United States Department of the Interior
Bureau of Land Management

Las Cruces, New Mexico February 1996

DRAFT

Environmental Impact Statement
Copper Flat Project

BUREAU OF LAND MANAGEMENT

The Bureau of Land Management is responsible for the balanced management of the Public Land and resources and their various values so that they are considered in the combination that will best serve the needs of the American people. BLM management is based upon the principles of multiple use and sustained yield; a combination of uses that takes into account the long-term needs of future generations of renewable and nonrenewable resources. These resources include recreation, range, timber, minerals, watershed, fish and wildlife, wilderness and natural, scenic, scientific and historical values.

BLM-NM-PL-06-001-1793

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:

In Reply Refer to: 1793

Dear Reviewer:

Enclosed for public review and comment is the Draft Environmental Impact Statement (DEIS) for the Copper Flat Mining Project. The project is being proposed by Alta Gold Company, Inc. Your review and comments are needed at this time to ensure that your concerns have been considered in the planning process.

The EIS analyzes impacts of the reinitiation of copper mining in the Hillsboro Mining District near Hillsboro, New Mexico, based on the plan of operations submitted to the Bureau of Land Management (BLM). Several alternatives, which consist of the No Action Alternative, a Reduced Stripping Ratio Alternative, and a Consolidated Waste Rock Disposal Area Alternative are also examined. The DEIS addresses those issues and concerns which were raised during the public scoping period held from June 3, 1994 to July 5, 1994. 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 April 15, 1996 and must be submitted in writing to:

Copper Flat EIS Team Leader
Bureau of Land Management
Las Cruces District
1800 Marquess Street
Las Cruces, NM 88005

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

Public hearings to accept verbal and written comments have also been scheduled for the following dates, places, and times:

DATE/TIME	CITY	LOCATION
March 26, 1996/7:00 p.m.	Hillsboro, New Mexico	Fire Station
March 27, 1996/7:00 p.m.	Truth or Consequences, New Mexico	Civic Center, 400 West Fourth Avenue

Depending upon the number of people who wish to make a statement, a time limit may be placed 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 EIS.

If you would like any additional information, please contact Russell Jentgen, EIS Team Leader, at (505) 525-4351.

Sincerely,

Timothy M. Murphy
Area Manager
Caballo Resource Area

COPPER FLAT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

(X) DRAFT ( ) FINAL

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

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

2. Abstract: In 1997 Alta Gold Company (Alta) proposes to reinitiate copper mining activities in the Hillsboro Mining District located near Hillsboro, New Mexico. The Copper Flat Project (Proposed Action) would involve construction and operation of ore crushing facilities and a copper and molybdenum concentrator. The Proposed Action also would require the expansion of existing waste rock disposal areas, and enlargement of the existing pit and tailings impoundment facility. The majority of mining and most tailings disposal would take place on private land. Public land would be needed for portions of the waste rock disposal areas, the expanded tailings impoundment area, haul roads, and the plant area. Of the approximately 537 acres of BLM-managed public land required for the project, about 179 acres would be newly disturbed. In addition, approximately 566 acres of private land would be used to implement the Proposed Action. Mining would occur 20 hours per day/350 days per year; the mine is expected to have an active life of 10 years, plus several years for reclamation activities. Average daily production is estimated at 280 tons of copper concentrate.

This Draft Environmental Impact Statement (DEIS) analyzes the environmental effects of the Copper Flat Project, plus the No Action Alternative and two additional alternatives that would involve different proposed mine designs and operations.

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

4. For further information contact:

Russell Jentgen
Copper Flat EIS Team Leader
BLM - Las Cruces District
Caballo Resource Area
1800 Marquess
Las Cruces, NM 88005
Telephone (505) 525-4351

Send comments to address provided above.

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

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

7. County that will be directly affected: Sierra County

RECOMMENDED:

Timothy M. Murphy
Area Manager
Caballo Resource Area

APPROVED:

Linda S. C. Rundell
District Manager
Las Cruces District

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SUMMARY

Alta Gold Company, Inc. (Alta) proposes to reinitiate copper mining activities in the Hillsboro Mining District located near Hillsboro, New Mexico. The District, located approximately 30 miles southwest of Truth or Consequences, New Mexico, dates back to 1877 with placer mining operations in Greyback Wash. The Copper Flat site was initially developed in 1982 by the Copper Flat Partnership, Ltd. The mine operated for only a 3-month period and the area was reclaimed in 1986. In 1994, Alta purchased the mine site from Gold Express Corporation. Alta intends to develop the site in a fashion similar to the plan used in the 1982 operation and to the operation proposed by Gold Express in their 1991 Plan of Operation. This would include expanding the existing open-pit mine, constructing new concentrating facilities on existing buried foundations, and expanding the waste rock disposal and tailings impoundment areas. Currently existing surface disturbances from historic mining activities in the area total approximately 656 acres. Mining remains the major land use in the area.

PURPOSE AND NEED

Alta has economically driven project objectives and believes there is a demand for copper concentrate. Alta's objectives are to reinitiate copper mining activities in the District; extract economically recoverable copper and other associated metals, such as molybdenum, determined to exist in the area; and optimize ore recovery and minimize new surface disturbances by mining existing ore deposits.

