. t. extimus*), which occurs in New Mexico, is commonly known as the southwestern willow flycatcher and breeds locally in Arizona, southeastern California, New Mexico, western Texas, and southern Utah (Unitt 1987; Browning 1993). Migrant birds occur statewide in spring and fall, with breeding birds in the Chama, Rio Grande, Zuni, San Francisco, Gila, and Hondo basins and the San Juan and western Sangre de Cristo Mountains (NMGF 1988).

Key habitat areas in New Mexico include Zuni (McKinley Co.), Corrales (Sandoval Co.), upper Elephant Butte Lake (Sierra Co.), Glenwood-Pleasanton (Catron Co.), and Cliff-Redrock (Grant Co.) (NMGFD 1988). In the proposed rule to list the subspecies, the USFWS delineates critical riparian habitat in New Mexico (USFWS 1993). One area includes the Rio Grande River from northern Albuquerque south to southbound Interstate 25. Another area includes the Gila River and the East and West Forks of the Gila River from El Rincon Creek upstream to Hell's Hole Canyon and the confluence of Taylor and Beaver Creeks in Catron and Grant Counties. Also, the Gila River from Hidden Pasture Canyon to Steeple rock Canyon in Grant and Hidalgo Counties, and sections of the San Francisco River in Catron County.

Background Information: This small bird is grayish-green with a whitish throat and two prominent wingbars. Throughout its range this species is closely associated with riparian habitats. The common dominator among breeding sites is the presence of willows. Browning (1993) notes that it breeds in swamps and willow thickets, usually along streams. In a Colorado study of nesting habitat (Sedwick and Knopf 1992) nesting was consistently associated with the abundance, density and coverage of willows, although nests were not immediately near water in mesic areas. In a study of a Sierra Nevada population nests were placed 1-2 meters above the ground within willow clumps (Flett and Sanders 1977). Breeding willow flycatchers in New Mexico occur from approximately 3,700 to 8,800 feet elevation, with occurrences above 7,000 feet restricted to the northern part of the state (NMGF 1988).

E. t. extimus is an insectivore, foraging in and above dense riparian vegetation capturing insects in flight and gleaning them from foliage (USFWS 1993). Nests normally contain 3-4 eggs (USFWS 1993), but clutch size in New Mexico is reported as 1-4 eggs, with an average of 2.25 (Hubbard 1987 *in* NMGF 1988). Breeding occurs from late May to late July and only one brood is raised per year.

The USFWS (1993) lists several reasons for this species decline including loss of riparian cottonwood-willow associations and the invasion of saltcedar (*Tamarix pentandra*), brood parasitism by brown-headed cowbirds (*Molothrus ater*), and the lack of adequate protective regulations. Populations in New Mexico are estimated at 100 pairs (Hubbard 1987 *in* NMGF 1988) and a decline in the population of breeding southwestern willow flycatchers has occurred due to habitat loss.

Populations in Study Area: The presence of southwestern willow flycatchers in the study area is very unlikely due to their dependence on willow thickets, which are not present in the study area; and, riparian habitats which are very limited in the study area, consisting of a couple of sparse stands of cottonwood and ash. The USFWS (1993) proposed designation of critical habitat for the willow flycatcher does not include areas within the study area.

Northern Goshawk (*Accipiter gentilis*)

Legal Status: The northern goshawk is a federal Category 2 candidate species for threatened or endangered status (59 FR 58990; Nov. 15, 1994). This species is not listed by the state of New Mexico. The Apache northern goshawk (*Accipiter gentilis apache*) is a BLM sensitive species.

Distribution: The northern goshawk is found in North America from central Alaska across Canada to Mexico, excluding the south-central and southeastern states (Johnsgard 1990). In New Mexico, breeding birds occur in the northern 2/3 of the state and wintering birds occur statewide except the southeastern quarter (Johnsgard 1990).

Background Information: The name "Goshawk" was derived from the Anglo-Saxon word *gos* for goose and *havoc* for hawk, meaning a hawk that captures geese (Clark and Wheeler 1987). The northern goshawk is our largest accipiter, about the size of a red-tailed hawk (*Buteo jamaicensis*). *Accipiter gentilis* is blue-gray on the back and wings, with fine gray streaks on a dull white or gray breast.

A. gentilis is found in northern and mountainous coniferous, deciduous, and mixed forests (Reynolds et al. 1992). Although tree species vary, the woodlands they inhabit generally have a relatively high percent canopy cover. Understory cover and tree size is highly variable, but they generally require a high density of large trees and an open understory.

Goshawks feed on medium-sized birds and mammals which they capture on the ground, in trees, or in the air (Reynolds et al. 1992). Home ranges for goshawks consist of three major components: a nest area, a post-fledging family area, and a foraging area. Home range sizes are estimated to be 5,400 acres (Reynolds et al. 1992). They hunt in mature forests and open woodlands, either cruising 7 to 12 feet above the ground or using the "perch and watch" method as they search for moderate- to large-sized birds and mammals (Johnsgard 1990). Research in New Mexico by Kennedy (1988) found goshawks hunting regularly in areas 0.5-mile to approximately 5.0 miles from the nest site. Goshawks use alternate nest trees, with some trees being used more than one year or for decades.

Nesting usually occurs in late successional or mature forest types and nests are often located in large trees on north to east aspects of flat- to moderately-sloped lands (Reynolds et al. 1992). Large trees are used to support a bulky nest structure. Kennedy (1988) did not observe a preference for site aspect, found that slopes averaged 17% at nest sites, and noted that nest trees were within 0.6-mile of a permanent water source. Taller trees were selected for nest trees, with the average being 85 feet tall, and all nests were in ponderosa pine (*Pinus ponderosa*), aspen (*Populus tremuloides*), and Chihuahua pine (*Pinus leiophylla*). Nest sites were located from 5,900 feet elevation to 8,400 feet. Goshawk pairs occupy nest areas from March until September (Reynolds et al. 1992), with young being fledged in mid- to late-June (Kennedy 1988).

Suspected declines in populations may be related to timber harvesting, although fire suppression, livestock grazing, drought, and toxic chemicals may also be factors (Reynolds et al. 1992). Management recommendations include minimizing logging of riparian canyons and closing of roads close to nest sites (Kennedy 1988).

Populations in the Study Area: Potential wintering habitat exists in the study area, but breeding birds are confined to the north. Wintering birds could occur in the study area, but it is unlikely that breeding birds would.

Ferruginous Hawk (*Buteo regalis*)

Legal Status: The ferruginous hawk is a federal Category 2 candidate species for threatened or endangered status (59 FR 58990; Nov. 15, 1994). This species is not listed by the state of New Mexico.

Distribution: This North American species is a bird of the open country of the west, where it is found breeding from eastern Washington, across the Canadian provinces to southwest Manitoba, south to eastern Oregon, Nevada, southeastern Arizona, northern New Mexico, north-central Texas, western Oklahoma, and western Kansas (AOU 1983, Palmer 1988). During the winter the species occupies the southern half of its breeding range and south to Baja California and central Mexico (AOU 1983).

Background Information: The breeding habitats of this species are described as grasslands, sagebrush, saltbush-greasewood shrub, and periphery pinyon-juniper woodlands or, more generally, the arid, semiarid, and grassland regions of western North America characterized by level and rolling terrain and foothills (Palmer 1988), often with rock outcrops, and scattered trees (AOU 1983). Winter habitats, similar to breeding habitats, are described as open terrain from grasslands to desert (Palmer 1988).

This raptor species is very flexible in the types of sites that are utilized for nesting. Nest sites include trees, cliffs, bluffs, cut banks, ground, power poles, hay stacks, windmills, old chimneys, etc. (Herron et al. 1985, Palmer 1988). Ground nests are often placed on knolls, bluffs, or ridges. Tree nests are found along streams and rivers (AOU 1983), where trees are present in open country, or on slopes overlooking open grasslands below (Herron et al. 1985).

The diet of this species is described as consisting almost entirely of grassland rodents and lagomorphs (Johnsgard 1990, Herron et al. 1985). Prey taken range in size from mice to jackrabbits (Palmer 1988). Palmer (1988), citing the work of others, reports the diet consisting of mammals (85%), birds (10.5%), reptiles (2.6%), amphibians (+), and insects (1.7%).

Populations in the Study Area: Considering its migratory movements, and the few reports of birds in areas surrounding the study area, individuals of this species could occur during migration. Individuals of this species could spend part of the winter period in the study area, probably in very low numbers, and irregularly. Presence would be governed by the availability of appropriate prey, in particular cottontails and jackrabbits.

Northern Gray Hawk (*Buteo nitidus maximus*)

Legal Status: The northern gray hawk is a federal Category 2 candidate species for threatened or endangered status (59 FR 58990; Nov. 15, 1994). This species is not listed by the state of New Mexico.

Distribution: The gray hawk is a tropical species occurring from southern Texas along the lower Rio Grande Valley to southeastern Arizona, south into Mexico, Central and South America to northern Argentina (Johnsgard 1990). They also occur in New Mexico along the Gila and Mimbres Rivers and at San Simon Cienega in Hidalgo County, New Mexico (USFWS 1995a).

Background Information: In Latin, *nitidus* means "bright, shining", characterizing the bird's silvery coloration which leads to another common name, shining buzzard-hawk (Clark and Wheeler 1987). In the southwest it is most common and breeds in deciduous vegetation along permanent streams with open land nearby where populations of lizards, snakes, and frogs are present.

Gray hawks hunt from perches, utilizing low glides, and rapid stoops (Clark and Wheeler 1987). Their relatively short wings and long tail allow them to maneuver in dense underbrush in pursuit of prey. They feed on a variety of prey items with snakes and lizards the preferred prey followed by small birds. Mammals represent a small percentage of prey consumed (Johnsgard 1990).

Nests are relatively small and inconspicuous, built in the upper canopy of large trees such as cottonwoods, mesquites, and oaks (Johnsgard 1990). Nesting takes place from March to July, with clutches averaging two eggs (Terres 1991).

As of the mid-1980's, the nesting population in the United States was approximately 50 pairs, which makes it one of the rarest North American hawks, along with the aplomado falcon (Johnsgard 1990). The primary threat to this species in the southwest is the continued loss of riparian woodlands along rivers.

Populations in the Study Area: Due to the absence of preferred nesting habitat, it is unlikely that this species occurs in the study area.

TABLE A-3
BIRDS
Permanent resident and breeding birds likely to be found in the area of the Little Rock Mine.