The Bureau of Land Management (BLM) has the responsibility and authority to manage the natural resources of the Caballo Resource Area. The BLM Las Cruces District published a Draft Environmental Assessment (EA) for the Copper Flat Project in 1992. In October of 1993 BLM management determined that an Environmental Impact Statement (EIS) would be required for the project, and a Notice of Intent (NOI) to prepare the EIS was published in the Federal Register on June 3, 1994.

This EIS was prepared in compliance with the National Environmental Policy Act (NEPA), and in accordance with BLM Handbook H-1790-1 and the New Mexico Information Bulletin No. NM-94-071. The proposed use of public lands and NEPA are the driving mechanisms for requiring an environmental analysis and this environmental document. The EIS considers the potential environmental impact to both public and private lands that may result from reinitiating copper mining activities at the Hillsboro Mining District.

PROPOSED ACTION

The Copper Flat Project would involve the construction and operation of new ore crushing facilities, and a copper and molybdenum concentrator. Electrical distribution lines, on-site water lines, and access roads would also be constructed or expanded. Access and utility lines to the mine are currently in place. The Proposed Action would also include expansion of the existing pit; expanded use of existing waste rock disposal areas and construction of berms, runoff catchment channels, and basins; expansion of the existing tailings impoundment, and construction and operation of a new tailings slurry pipeline. Withdrawal of groundwater at an average rate of 2,000 gallons per minute for concentrating activities would occur over 10 years.

The site of the Proposed Action is located in Sierra County, New Mexico, approximately 30 miles southwest of Truth or Consequences, New Mexico. The town of Hillsboro lies about 3 miles southwest of the Copper Flat Project area. The majority of mining and tailings impoundment would take place on privately-owned land. Use of public land would be required for the plant area, the majority of the East Waste Rock Disposal area, and portions of the North and West Waste Rock Disposal areas and the tailings impoundment.

Approximately 537 acres of public land managed by the BLM, Las Cruces District Office, and approximately 566 acres of private land would be used to implement the Proposed Action. Approximately 179 acres of public land would be newly disturbed as a result of the Proposed Action. Approximately 690 acres of previously disturbed land (public and private) would be redisturbed.

Initiation of construction activities is planned for 1996. Mining operations would commence approximately 15 months later in 1997 and would continue for about 10 years. Reclamation would continue for approximately another 3 to 4 years. An average daily production of approximately 280 tons of copper concentrate is planned for the facility. These figures are subject to change throughout the life of the facility, since milling rates, ore and concentrate grades, potential ore reserves, and other operating parameters may change.

ALTERNATIVES TO THE PROPOSED ACTION

No Action Alternative

Under the No Action Alternative, copper mining at the Copper Flat Mine would not occur and the proven ore reserves in the area would remain undeveloped. No construction of the ore crushing facilities, the copper concentrator, the tailings impoundment disposal facility, or other related facilities would occur. No reclamation on previously disturbed land would occur.

Reduced Stripping Ratio Alternative

This alternative is based on a different economic analysis than the Proposed Action. This new analysis, which utilized current commodity and economic parameters, indicates that Alta could mine a lower copper ore grade with a lower stripping ratio while maintaining a reasonable profit. Total production rate would remain the same. The amount of copper ore mined would be slightly less than that mined under the Proposed Action (65.5 million tons versus 71 million tons, respectively), but 54 percent less waste rock would be removed (23.5 million tons). Under this alternative 54 percent of the rock considered waste rock under the Proposed Action would be as processed as ore.

The only disturbance and operational differences between this alternative and the Proposed Action would be:

- The majority of the waste rock would be placed on the three dumps located adjacent to the pit (see Chapter 2, Figure 2-5). The West Waste Rock Disposal area would be the same size and configuration as in the Proposed Action. The North Waste Rock Disposal area would expand farther to the south along the western flank of Animas Peak, and the low grade stockpile shown in the Proposed Action would become the South Waste Rock Disposal area.

- Approximately 6 million tons of waste rock would be placed in the East Waste Rock Disposal area. This would reduce the size of the dump from 130 acres in the Proposed Action to 35 acres under this alternative. This dump would be constructed in two lifts, a lower one with a crest elevation of approximately 5,560 feet above sea level (asl) and an upper one which would slope upward to a height of 5,600 feet asl at an approximate 2 percent grade from the current dump elevation of 5,560 feet asl. The construction of two lifts would facilitate slope reduction during reclamation, which would occur concurrently with operations as portions of the dump become inactive.

- The pit would be shallower than under the Proposed Action with a bottom depth of 4,800 feet asl, and an area of 96 acres, as compared to a depth of 4,780 feet asl and an area of 111 acres under the Proposed Action.

- Two of the haul trucks may not be needed due to the reduced waste rock haulage.

Consolidated Waste Rock Disposal Alternative

This alternative is similar to the Proposed Action however, no new disturbance would occur to the West and North Waste Rock Dumps and the East Waste Rock Disposal area would be increased (see Chapter 2, Figure 2-6). In this alternative, all of the waste rock material would be placed in the East Waste Rock Dump, with the partially oxidized (transitional) material segregated within the dump. The design of the internal segregation area could include:

- Compaction of unoxidized waste rock below the base of the segregated waste rock;
- Placement of transitional waste rock in shallow lifts (10 to 25 feet);
- Compaction of each lift after placement; and
- Compaction of the upper surface of the segregated waste rock.