Species		
Common Name	**Scientific Name**	**Habitat Type**
	FALCONIFORMES	
Turkey Vulture	*Cathartes aura*	piñon-juniper, grasslands
Cooper's Hawk	*Accipiter cooperii*	Ponderosa pine, piñon-juniper
Red-tailed Hawk	*Buteo jamaicensis*	all types
American Kestrel	*Falco sparverius*	piñon-juniper, grasslands
		grasslands
	GALLIFORMES	
Gambel's Quail	*Callipepla gambelii*	semi-arid grasslands
	COLUMBIFORMES	
Band-tailed Pigeon	*Columba fasciata*	ponderosa pine, piñon-juniper
Mourning Dove	*Zenaida macroura*	all habitat types
	CUCULIFORMES	
Greater Roadrunner	*Geococcyx californianus*	piñon-juniper, grasslands
	STRIGIFORMES	
Barn Owl	*Tyto alba*	piñon-juniper, grasslands
Western Screech-Owl	*Otus kennicottii*	piñon-juniper, grasslands
Great Horned Owl	*Bubo virginianus*	all habitat types
	CAPRIMULGIFORMES	
Lesser Nighthawk	*Chordeiles acutipennis*	grasslands
Common Poorwill	*Phalaenoptilus nuttallii*	piñon-juniper, grasslands
Whip-poor-will	*Caprimulgus vociferus*	piñon-juniper
	APODIFORMES	
Black-chinned Hummingbird	*Archilochus alexandri*	piñon-juniper, grasslands, riparian
	PICIFORMES	
Acorn Woodpecker	*Melanerpes formicivorus*	ponderosa pine, piñon-juniper
Ladder-backed Woodpecker	*Picoides scalaris*	grasslands, riparian

Table A-3 (continued)
Birds

Species		
Common Name	**Scientific Name**	**Habitat Type**
PASSERIFORMES		
Tyrannidae - Tyrant Flycatchers		
Western Wood-Pewee	*Contopus sordidulus*	ponderosa pine, piñon-juniper, riparian
Black Phoebe	*Sayornis nigricans*	riparian
Say's Phoebe	*S. saya*	piñon-juniper, grasslands
Ash-throated Flycatcher	*Myiarchus cinerascens*	piñon-juniper, grasslands
Cassin's Kingbird	*Tyrannus vociferans*	ponderosa pine, piñon-juniper, riparian
Corvidae - Jays and Crows		
Scrub Jay	*Aphelocoma coerulescens*	ponderosa pine, piñon-juniper
Gray-breasted Jay	*A. ultramarina*	piñon-juniper, chaparral
Common Raven	*Corvus corax*	all habitat types
Paridae - Chickadees, Titmice		
Bridled Titmouse	*Parus wollweberi*	
Plain Titmouse	*P. inornatus*	piñon-juniper
Aegithalidae - Bushtits		
Bushtit	*Psaltriparus minimus*	piñon-juniper
Sittidae - Nuthatches		
White-breasted Nuthatch	*Sitta carolinensis*	ponderosa pine, piñon-juniper
Pygmy Nuthatch	*S. pygmaea*	ponderosa pine
Troglodytidae - Wrens		
Rock Wren	*Salpinctes obsoletus*	ponderosa pine, grasslands
Canyon Wren	*Catherpes mexicanus*	riparian
Bewick's Wren	*Thryomanes bewickii*	piñon-juniper, grasslands
House Wren	*Troglodytes aedon*	ponderosa pine, piñon-juniper
Muscicapidae - Old World Warblers		
Blue-gray Gnatcatcher	*Polioptila caerulea*	piñon-juniper, grasslands, riparian
Western Bluebird	*Sialia mexicana*	ponderosa pine, piñon-juniper, grasslands
Mimidae - Mockingbirds and allies		
Northern Mockingbird	*Mimus polyglottos*	grasslands
Crissal Thrasher	*Toxostoma crissale*	piñon-juniper

Table A-3 (continued) Birds		
Species		
Common Name	**Scientific Name**	**Habitat Type**
Ptilogonatidae - Silky-flycatchers		
Phainopepla	*Phainopepla nitens*	piñon-juniper, grasslands, riparian
Lannidae - Shrikes		
Loggerhead Shrike	*Lanius ludovicianus*	piñon-juniper, grasslands
Vireonidae - Vireos		
Gray Vireo	*Vireo vicinior*	piñon-juniper
Solitary Vireo	*V. solitarius*	ponderosa pine, piñon-juniper
Hutton's Vireo	*V. huttoni*	chaparral
Emberizidae - Warblers, New World Finches, and allies		
Virginia's Warbler	*Vermivora virginiae*	ponderosa pine, piñon-juniper, riparian
Yellow Warbler	*Dendroica petechia*	open scrub, near water
Black-throated Gray Warbler	*D. nigrescens*	piñon-juniper, Ponderosa pine
Hepatic Tanager	*Piranga flava*	piñon-juniper, Ponderosa pine, riparian
Western Tanager	*P. ludoviciana*	Ponderosa pine, chaparral, piñon-juniper
Black-headed Grosbeak	*Pheucticus melanocephalus*	piñon-juniper, pine-oak
Blue Grosbeak	*Guiraca caerulea*	grasslands, chaparral, piñon-juniper
Rufous-sided Towhee	*Piplo erythrophthalmus*	chaparral, riparian
Canyon, or Brown, Towhee	*P. fuscus*	chaparral, riparian
Chipping Sparrow	*Spizella passerina*	chaparral, pine-oak
Black-chinned Sparrow	*S. atrogularis*	chaparral, grasslands
Brown-headed Cowbird	*Molothrus ater*	woodlands (forest edge)
Hooded Oriole	*Icterus cucullatus*	riparian, mesquite
Fringillidae - Old World Finches and allies		
House Finch	*Carpodacus mexicanus*	
Lesser Goldfinch	*Carduelis psaltria*	
Sources: Hubbard 1970; Russell 1990.		

Reptiles

Texas Horned Lizard (*Phrynosoma cornutum*)

Legal Status: The Texas horned lizard is a Category 2 candidate for federal listing as threatened or endangered (59FR 58994, Nov 15, 1994). This species is not listed by the state of New Mexico, but is considered a BLM sensitive species.

Distribution: This species can be found from Kansas south into Mexico, extending from the Gulf Coast of Texas west to extreme southeastern Arizona. In New Mexico it occurs across the state except in the north-central, northwest corner, and west-central portions of the state (Stebbins 1985).

Background Information: Characteristics of this species include variable color from brown to reddish, depending on the soil color, a beige or whitish middorsal stripe, with dark blotches on the back, tail, and neck, and distinctive dark stripes radiating from the eye region on the sides of the face. Two prominent horns on the back of the head and enlarged scales on the throat (Stebbins 1985).

The Texas horned lizard is a ground-dwelling lizard that is active during the day. It inhabits flat arid and semi-arid open country with sparse plant growth, primarily bunchgrass, cactus, juniper, acacia, and mesquite. Although soils are generally hardpan, some loose soil is usually present, in which they bury themselves. It is found to 4,800 feet elevation in Mexico (Stebbins 1954).

This species feeds on ants, but also eats other insects including beetles, grasshoppers, and spiders. Mating occurs in late April and May, with eggs being laid beneath dry sandy soil from May to July (Stebbins 1954). Clutch size ranges from 14 to 37 eggs and the young hatch after approximately 1.5 months.

Populations in Study Area: The study area is in the range of this species, however this species prefers flat habitat or arid open country and elevations generally lower than that of the study area. It is unlikely that this species is present in the study area.

Narrow-headed Garter Snake (*Thamnophis rufipunctatus*)

Legal Status: The narrow-headed garter snake is a Category 2 candidate for federal listing as threatened or endangered (59FR 58995, Nov 15, 1994). This species is considered threatened by the state of New Mexico.

Distribution: This garter snake ranges from central and eastern Arizona and southwestern New Mexico, south into the Sierra Madre Occidental and central Durango, Mexico (Stebbins 1985). In New Mexico, this species occurs on and below the Mogollon Plateau in Pacific drainages in Catron, Grant, and Hidalgo Counties (NMGF 1988). This species has been found in the east fork of the Gila River in Grant County (Stebbins 1985).

Background Information: Unlike most other garter snakes, the narrow-headed garter snake lacks well-developed stripes; instead, this species has conspicuous dark brown, blackish, or red spots running the length of its body with the spots fading towards the tail (Stebbins 1985). This species is heavier-bodied than other garter snakes with adults being two to three feet in length (NMGF 1988).

Habitat ranges from aquatic areas in piñon-juniper and oak-pine belts to ponderosa pine forests (Stebbins 1985). The narrow-headed garter snake is highly aquatic and is attracted to permanent rocky streams (Stebbins 1954). It occurs along rocks adjacent to water or in streams where they prefer quiet pools and well lit areas. It has been found in riparian habitat of the Gila River along the Arizona-New Mexico border at approximately 4200 feet elevation, to coniferous woodlands at 7500 feet or higher (NMGF 1988).

This predator feeds on fish, tadpoles, frogs, and salamanders (Stebbins 1985). A study done in New Mexico found this species feeding exclusively on fish (Fleharty 1967 *in* NMGF 1988). The aquatic nature of this species is evident: when it is disturbed, it dives into the water and swims to the bottom (Stebbins 1954). The narrow-headed garter snake is live-bearing with the young being born in summer.

This species is not abundant in the United States and probably occurs in low densities in New Mexico (NMGF 1988). Major threats include habitat loss or alteration, killing, collecting, and the introduction of exotic species such as bullfrogs (*Rana catesbeiana*) and bass (*Micropterus* spp.) (NMGF 1988). Stream channelization and other vegetation disruptions may lead to extirpation, since the species uses shrubs and snags for thermoregulation (Rosen and Schwalbe 1988).

Populations in Study Area: Due to this species propensity for permanent rocky streams, it is unlikely that it would occur in the study area, since there is no permanent stream habitat.

Reticulate Gila Monster (*Heloderma suspectum suspectum*)

Legal Status: The reticulate gila monster is not federally listed, but it is considered by the state of New Mexico to be endangered (group 1) (NMGF 1988). The BLM considers the Gila monster as sensitive.