The East Waste Rock Disposal area would be constructed in three lifts at 5,450, 5,550, and 5,650 feet each with setback distances sufficient to create an overall slope of not greater than 2.5H:1V. After completion of the disposal area, the slopes would be regraded, creating final slopes of not greater than 2.5H:1V with 10-foot-wide benches at each lift. The East Waste Rock Disposal area would be 158 acres in size under this alternative, compared to 130 acres under the Proposed Action.

The existing disturbance at the West and North Waste Rock Disposal areas would be reclaimed during operations, as soon as equipment availabilities allow. Some unoxidized waste rock may be used to reshape these dumps to enhance runoff during recontouring prior to revegetation, but no substantial volume of material would be added to either area. The lean ore stockpile would be used to temporarily store lower grade ore until processed similar to the Proposed Action. Most of the low grade ore would be processed during the operation, although some may be processed following cessation of mining.

IMPORTANT ISSUES AND IMPACT CONCLUSIONS

A number of important issues were raised during scoping for the Copper Flat Project EIS. These issues along with their impact conclusions are presented below by resource area. Impact conclusions include the implementation of any mitigation measures that may have been identified. Where the impact conclusion would differ for an alternative compared to the Proposed Action, this difference has been noted. A much more detailed comparison of impacts among alternatives can be found on the summary table presented at the end of Chapter 2.0 (Table 2-4).

Geology and Minerals

Issue: Potential for acid rock drainage (ARD)

Conclusion: No impacts to groundwater or surface water quality from ARD are expected from the waste rock disposal areas, pit, or tailings impoundment. Transitional waste rock disposal areas have the potential to generate runoff with low pH levels, but modeling has shown that this is unlikely due to low reactivity, low precipitation, and high evaporation rates. Drainage from transitional waste rock dumps would be directed to the pit lake where it would be prevented from affecting groundwater due to the evaporative sump action of the pit lake. Impacts from the proposed tailings impoundment are expected to be negligible with the implementation of the proposed seepage collection systems.

Issue: Potential for seismic and subsidence effects

Conclusion: A magnitude 6.0 earthquake 15 miles from the mine site is the maximum credible earthquake predicted for the area. Evaluations indicate that the tailings impoundment dam and other structures to be located at the mine site would be structurally adequate to handle an earthquake of this magnitude.

Water Quantity and Quality

Issue: Reduction of surface water levels in Percha Creek, Las Animas Creek, and Caballo Reservoir

Conclusion: Based on modeling, no effects on the surface flow in Las Animas Creek are anticipated. Effects to surface water flow in Caballo Reservoir and Percha Creek are expected to be minimal with potential drawdown effects on Percha Box expected to be blocked by local fault geology.

Issue: Impacts to surface water quality from mining activities, e.g., sedimentation

Conclusion: Based on review of effects to surface water during previous operations at the site, minimal effects to surface water are anticipated.

Issue: Poor water quality in pit lake following mining

Conclusion: Pit water chemistry is expected to remain similar to existing conditions; water is not expected to be acidic but would exceed New Mexico human health and domestic use surface water standards for certain chemical parameters such as sulfates. Pit water quality currently does not meet State livestock/wildlife standards for copper; although it does fall under benchmark toxicity values for wildlife water consumption for various indicator species.

Issue: Contamination of groundwater by infiltration of tailings water

Conclusion: A system of capture wells and trenches are expected to collect seepage from the tailings impoundment area and redirect it back to the plant site for use as process water. No contamination of groundwater is expected to occur from infiltration.

Issue: Drawdown of wells and springs in the project vicinity

Conclusion: Based on modeling, 10 years after mining begins, drawdown from pit dewatering could range from 100 feet at the pit to 1 to 3 feet at the Pague well north of the mine site. In the vicinity of the production wells, drawdown would range from 20 feet at the production wells to 10 to 12 feet in wells located near Las Animas Creek and 3 to 4 feet in wells near the lower reaches of Percha Creek 10 years after mining begins. After 140 years, permanent drawdown in the mine area as a result of pit lake evaporation could be 10 feet in Warm Springs Canyon and up to 20 to 30 feet on portions of the Ladder Ranch adjacent to the mine. Water levels in the area of the production wells should have returned to pre-pumping levels after 140 years.

Issue: Cumulative impacts on water resources

Conclusion: Same as previous conclusion.

Soils

Issue: Permanent loss of soils under the tailings impoundment and waste rock dumps

Conclusion: Available topsoil from the tailings impoundment and waste rock dumps would be salvaged and stockpiled prior to any project disturbance, and would be used during reclamation.

Vegetation

Issue: Loss of wetlands, riparian areas and other vegetation types

Conclusion: No wetland areas were identified within the mine area. Riparian vegetation was identified in association with three seeps located in the Greyback Wash area to the south and east of the plant area. Alta will provide supplemental water to Greyback Wash during operation to maintain the riparian vegetation. Following mine closure, Alta will recontour the area to approximate original drainage patterns. If the recontouring does not facilitate surface drainage into the wash, the herbaceous riparian vegetation may be affected. Approximately 414 acres of previously undisturbed desert grassland would be disturbed during mine construction and operation; however, reclamation efforts are expected to revegetate these acres as well as areas disturbed by previous mining operations with similar levels of vegetative cover and species.