Distribution: The Gila monster occurs from southwestern Utah to northern Sinaloa, Mexico; southeastern California to southwestern New Mexico (Stebbins 1985). In New Mexico, it occurs from the Gila Valley to Redrock, from the Arizona border east to the eastern slopes of the Peloncillo Mountains in Hidalgo County, northward to Cliff in Grant County, and eastward to Las Cruces (NMGF 1988).

Background Information: This species is the only venomous lizard in the United States. It is has a large, heavy body covered with beaded scales, a large head, fat tail, and short limbs. The contrasting coloration patterns are pink, orange, or yellow and black. The subspecies *Heloderma suspectum suspectum* coloration is dominated by black on the dorsal surface with pink blotches, and a reticulate pattern with obscure crossbands. The color pattern of this species helps to conceal it in dim light.

The Gila monster is found in shrubby, grassy, and succulent desert areas. In New Mexico it seems to prefer rough desert shrubs or grassy plains (Stebbins 1954). It occurs on lower slopes and plains, and canyon bottoms with permanent or intermittent streams. Habitat structure includes boulders, rock crevices, or dense vegetation with accumulated litter where burrows can be constructed.

This lizard is active primarily at night and preys on small mammals, snakes, lizards, the eggs of birds and reptiles, invertebrates, and carrion. Eggs are laid primarily from July to August, with clutches averaging 5. The eggs overwinter and hatch the next spring.

The Gila monster has been threatened by habitat destruction and alteration and the species is not as prevalent as it once was. It has also been threatened by pet collectors, as well as wanton killings by humans.

Populations in Study Area: The study area is in the range of this species and it could occur in the study area in rocky, moist, habitats with appropriate coversites.

Amphibians

Arizona Toad (*Bufo microscaphus microscaphus*)

Legal Status: The Arizona toad is a Category 2 candidate for federal listing as threatened or endangered (59FR 58995, Nov 15, 1994). It is not listed by the state of New Mexico. It is considered a BLM sensitive species.

Distribution: This subspecies is found in tributaries of the Colorado River from southwestern Utah, southern Nevada, central Arizona, and western New Mexico, and south into Mexico.

Background Information: *Bufo microscaphus microscaphus* is a subspecies of the southwestern toad (*B. microscaphus*). This subspecies has a homogeneous warty appearance and is greenish gray to brown with a light-colored stripe across the head, and unlike other southwestern toads, it lacks dark spotting on the back (Stebbins 1985).

This toad inhabits washes, streams, and arroyos in semiarid areas. In Arizona and New Mexico it is found along rocky streams in pine-oak woodlands. It occurs from near sea level to approximately 6,000 feet elevation in the United States, to around 8,500 feet in Mexico. Adults are nocturnal except during breeding season, which extends from March to July (Stebbins 1985). They breed in brooks and streams.

Populations in Study Area: The range and habitat of this species is probably west and north of the study area in tributaries of the Gila River. It is unlikely that this species would occur in the study area.

Chiricahua Leopard Frog (*Rana chiricahuensis*)

Legal Status: The Chiricahua leopard frog is a Category 2 candidate for federal listing as threatened or endangered and has been recommended for listing as endangered Group 1 by the state of New Mexico.

Distribution: The Chiricahua leopard frog ranges from the mountains of central and southwestern Arizona and the Sierra Madre Occidental to southern Durango, Mexico. Isolated populations are known to occur in Socorro County, New Mexico and possibly in Dona Ana County (Stebbins 1985). This species is apparently absent from the Lower Gila River Basin.

Background Information: This species is similar to, and often hybridizes with, Yavapai leopard frog where the ranges overlap. It is a highly aquatic species inhabiting rocky streams, permanent springs, and earthen stock tanks ranging from desertscrub and grassland habitats to chaparral and mixed oak-pine woodlands. Deep rock-bound pools are often associated with rivers supporting populations of this leopard frog (Stebbins 1985).

Leopard frogs feed on insects and other invertebrates in and near the water. Predators include raccoons, ringtails, and several species of snakes, black hawks, and fish. The introduction of the bullfrog, which also preys on leopard frogs, is considered a major threat to their survival. Populations are also threatened by the destruction and degradation of wetland habitat (Schwalbe 1988).

Populations in the Study Area: The Chiricahua leopard frog is highly aquatic and it is very unlikely for populations to occur within the proposed mine site due to lack of suitable habitat (Jennings, personal communication 1995; Painter, personal communication 1995).

Yavapai or Lowland Leopard Frog (*Rana yavapaiensis*)

Legal Status: The Yavapai leopard frog is a Category 2 candidate for federal listing as threatened or endangered and is listed as endangered Group 1 by the state of New Mexico.

Distribution: The Yavapai leopard frog ranges from northwestern Arizona, the Colorado and Virgin river drainages, south to Yuma, and across a narrow band through central Arizona to the east, south to southeastern Arizona, and southwestern New Mexico.

Background Information: This species is similar to, and often hybridizes with, the Chiricahua leopard frog where the ranges overlap. It is generally an aquatic species, although it can survive periods of time away from a permanent water source (Jennings, personal communication 1995). Yavapai leopard frogs inhabit permanent pools of foothill streams, overflow ponds and side channels of major rivers, and, in drier areas, more or less permanent stock tanks (Stebbins 1985). Populations occur within desertscrub and grassland habitats and mixed oak-pine woodlands at elevations ranging from sea level to 4,800 feet, but generally are found below 3,300 feet (Schwalbe 1988).

Leopard frogs feed on insects and other invertebrates in and near the water. Predators include raccoons, ringtails, and several species of snakes, black hawks, and fish. The introduction of the bullfrog, which also preys on leopard frogs, is considered a major threat to their survival. Populations are also threatened by the destruction and degradation of wetland habitat.

Populations in the Study Area: No populations are know to occur within the vicinity of the proposed mine site. Although this species is occasionally found away from a permanent water source, it is unlikely that any occur at the site (Jennings, personal communication 1995; Painter, personal communication 1995).

TABLE A-4 REPTILES AND AMPHIBIANS Reptiles and amphibians which may occur in the area of the Little Rock Mine.	
Common Name	**Scientific Name**
SALAMANDERS	
Tiger Salamander	*Ambystoma tigrinum*
FROGS AND TOADS	
Southern Spadefoot (toad)	*Scaphiopus multiplicatus*
Arizona Toad or Southwestern Toad	*Bufo microscaphus*
Red-spotted Toad	*B. punctatus*
Woodhouse's Toad	*B. woodhousei*
Canyon Treefrog	*Hyla arenicolor*
Bullfrog	*Rana catesbeiana*
Lowland Leopard Frog	*Rana yavapaiensis*
TURTLES AND TORTOISES	
Sonoran Mud Turtle	*Kinosternon sonoriense*
LIZARDS	
Lesser Earless Lizard	*Holbrookia maculata*
Collared Lizard	*Crotaphytus collaris*
Desert Spiny Lizard	*Sceloporus magister*
Clark's Spiny Lizard	*Sceloporus clarki*
Prairie or Plateau Lizard	*Sceloporus undulatus*
Tree Lizard	*Urosaurus ornatus*
Short-horned Lizard	*Phrynosoma douglassi*
Great Plains Skink	*Eumeces obsoletus*
Chihuahuan Spotted Whiptail	*Cnemidophorus exsanguis*
Western Whiptail	*Cnemidophorus tigris*
Madrean Alligator Lizard	*Elgaria (=Gerrhonotus) kingii*

Table A-4 (continued)
Reptiles and Amphibians

Common Name	Scientific Name
SNAKES	
Western Blind Snake	*Leptotyphlops humilis*
Ringneck Snake	*Diadophis punctatus*
Striped Whipsnake	*Masticophis taeniatus*
Western Patch-nosed Snake	*Salvadora hexalepis*
Mountain Patch-nosed Snake	*S. grahamiae*
Glossy Snake	*Arizona elegans*
Gopher Snake	*Pituophis melanoleucus*
Kingsnake (desert)	*Lampropeltis getulus*
Black-necked Garter Snake	*Thamnophis cyrtopsis*
Checkered Garter Snake	*T. arcianus*
Lyre Snake	*Trimorphodon biscutatus*
Night Snake	*Hypsiglena torquata*
Western Diamondback Rattlesnake	*Crotalus atrox*
Banded Rock Rattlesnake	*C. lepidus klauberi*
Black-tailed Rattlesnake	*C. molossus*
Western Rattlesnake	*C. viridis*

Sources: Bernard and Brown 1978; Stebbins 1985

Glossary

GLOSSARY

Acidic	A substance whose water solution dissolves active metals with the liberation of hydrogen; has a pH of less than 7.0.
Acre-Foot	The volume of water that will cover an area of one acre to a depth of one foot.
Alkali	Any soluble substance, as a mineral salt or mixture of salts, that is strongly basic and can neutralize acids, has a pH greater than 7.0; strong alkaline substances are caustic.
Alluvium	A general term for all detrital deposits resulting from the operations of modern rivers, including the sediments laid down in river beds, floodplains, lakes, and fans at the foot of mountain slopes and estuaries.
Alternative (action)	An option for meeting stated need.
Ambient	That portion of the atmosphere, external to buildings, to which the general public (or neighboring businesses) has access.
Analyte	Chemical constituents detected as a part of analysis or testing.
Aquatic	Growing or living in or near the water.
Aquifer	A stratum of permeable rock, sand, etc., which contains water. Water source for a well.
Archaeology	The science that investigates the history of peoples by the remains of earlier periods of their existence.
Arroyo	A gully or wash of an intermittent or ephemeral stream in an arid or semiarid region.
Artifact	Any object showing human workmanship or modification, especially from a prehistoric or historic culture.
Avifauna	Birds of a specified region or time.
Botanist	A specialist in botany—a branch of biology that studies plants.
Chihuahuan Desert Scrub	Cactus and plants that are characteristic of the Chihuahuan Desert—e.g. saguaro, pin cushion, and cholla cactus; cat claw, mesquite, and paloverde.

Candidate Species Species identified by the U.S. Fish and Wildlife Service as appropriate for listing as threatened or endangered.

Cienega Spanish word for marsh.

Claimant A person who makes a claim—e.g. right of ownership.

Contrast The diversity of adjacent parts, as in color, tone, or emotions. The closer the juxtaposition of two dissimilar perceptions, in time or space, the more powerful the appeal of the attention.

Cultural Resources Archaeological, historic, and traditional cultural resources, including buildings, sites, districts, structures, or objects having historical, architectural, archaeological, cultural or scientific importance.