Wildlife and Fisheries Resources

Issue: Loss of native habitat utilized by migratory birds and other wildlife species

Conclusion: Approximately 414 acres of native grassland habitat would be newly disturbed, resulting in direct loss of forage, breeding areas, and cover; displacement; and habitat fragmentation. Reclamation efforts would revegetate these areas. However, native shrub species removed by mining activities would regenerate only over a long period of time (40 to 60 years) after mine reclamation, resulting in long-term impacts to forage and thermal cover availability. The eventual reclamation of 558 acres of land disturbed by previous mining activities would be beneficial to wildlife resources.

Issue: Exposure of birds, and possibly other wildlife, to poor quality water in the pit lake

Conclusion: Pit lake water quality following mine closure is expected to be similar to existing conditions. Based on the results of pit lake water sampling conducted in 1993 and 1994 (SRK 1995), existing pit lake water quality falls within accepted parameters for New Mexico State livestock and wildlife water quality standards,with the exception of copper, which exceeded State standards. The previous pit lake water sampling analysis measured total metals levels; however, State livestock and wildlife standards are based on total dissolved metals. Total dissolved metals levels in the pit lake water may be lower than total metals.

Issue: Impacts to threatened and endangered and candidate species.

Conclusion: No impacts to any Federally listed threatened or endangered species were identified for the EIS analysis. Four Federal candidate bat species, the pale Townsend's big-eared bat, occult little brown bat, fringed myotis, and Yuma myotis, could be directly or indirectly impacted by mine development and operational activities. The Proposed Action could impact the loggerhead shrike from direct disturbance to breeding birds and long-term habitat loss. The ferruginous hawk could be impacted, if mining activities were to occur within 0.50 mile of an occupied nest site. Minor impacts to foraging habitat for the Baird's sparrow would result from mine expansion. Direct mortalities to the Texas horned lizard would likely occur.

Social and Economic Values

Issue: Increase in employment in Sierra County

Conclusion: Construction. About 91 employees at the peak level of construction would come from the local area. Approximately 26 indirect jobs would be created during the construction period, of which 18 are projected to be filled by local area residents.

Operations. Direct and indirect new jobs would total approximately 296. It is projected that 70 percent of the workers or approximately 207 would come from the local area.

Issue: Increase in demand for housing and services

Conclusion: Construction. There will be a temporary (12 to 18 months) demand for as many as 47 housing units, primarily short-term units. Increased demand could be met by existing available housing units.

Operations. Indirect and direct impacts of the project may generate the demand for as many as 89 housing units. Increased demand could be met by existing available housing units.

Issue: Impacts on local economy and tax structure

Conclusion: Construction. Approximately $4,500 in sales tax revenue could be generated per month by mine expenditures.

Operations. This project would generate as much as $465,519 sales tax revenue from direct and indirect employee expenditures, would increase property tax revenue, and would generate about $840,000 in minerals tax revenue for each year of operation.

Issue: Potential unexpected closure of the mine due to outside economic conditions such as a drop in the national or world price of copper or interest rates

Conclusion: Federal and State social safety regulations would ensure that assimilation of unemployed workers would occur as rapidly as possible. Both Federal and State regulations provide for assistance in economic assessment, retraining, job search, and other social assistance. Negative impacts would be temporary.

Land Use and Recreation

Issue: Loss of hunting opportunities (i.e., deer, quail, doves)

Conclusion: A temporary loss of hunting opportunities would occur during the life of the Project as a result of access being restricted at the mine.

Issue: Impacts to State Trust Lands

Conclusion: No State Trust Lands were identified within the proposed mine area, although State Trust Lands occur in proximity to the tailings impoundment dam and the production well field. Use of these wells could result in a drawdown of 10 to 12 feet for wells on adjacent State Trust Lands during the life of the Proposed Action. No impacts to the State Trust Lands located southeast of the mine access off of Highway 152 (S32, T15S, R6W) are expected. The existing water pipeline from the production wells to the mine would continue to cross State Trust Lands, however, no additional construction is necessary and no additional impacts are expected.

Visual Resources

Issue: Impacts to the Lake Valley Back-Country Byway

Conclusion: The project may enhance the recreational touring experience/interpretive aspects for which the byway was designated (historic mining and ranching activities with Copper Flat Mine currently highlighted) for some while the presence of an active mine and associated traffic could possibly detract from a quality touring experience for others.

Transport of Process Materials, Products, and Hazardous Wastes

Issue: Increase in truck traffic and accident potential on area roadways

Conclusion: Based on statistical estimates, approximately 9 accidents related to mine truck traffic would occur during the 10-year life of the project.

Issue: Accidents resulting in a spill of hazardous material

Conclusion: Based on a statistical estimate, <.1 truck accidents resulting in a spill would occur during the life of the project.

Reclamation

Issue: Concern about reclamation requirements for the project.

Conclusion: As required by State and Federal reclamation regulations, Alta will meet all reclamation requirements to obtain reclamation bond release.

AGENCY-PREFERRED ALTERNATIVE

In accordance with NEPA, and as required by the Council on Environmental Quality (40 CFR 1502.14) the BLM has identified their preferred alternative for the project at the Draft EIS stage in the environmental review process. The Agency-Preferred Alternative consists of the Reduced Stripping Ratio Alternative. Rationale behind the decision is outlined in Section 2.6, Agency-Preferred Alternative.

1.0 INTRODUCTION

1.1 PROPOSED ACTION

Alta Gold Company proposes to rebuild the Copper Flat mining facility near Hillsboro, New Mexico, essentially as it existed in 1982. Reconstruction would involve utilization of existing foundations and previously disturbed land. Alta's goal is to limit project disturbance primarily to the areas that were impacted by the previous operation from 1980 through 1986. New disturbances of land would be kept to a minimum. The construction phase of the project is expected to take approximately 12 to 18 months.

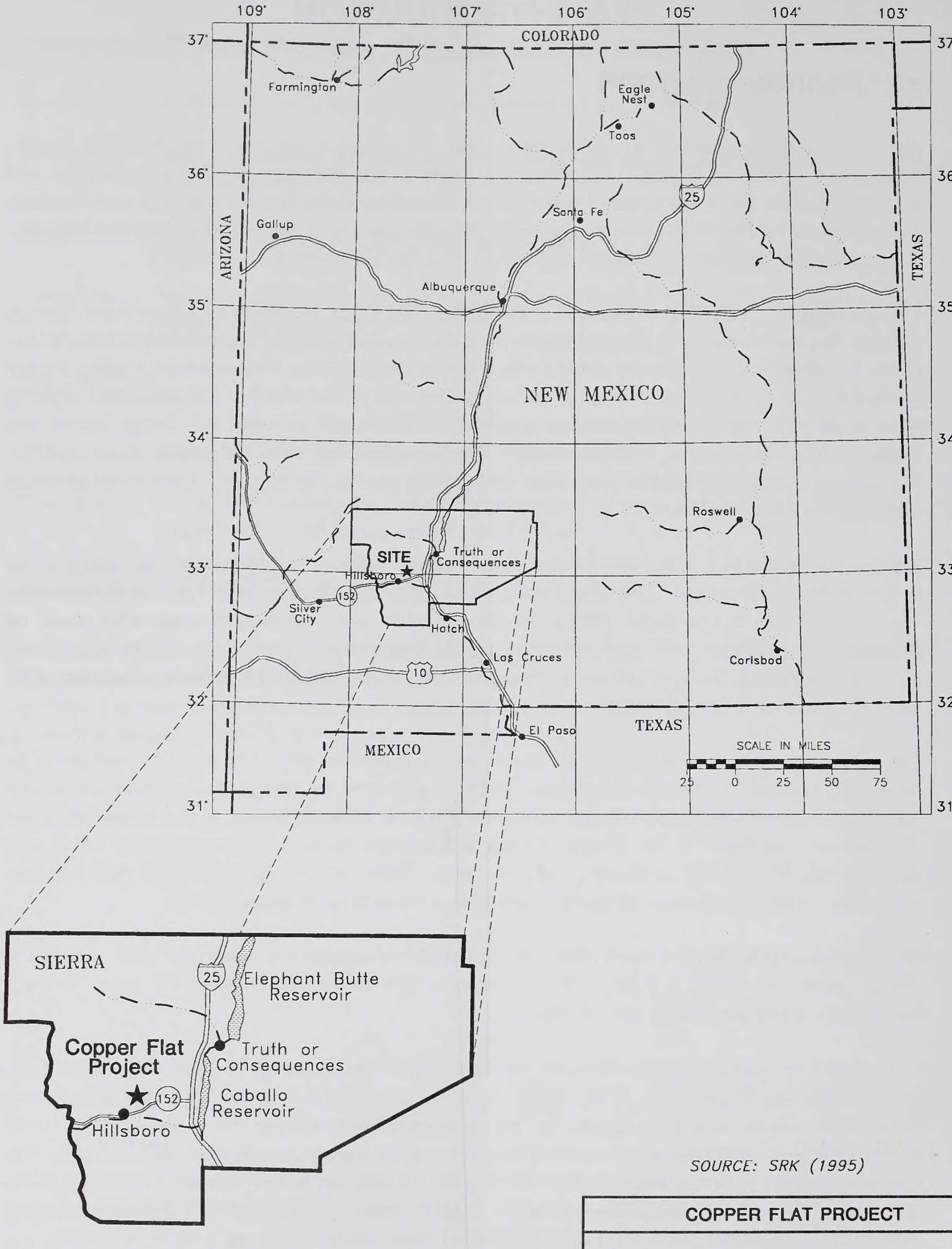
The ore body at Copper Flat is exposed at the surface and would be mined by conventional open-pit methods in a manner similar to the 1982 operation. The mine would produce approximately 60 million tons of ore, 51 million tons of overburden, and 11 million tons of low grade ore. If economically feasible, the low grade ore would be processed during operations or at the end of the mine life. Pre-production stripping was completed in 1982 during the previous operation. Material would be drilled and blasted, loaded, and hauled to the primary crusher, and then conveyed to the process mill, where the mineral values would be removed by conventional flotation processes. No leaching process will be used. Overburden would be placed on the ground surface.

The operation would be a 16,500-ton-per-day, copper sulfide flotation mill using standard technology similar to that of the prior operation. The mining operation would produce an estimated 5.76 million tons of ore and 1 million tons of low grade material annually. Copper and molybdenum concentrate would be produced. No smelting or refining would occur on site. Overburden and tailings production is estimated to be 6.5 million and 5.70 million tons per year, respectively. An operational life expectancy of approximately 11 to 13 years is projected at this time.

The majority of mining activity would take place on privately-owned land. Use of public land would be required for portions of the waste rock disposal areas, the plant area, pit, tailings impoundment, the existing water production well field power and pipeline corridors, and the transmission line. Approximately 537 acres of public land managed by the Bureau of Land Management (BLM), Las Cruces District Office, and approximately 566 acres of private land would be used to implement the proposed project. Approximately 179 acres of public lands would be newly disturbed as a result of the Proposed Action.