Cumulative Impact The impact on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Dewater To remove water from a solution containing wastes in order to concentrate and then dispose of the wastes.

Dikes A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks.

Direct Impacts Effects which are caused by the action and occur at the same time and place (40 CFR 1508.8(a)).

Effects (See Impacts) Physical, biological, social, and economic results (expected or experienced) resulting from achievement of outputs. Effects can be direct, indirect, and cumulative, and may be either beneficial or detrimental.

Endangered Species Those species officially designated by the U.S. Government that are in danger of extinction throughout all or a significant portion of its range.

Endemic Plants, animals that are native to a particular region or country.

Environmental Impact Statement (EIS) A federally mandated report that analyzes potential environmental effects of federally funded projects or projects involving lands with federal jurisdiction.

Ephemeral Present only during a portion of the year such as water courses which flow briefly in response to precipitation.

Erosion The group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface.

Extraction The act of extracting or drawing a substance out of the earth, or some other object (e.g. extracting a tooth).

Fault A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.

Fauna The wildlife or animals of a specified region or time.

Federal Land Policy and Management Act of 1976 (FLPMA) This Act of Congress established public land policy for the management of all lands administered by the BLM. FLPMA specifies several key directions for the BLM, notably that management be on the basis of multiple use and sustained yield; land-use plans be prepared to guide management actions; public lands be managed for the protection, development, and enhancement of resources; public lands generally be retained in federal ownership; and public participation be included in reaching management decisions.

Floodplain That portion of a river valley adjacent to a stream or river channel which is covered with water when the stream overflows its banks during flood stage.

Forb Any herbaceous plant not a grass or sedge.

Game Species Any species of wildlife or fish for which seasons and bag limits have been prescribed, and which are normally harvested by hunters, trappers, and fishermen under state or federal laws, codes, and regulations.

Genus One of the major taxonomic groups used to scientifically classify plants or animals: several closely related species, or one species, make up one genus, while several genera, or one genus, make up a family.

Geology The science that relates to the earth, the rocks of which it is composed, and the changes that the earth has undergone or is undergoing.

Graben A block, generally long compared to its width, that has been downthrown along faults relative to the rocks on either side.

Granite A plutonic or igneous intrusive rock.

Great Basin Conifer Woodland	Piñon-juniper woodland.
Habitat	The region where a plant or animal naturally grows or lives.
Herbaceous	Of, or having the nature of, an herb or herbs as distinguished from woody plants.
Horst	A block of earth's crust, generally long compared to its width, that has been uplifted along faults relative to the rocks on either side.
Host Rock	A body of rock serving as a host for other rocks or mineral deposits such as a rock susceptible to mineral solutions.
Hydrologic	The distribution of surface and underground waters.
Hydrology	The science that relates to the water of the earth.
Igneous Rock	Rocks solidified from molten magma (volcanic rock), at or below the surface of the earth.
Impacts	(See Effects) Physical, biological, social, and economic results (expected or experienced) resulting from achievement of outputs. Effects can be direct, indirect, and cumulative and may be either beneficial or detrimental.
Impoundment	An enclosure of water or other solutions for irrigation or other distribution.
Indirect Effects	Secondary effects which occur in locations other than the initial action or significantly later in time.
Insectivorous	Feeds chiefly on insects.
Interior Chaparral	A thicket of shrubs and thorny bushes in the Southwest.
Intrusive Rocks	An igneous rock mass formed beneath the earth's surface.
Leaching	The removal of soluble material from soil or other material by percolating through soluble water or other solutions.
Leach Stockpile	A storage pile of leached material from the extraction process for ore removal.
Loam	A rich soil composed of clay, sand and some organic matter.
Locateable Minerals	Valuable mineral deposits that include precious metals, base metals, refractory metals and by special enactment building stone and saline deposits.

Madrean Evergreen Woodland — A woodland typically composed of oaks, pine, and juniper.

Migratory — Birds, animals, or people that migrate, or move from one region or country to another.

Mine Pit — An opening or excavation for the extraction of a mineral deposit.

Mitigation — Includes:

- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree of magnitude of the action and its implementation.
- Rectifying the impact of repairing or restoring the affected environment.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action .
- Compensating for the impact by replacing or providing substitute resources or environments.

Native Vegetation — Vegetation originating in a certain region or locality.

National Environmental Policy Act of 1969 (NEPA) — Public Law 91-190. Establishes environmental policy for the United States. Among other items, NEPA requires federal agencies to consider environmental values in decision-making processes.

Nonpoint Source Pollution — Sources from which the pollution discharged are (1) induced by natural process, including precipitation, seepage, percolation, and runoff; (2) not traceable to any discrete or identifiable facility; and (3) better controlled through the utilization of Best Management Practices, including process and planning techniques. This includes natural pollution sources not directly or indirectly caused by man.

Obliteration — The reclamation and or restoration of land to resource production from that of another use such as roadways or facilities.

One-hundred (100) year flood — A flood with a magnitude which may occur once every 100 years. A 1-in-100 chance of a certain area being inundated during any year.

Outbuildings — A structure, as a garage or barn, separate from the house or main building.

Outcrop — That part of a geologic formation or structure that appears at the surface of the earth.

Overburden	Material of any nature, consolidated or unconsolidated, overlying an ore deposit, excluding topsoil.
Patented Mining Claim	A government instrument (or deed) that conveys legal title for public land to an individual or another government entity.
Pathogenic	A specific causative agent.
Perched Water	Unconfined ground water separated from an underlying main body of ground water by an unsaturated zone.
Perennial Stream	A stream or part of a stream that flows continuously during all of the calender.
Permeability	The measure of the ease with which a fluid can diffuse through a particular porous material.
Petran Montane Conifer Forest	Ponderosa pine forest.
pH	A measure of how acid or how caustic (basic) a substance is on a scale of 0-14. A pH of 7 indicates that a substance is neutral, pH less than 7 is acidic, and pH greater than 7 is basic.
Porphyry	A rock texture characterized by large megascopic crystals surrounded by a matrix of microscopic minerals.
Precambrian	The period of geologic time from approximately 570 million years ago back to the formation of the earth.
Prehistoric Resources	Sites and associated artifacts that date from before the time of written records, which do not appear before the arrival of Spanish explorers in the sixteenth century in the American Southwest.
Prey	An animal hunted or killed for food by another animal.
Primitive Area	An area that is not developed; a pristine natural area.
Proximate	Something that is nearest in space, order, time, etc. to an item.
Quaternary	A unit in geologic time extending from the present to approximately 2 million years ago.
Range	A large, open area of land over which livestock can wander and graze.

Range Allotment A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under a range allotment management plan. It is the basic land unit used to facilitate management of the range resource on National Forest System, BLM lands, state, and associated lands administered by federal and state land management agencies.

Raptor Birds of prey such as hawks, owls, and eagles.

Rare Species A designation for animals that are not presently threatened with extinction, but occur in such small numbers throughout their range that they may become endangered if their environments worsen.

Reclamation The restoration of land to resemble its original condition or an acceptable substitute as to shape, vegetation, and wildlife.

Recreation Opportunity The combination of recreation settings, activities, and experiences provided by an area.

Recreation Opportunity Spectrum (ROS) A method of measuring the ability of the forest land to meet the various types of demands imposed by a variety of recreation uses.

Recruitment Refers to new species of plants that begin growing in a region.

Residual Ore Left over ore, after part or most of the ore is taken away.

Residuum (geology) Residue; an accumulation of rock debris formed by weathering and remaining essentially in place.

Revegetation The reestablishment and development of self-sustaining plant cover. On disturbed sites, This normally requires human assistance such as seed bed preparation, reseeding, and mulching.

Riparian An aquatic or terrestrial ecosystem that is associated with bodies of water, such as streams, lakes, or wetlands, or is dependent upon the existence of perennial, intermittent, or ephemeral surface or subsurface water drainage. Riparian areas are usually characterized by dense vegetation and an abundance and diversity of wildlife.

Roosting Sites A place with perches for birds.

Rooting Depth The depth to which a plant's, or tree's roots grow.

Seep	An area, generally small, where water or another liquid percolates slowly to the earth's surface.
Semi-arid	Characterized by little yearly rainfall and by the growth of a number of short grasses and shrubs: said of a climate or a region.
Semidesert Grassland	A semi-arid region characterized by grasses, thorny shrubs and cactus.
Special Status Species	Plants and wildlife species listed by U.S. Fish and Wildlife as endangered, threatened, proposed or candidates for such listing, BLM or Forest Service sensitive, or species of concern at the state level.
Spring	A place where ground water flows naturally from a rock or the soil on the land surface or into a body of surface water.
Stock (geology)	An igneous intrusion less than 40 square miles in surface exposure.
Stream Channelization	To change a stream channel through erosion.
Subsoil	The soil below the surface soil or topsoil.
Subspecies	Any natural subdivision of a species that exhibits small, but persistent morphological variations from other subdivisions of the same species living in different geographical regions or times.
Sustained Yield	To keep up, or maintain a consistent production or cultivation of material—such as ore or crops.
Substratum	Any layer lying below another layer such as rock units or soils.
Tailings	Waste or refuse left in various processes of mining.
Tailing pond	The residual water remaining from the mining process, usually associated with tailings.
Taxon	A taxonomic unit or family, as a species or family.
Tertiary	The first period of Cenozoic Era, spanning the time between 65 and 2 million years ago.

Threatened and Endangered (T&E) Species
Plants and animals listed by the U.S. Fish and Wildlife Service or the State of New Mexico as threatened or endangered (see Endangered Species, Threatened Species).

Threatened Species
Those species officially designated by the U.S. Government that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Topsoil
The upper part of the soil or "A" horizon which is the most favorable material for plant growth.

Total Dissolved Solids (TDS)
Salt, or an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, and nitrates of calcium, magnesium, manganese, sodium, potassium, and other cations that form salts.

Toxicity
The potential of a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentrations under which the effect takes place.

Unpatented Mining Claim
A claim made under the authority of the Mining Law of 1872 on vacant, unappropriated public land, where valuable locatable minerals have been discovered.

Vegetation Communities
Species of plants that commonly live together in the same region or ecotone.

Visual Quality Objectives
A desired level of visual quality based on physical and sociological characteristics of an area. It refers to the degree of acceptable alterations of the characteristics (Forest Service). Refer to Table 3-16, page 3-57, for management implications.

Visual Resource Management Classes
Classification containing specific objectives for maintaining or enhancing visual resources, including the amount of acceptable change to the existing landscape to meet established visual goals (BLM).

Waste Rock
In mining, rock that must be broken and disposed of in order to gain access to or upgrade the ore.

Watershed	A drainage basin; the region drained by, or contributing water to a stream, lake, or other body of water.
Wetlands	Those areas that are inundated by surface or ground water with a frequency sufficient to support vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

List of Acronyms/Abbreviations

LIST OF ACRONYMS

APP	acid producing potential
ANP	acid neutralizing potential
ARD	acid rock drainage
AUM	animal unit month
AVT	Ad Valorem Tax
bgs	below ground surface
BLM	Bureau of Land Management
cfs	cubic feet per second
dBA	decibels, "A" weighted
dB	decibel
EIS	environmental impact statement
EPA	Environmental Protection Agency
FLPMA	Federal Land Policy Management Act
gpm	gallons per minute
kV	kilovolt
L_{dn}	day-night average sound level
L_{eq}	equivalent noise level
MCL	maximum contaminant levels
mg/l	milligrams per liter
MMD	Mining and Minerals Division
MOA	Memorandum of Agreement
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMAAQS	New Mexico Ambient Air Quality Standards
NMAQCR	New Mexico Air Quality Control Regulation
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
PDMC	Phelps Dodge Mining Company
PM_{10}	particulate matter, 10 μm and less in diameter
ppm	parts per million
PSD	Prevention of Significant Deterioration

QA/QC	Quality Assurance/Quality Control
RNA	roaded natural area
ROS	Recreation Opportunity Spectrum
SCS	Soil Conservation Service
SHPO	State Historic Preservation Office
SPM	semi-primitive motorized
SX/EW	solution extraction/electrowinning
T&E	threatened and endangered
TDS	total dissolved solids
TSP	total suspended particulate matter
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNR	U.S. Natural Resources
VQO	visual quality objectives
VRM	visual resource management
XRF	x-ray fluorescence

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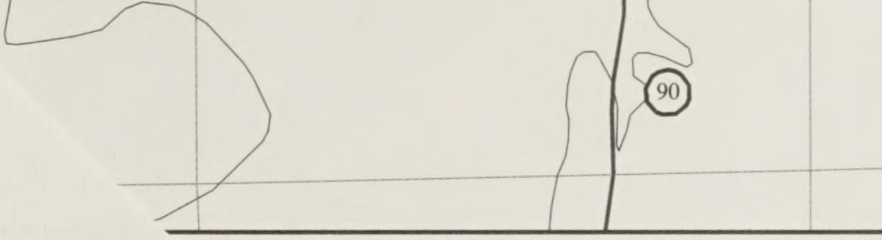

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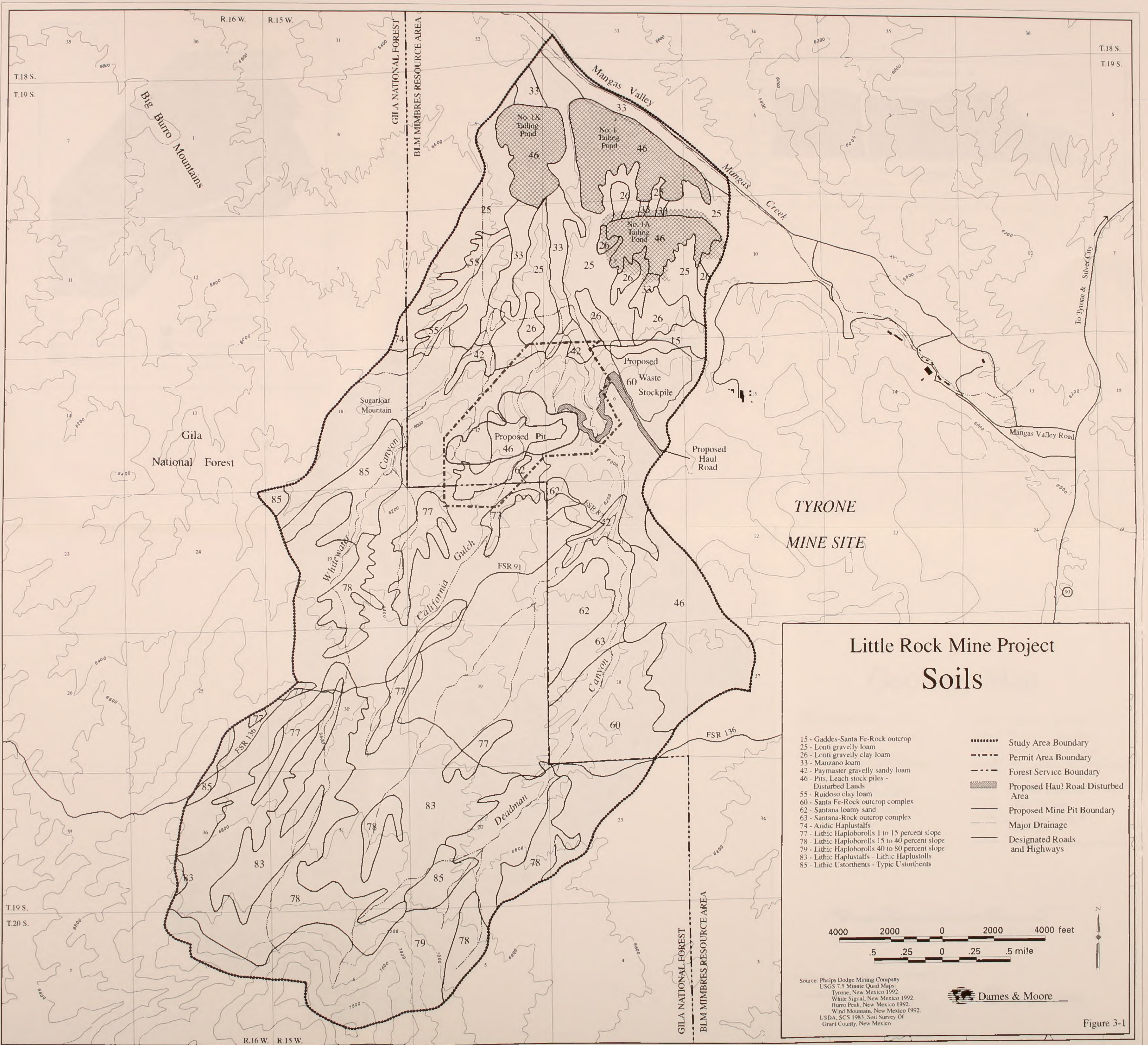

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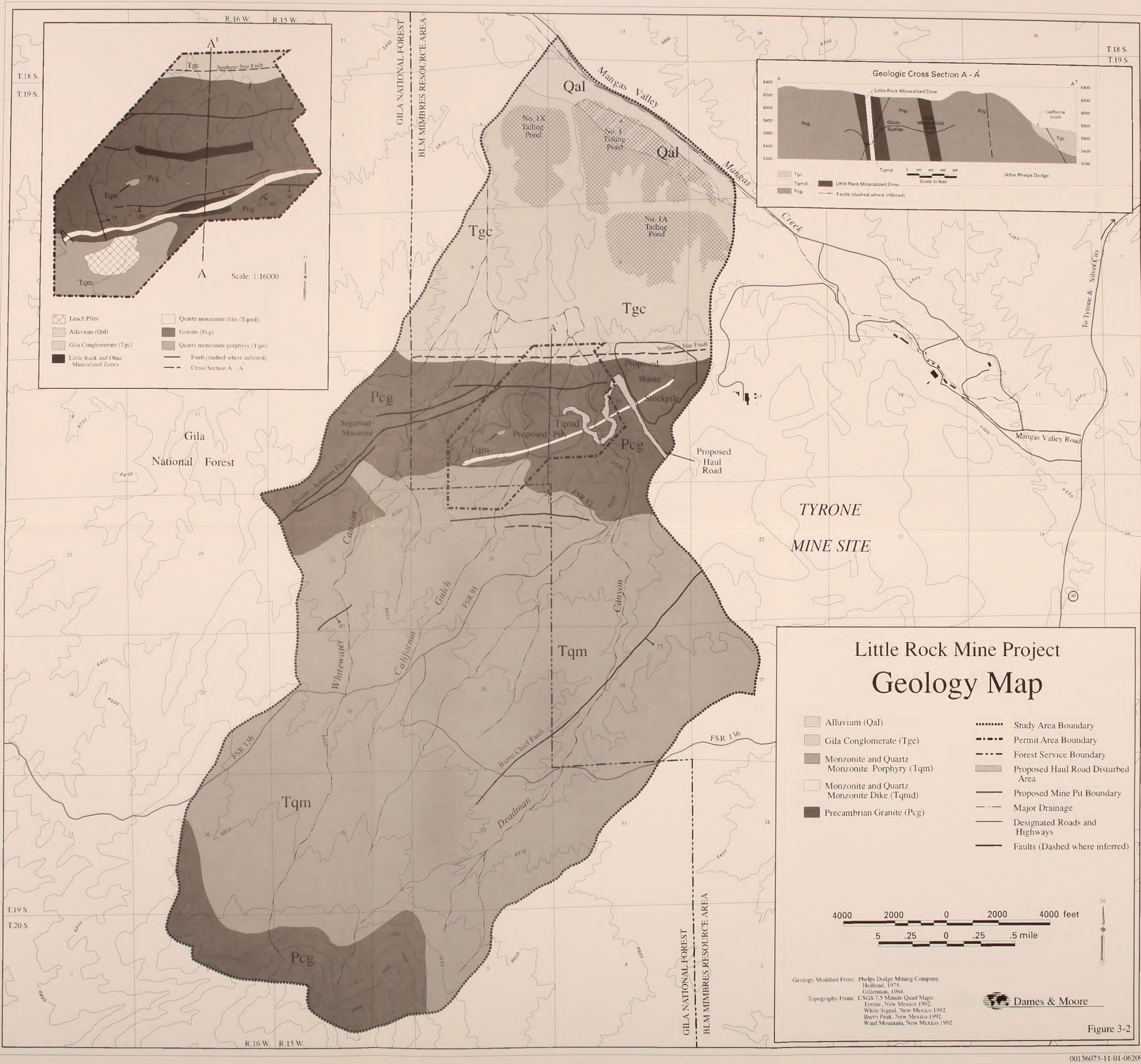