Construction is scheduled to begin in 1996. The start of mining operations is planned for 1997. Mining and milling operations would be initiated 15 to 18 months later and would continue for about 10 years. Reclamation would continue for several years.

The proposed project is located in Sierra County, New Mexico, approximately 30 miles southwest of Truth or Consequences (Figure 1-1). Hillsboro is about 3 miles southwest of the proposed project area (Figure 1-2). Power would be supplied to the project by Sierra Electric Co-op via existing 115-kV transmission lines. Water would be supplied from four existing wells located 8 miles east of Copper Flat. The water would be transported through an existing 20-inch diameter buried pipeline; two booster pump stations would be reconstructed along the pipeline. Electric power would be supplied to the wells and pump stations by Sierra Electric via existing 25-kV distribution lines. Access to the site is via State Highway 152

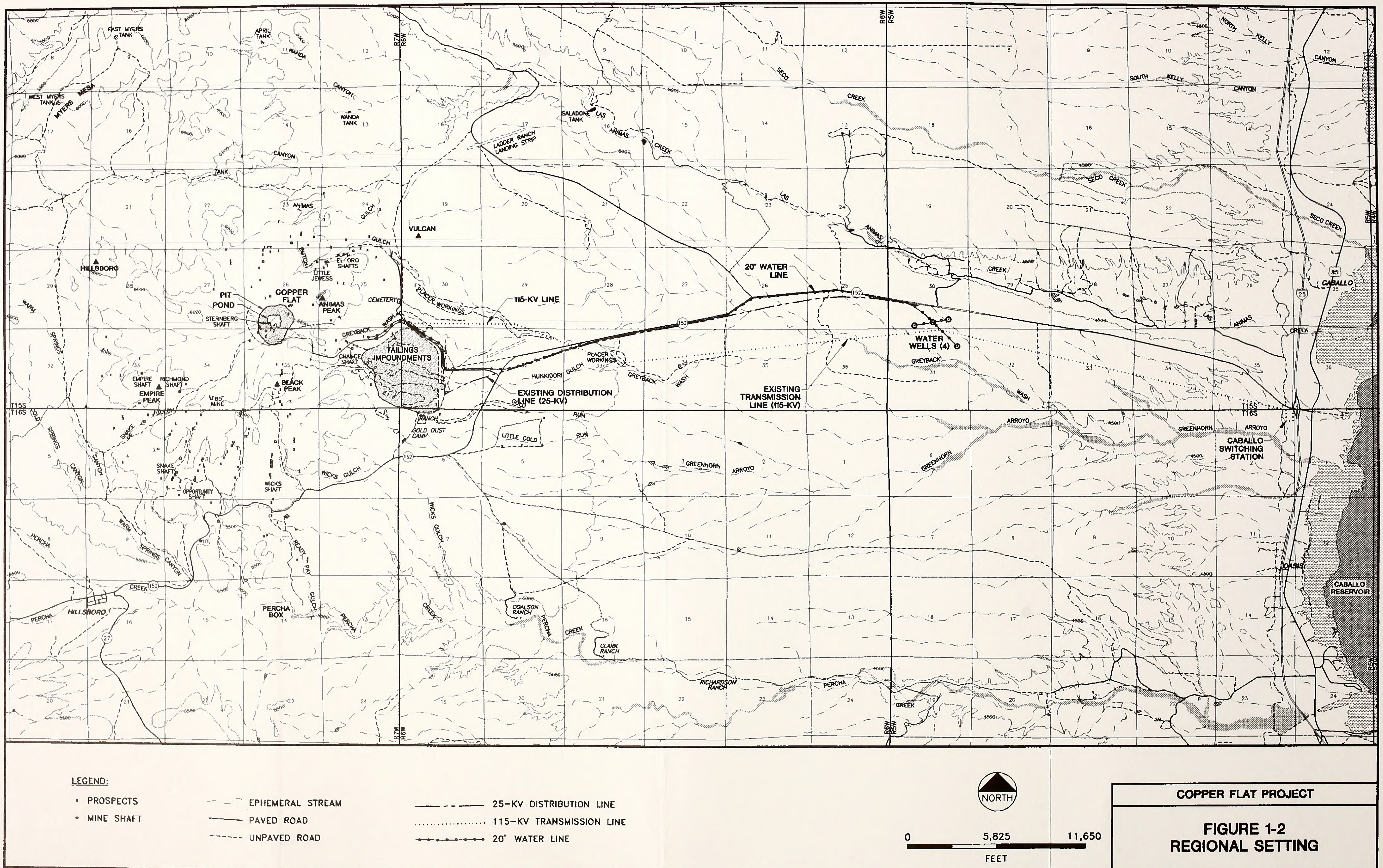


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE 1-1
PROJECT LOCATION

DATE: NOV/17/1995 ACAD FILE: 476\LOCAT



COPPER FLAT PROJECT

FIGURE 1-2
REGIONAL SETTING

DATE: NOV/17/1995 ACAD FILE: 476\476BASE

and the existing county road. No additional disturbance would be associated with the power, water, or access components of the project.