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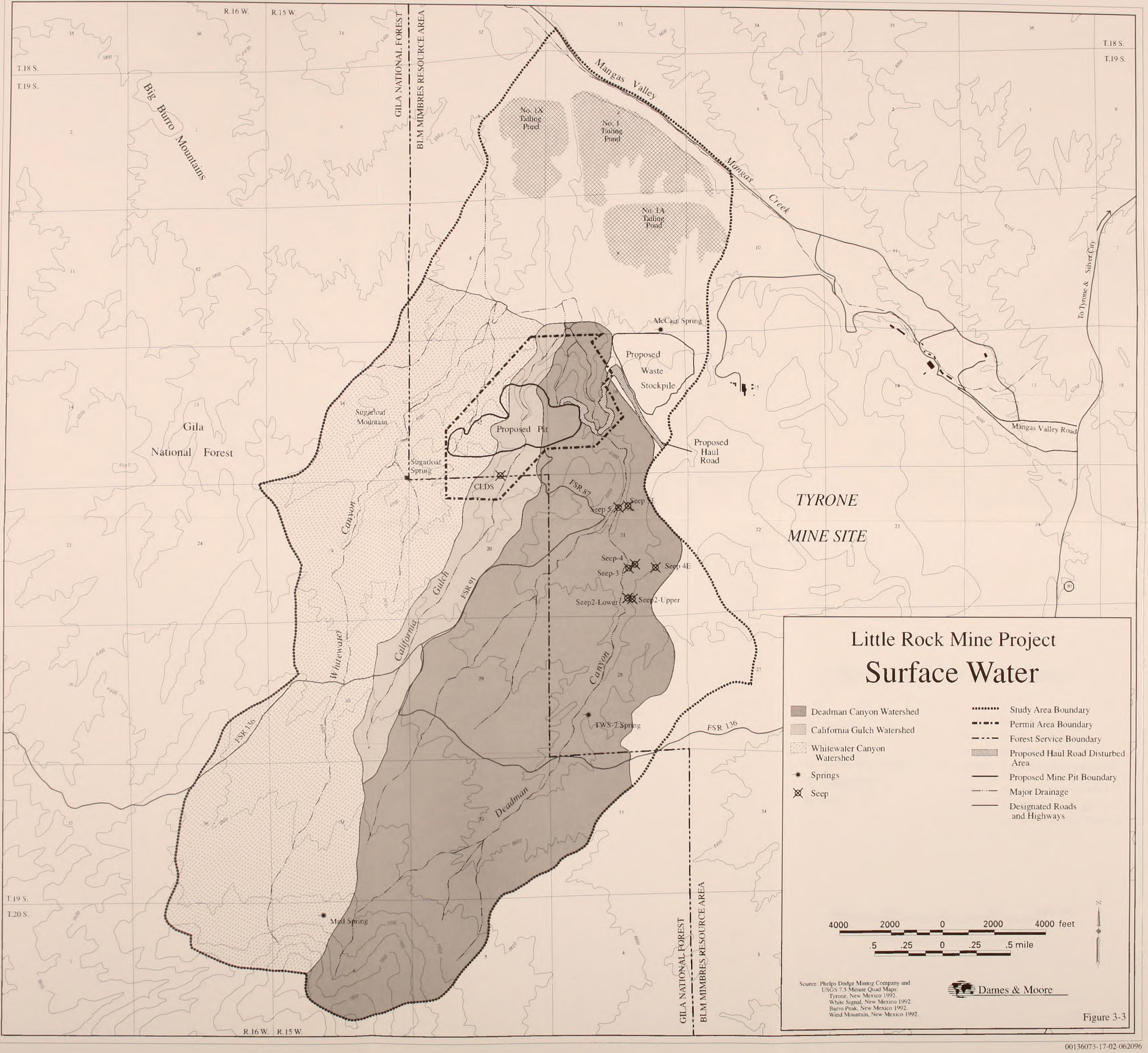

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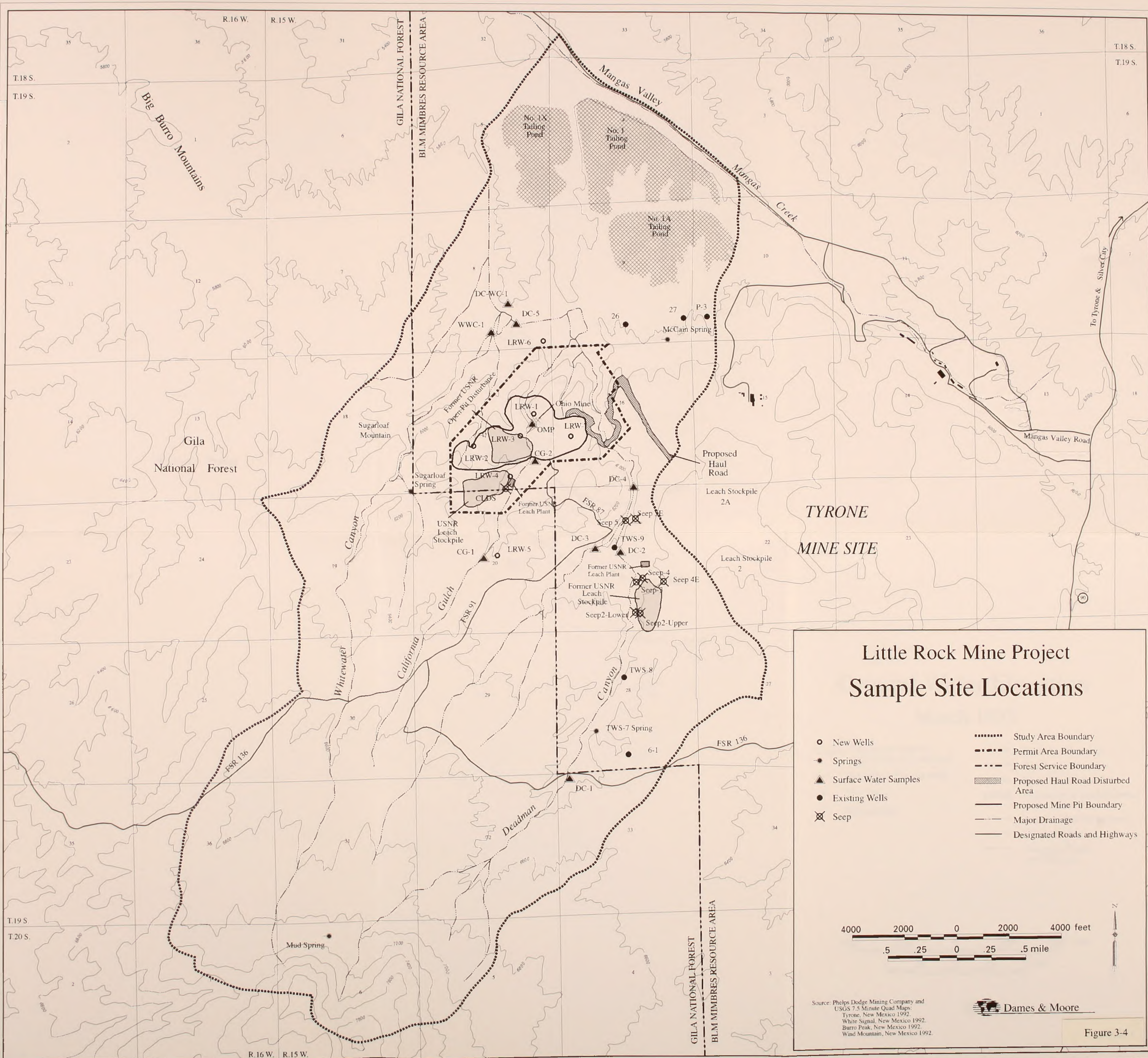

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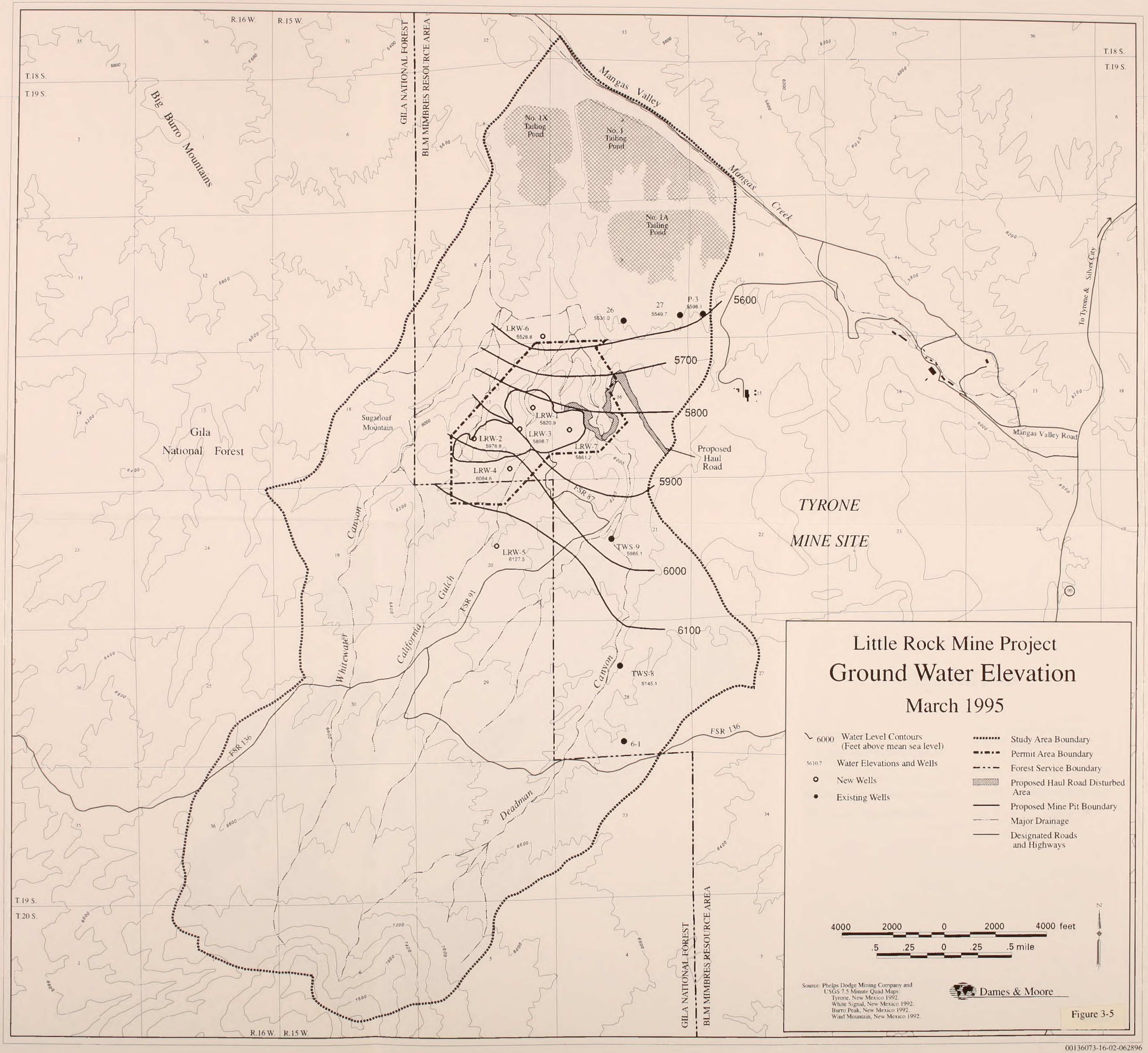

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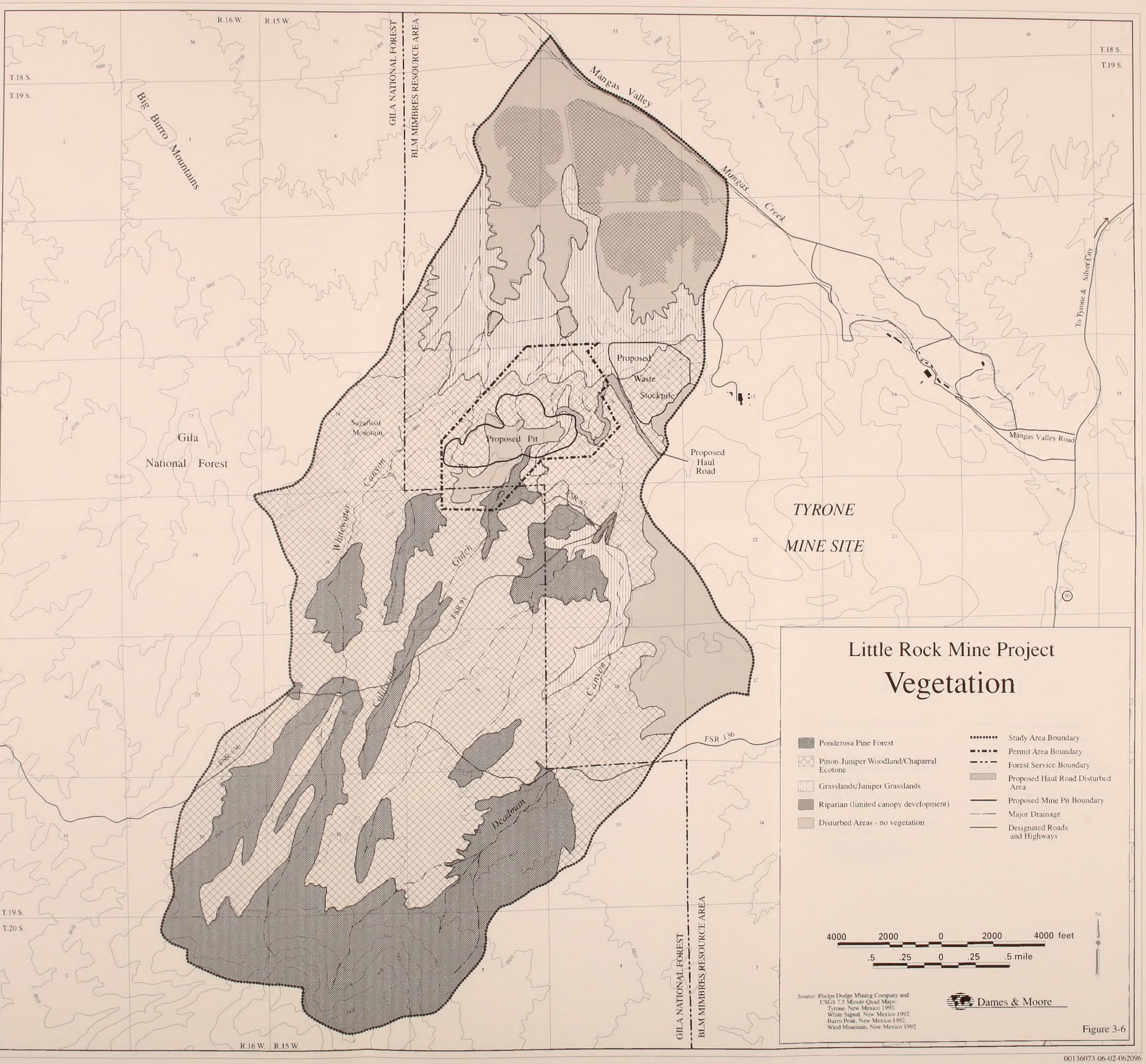
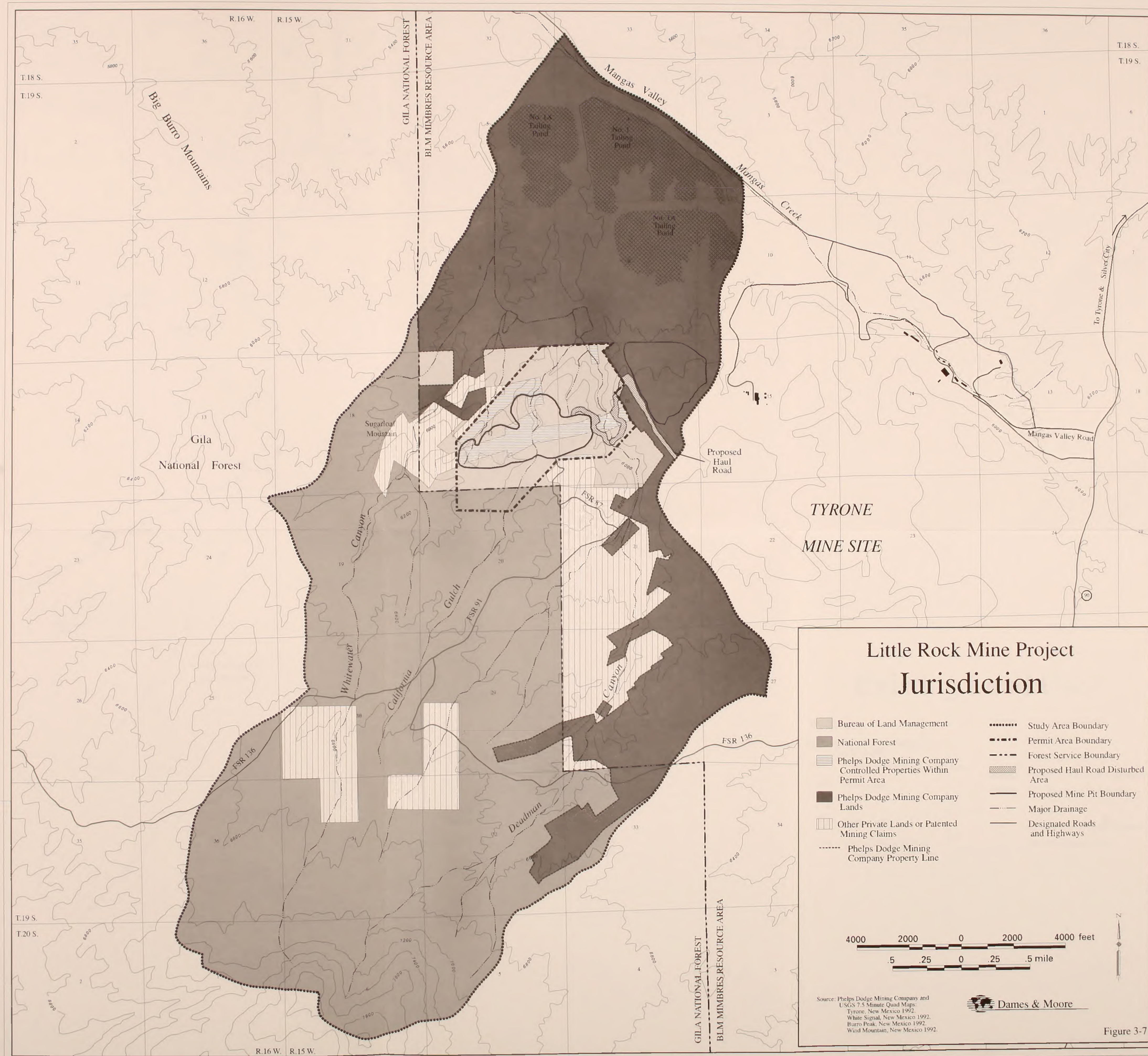


Little Rock Mine Project
Vegetation
Ponderosa Pine Forest
Pinon-Juniper Woodland/Chaparral Ecotone
Grasslands/Juniper Grasslands
Riparian (limited canopy development)
Disturbed Areas - no vegetation
Study Area Boundary
Permit Area Boundary
Forest Service Boundary
Proposed Haul Road Disturbed Area
Proposed Mine Pit Boundary
Major Drainage
Designated Roads and Highways
4000 2000 0 2000 4000 feet
.5 .25 0 .25 .5 mile
Source: Phelps Dodge Mining Company and USGS 7.5 Minute Quad Maps: Tyrone, New Mexico 1992. White Signal, New Mexico 1992. Burro Peak, New Mexico 1992. Wind Mountain, New Mexico 1992.
Dames & Moore
Big Burro Mountains
Gila National Forest
GILA NATIONAL FOREST
BLM MIMBRES RESOURCE AREA
Mangas Valley
Mangas Creek
Mangas Valley Road
To Tyrone & Silver City
Proposed Waste Stockpile
Proposed Pit
Proposed Haul Road
Sugarloaf Mountain
Whitewater Canyon
Gulch
California
Deadman Canyon
FSR 91
FSR 82
FSR 136
TYRONE MINE SITE
R.16 W. R.15 W.
T.18 S. T.19 S. T.20 S.