This Environmental Impact Statement (EIS) was prepared in compliance with the National Environmental Policy Act (NEPA), and in accordance with BLM Handbook H-1790-1 and the New Mexico Information Bulletin No. NM-94-071 addressing the analysis of cumulative impacts. The EIS considers the quality of the human environment from the physical impacts to both public and private lands that may result from reinitiating copper mining activities at the Copper Flat Mine. The proposed mining activities located on public lands are subject to review and approval by the BLM pursuant to the Federal Land Policy Management Act (FLPMA) and corresponding surface management regulations (43 CFR 3809). These activities and their approval by the BLM pursuant to FLPMA constitute a Federal action, and are thus subject to NEPA. The BLM has determined that the Copper Flat Project constitutes a major Federal action and has determined that an EIS be prepared to fulfill NEPA requirements.

1.2 RELEVANT HISTORY OF THE COPPER FLAT MINE

Mining began in the Hillsboro District in 1877 with placer mining operations along the drainages east of the current operation. Underground deposits were developed between 1911 and 1931. In the mid-1950s a small copper leaching operation existed in the Copper Flat area. Also in the 1950s, Newmont Mining Company and Bear Creek Mining Company initiated copper exploration on the property. Inspiration Consolidated Copper began exploration work in 1967, then, in 1974, Quintana Minerals Corporation (Quintana) leased the property from Inspiration. After installing an additional 127 exploration drill holes, Quintana defined sufficient reserves to begin development of the property.

In 1978, Quintana prepared an environmental assessment (EA) of their proposal to operate an open pit copper mine in the Copper Flat area. The Record of Decision (ROD) was issued by the BLM and in 1982, the Copper Flat Partnership, Ltd. with Quintana acting as the mine operator, developed and operated an open pit copper mine, including a 15,000-ton-per-day flotation mill and a tailings impoundment, at the Copper Flat site. Operations were terminated after a short period due to economic conditions. The plant remained on a "care and maintenance" status until 1986 when the facilities were sold and dismantled, the mining leases were returned to Inspiration, and the site was reclaimed. Gold Express Corporation acquired the property from Inspiration in 1991, and submitted a Plan of Operations (POO) to re-establish the operation in a manner similar to the 1982 operation and a draft environmental assessment (EA) was prepared. Following the comment period on the Draft EA, it became evident to the BLM that an EIS would be required. The EA was never finalized and no decision document was prepared. In a letter dated October 7, 1993, the BLM notified Gold Express that an EIS would be required for the project due to concerns related to several water resource issues.

In early 1994, Alta Gold Company acquired the Copper Flat Project from Gold Express Corporation and began plans to reinitiate mine operations. Site operation locations for the Proposed Action as proposed by Alta would generally be similar to those proposed by Gold Express in their 1991 Plan of Operations. The Proposed Action discussed in this EIS provides detail on Alta's proposed mining plans and operations. To date, historic mining activities have left a total of approximately 690 acres of surface disturbance in the proposed project area (see Figure 1-3 and Photo 1-1).

1.3 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.3.1 Alta Gold Company's Purpose and Need

Alta has economically driven project objectives and believes there is a demand for copper concentrate and molybdenum. Alta's objectives are as follows:

- Reinitiate copper mining activities at the Copper Flat site;
- Extract economically recoverable copper and molybdenum in the area; and
- Optimize ore recovery and minimize new surface disturbances by mining existing ore deposits.

1.3.2 BLM's Responsibilities and Relationship to Planning

The BLM has the responsibility and authority to manage the public land resources of the Caballo Resource Area (RA). Alta's use of public land in the Caballo RA requires conformance with BLM's surface management regulations (43 Code of Federal Regulations [CFR], Subpart 3809), as well as various statutes, including the Mining and Mineral Policy Act of 1970 (as amended) (MMPA) and Federal Land Policy and Management Act (FLPMA) of 1976 (as amended). BLM must review Alta's plans for exploration and development to ensure the following:

- Adequate provisions are in place to prevent unnecessary or undue degradation of Federal lands and to protect the non-mineral resources of the Federal lands;

- Measures to provide for reclamation of disturbed areas; and

- Compliance with applicable State and Federal laws.

Given the large percentage of Federal land in Sierra County, Federal management programs, particularly those administered by the BLM, will continue to significantly influence land use in the area. In addition, since the area includes unpatented mining and millsite claims on lands administered by the BLM, the BLM's land use plans, policies, and regulations have primary jurisdiction over land use activities on these parcels. The BLM has developed a Resource Management Plan (RMP)/EIS to guide long-term management of the lands that it manages.

BLM's RMP/EIS has no constraints that conflict with the Proposed Action. Management activities for the proposed project area are identified as grazing, wildlife, and recreation. Mineral resource development is in conformance with the RMP, and is consistent with Sierra County plans.