Figure 3-6



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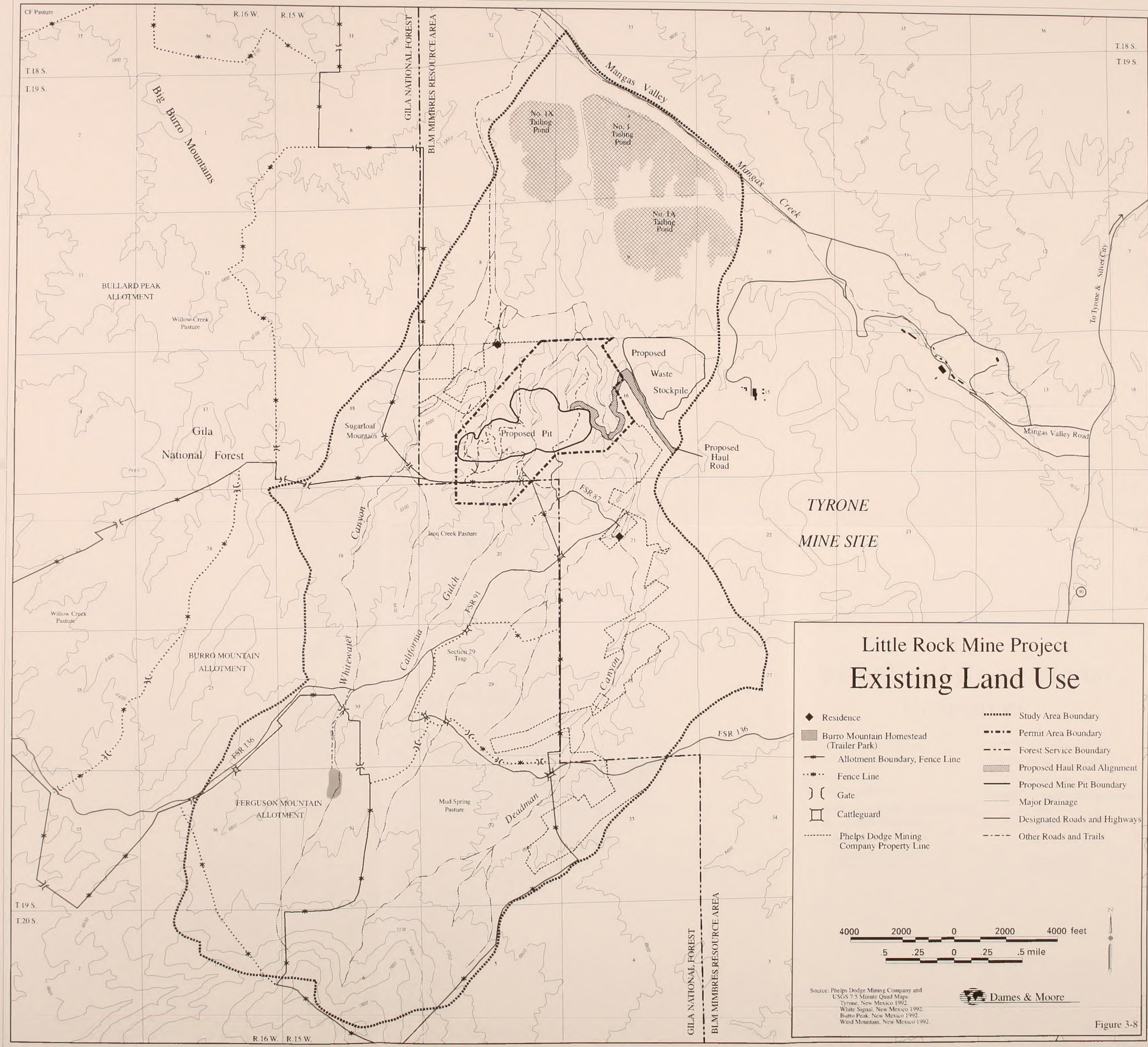

Little Rock Mine Project
Existing Land Use
Figure 3-8

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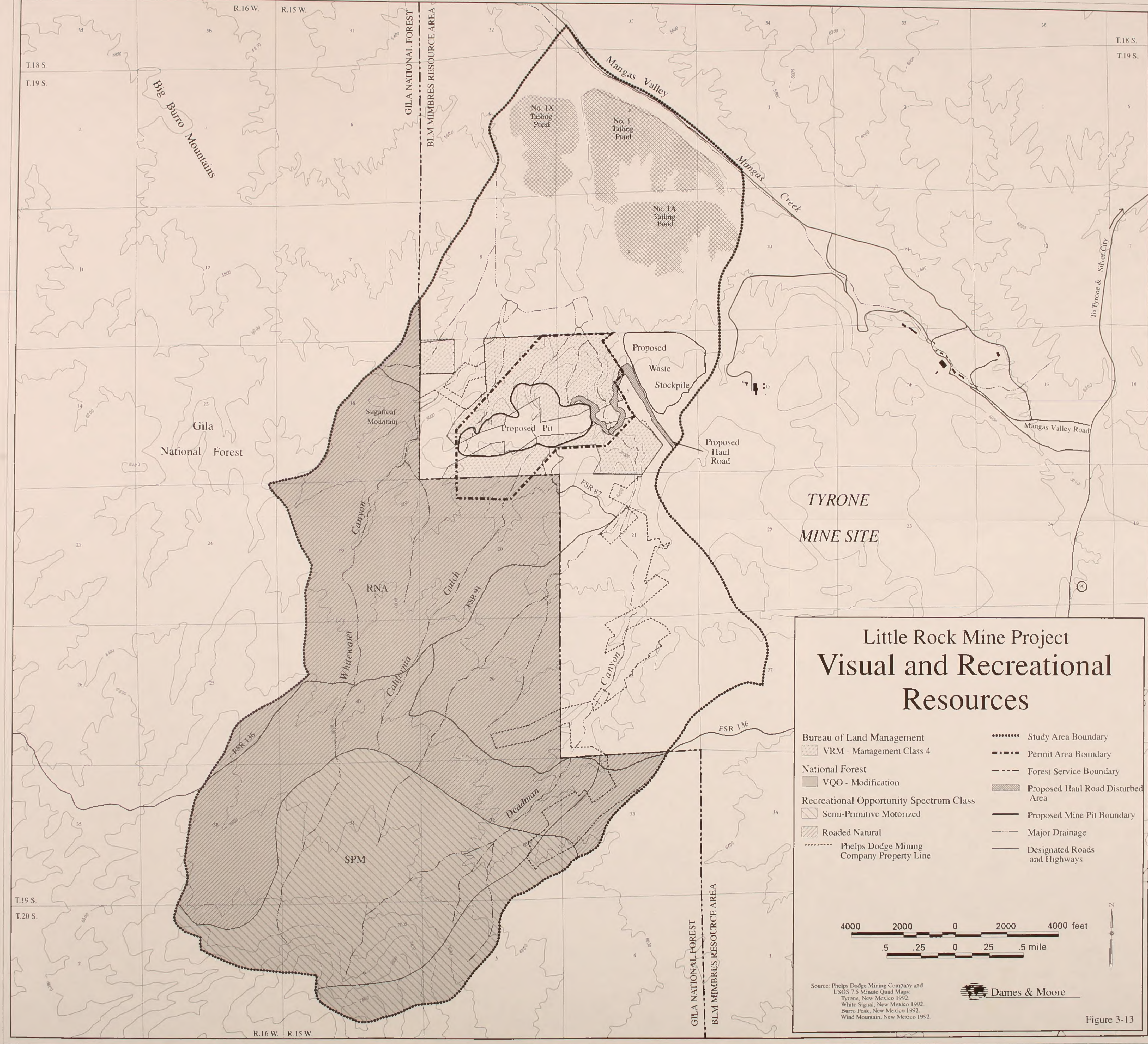

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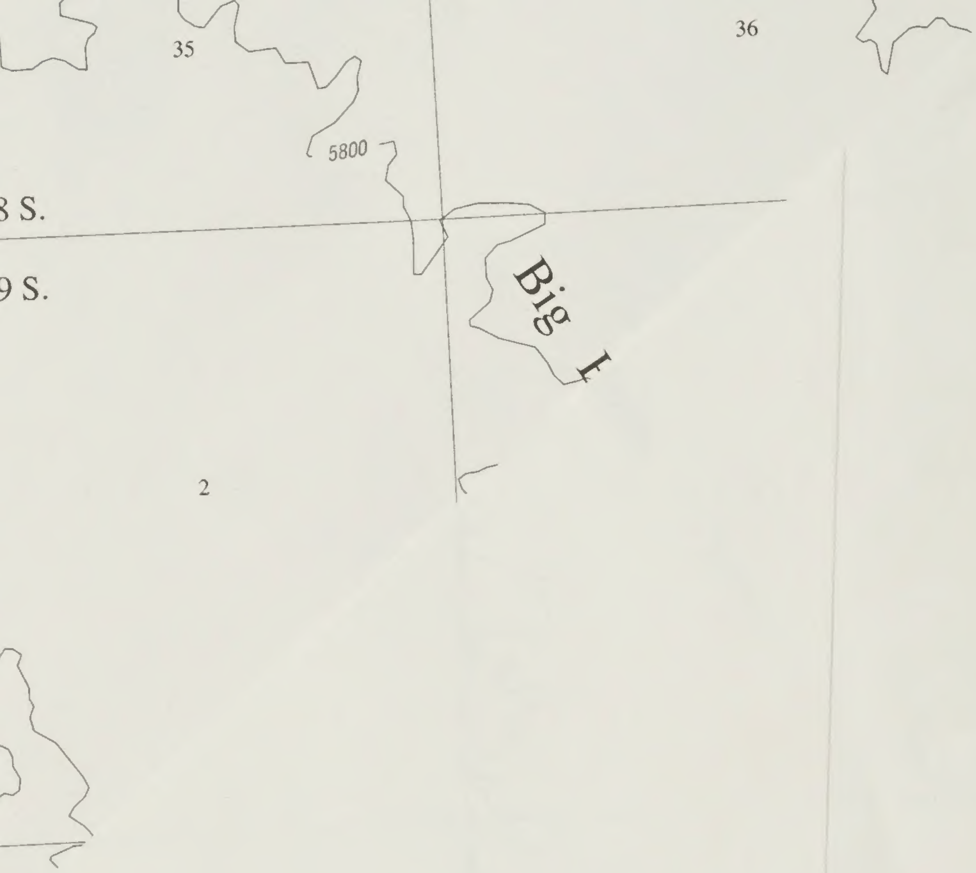
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