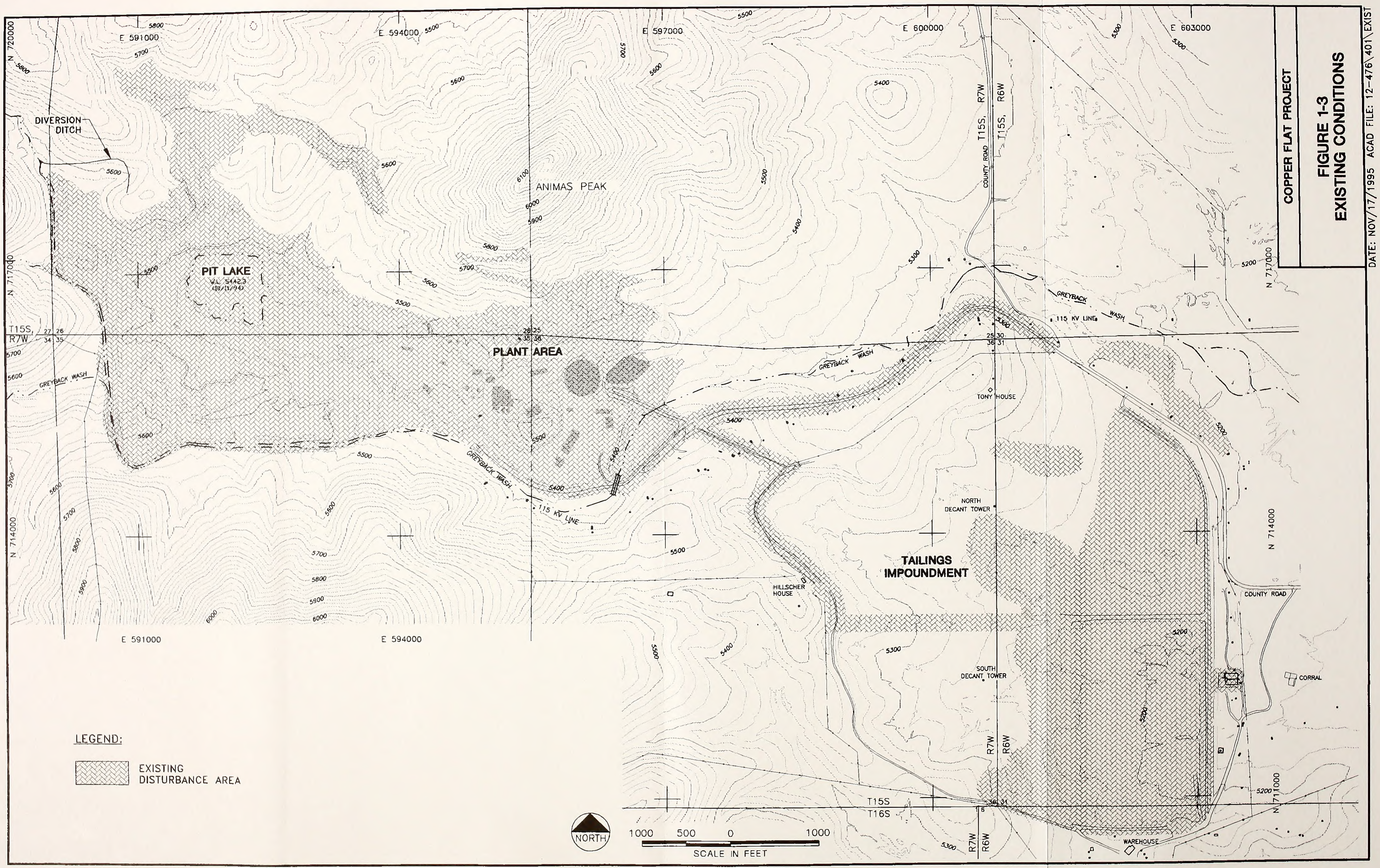

COPPER FLAT PROJECT
FIGURE 1-3
EXISTING CONDITIONS
DATE: NOV/17/1995 ACAD FILE: 12-476\401\EXIST
DIVERSION DITCH
PIT LAKE
ANIMAS PEAK
PLANT AREA
GREYBACK WASH
115 KV LINE
TONY HOUSE
NORTH DECANT TOWER
TAILINGS IMPOUNDMENT
HILLSCHER HOUSE
SOUTH DECANT TOWER
COUNTY ROAD
CORRAL
WAREHOUSE
E 591000
E 594000
E 597000
E 600000
E 603000
N 720000
N 717000
N 714000
N 711000
T15S, R7W
T15S, R6W
T15S
T16S
R7W
R6W
LEGEND:
EXISTING DISTURBANCE AREA
NORTH
1000 500 0 1000
SCALE IN FEET

PHOTO 1-1. EXISTING SITE AERIAL VIEW (1988)

Wilderness resources would not be affected by the Proposed Action, since none are present in the area and are therefore not addressed in the EIS. The BLM also is required to assess impacts to prime or unique farmlands, floodplains, Areas of Critical Environmental Concern, wild horses and burros; none of these resources occur within the Proposed Action. This elimination of nonrelevant issues follows the Council on Environmental Quality policy as stated in 40 CFR 1500.4.

1.4 APPLICABLE REGULATORY REQUIREMENTS AND COORDINATION

The permits shown on Table 1-1 would be required for the Proposed Action. Alta is responsible for applying for and acquiring these permits.

1.5 ORGANIZATION OF THE ENVIRONMENTAL IMPACT STATEMENT

This EIS follows the Council on Environmental Quality (CEQ) recommended organization (40 CFR 1508.9). Chapter 1.0 describes the purpose and need, and the role of the BLM; Chapter 2.0 provides a description of existing operations, and the Proposed Action and Alternatives; Chapter 3.0 describes the affected environment; and Chapter 4.0 describes direct, indirect, and cumulative impacts associated with the Proposed Action and Alternatives and possible mitigation to reduce or minimize impacts. Chapter 5.0 summarizes consultation, coordination, and public participation in the EIS process and includes the list of preparers. Appendices A, B, and C provide additional information on hydrology data, wildlife species, and visual resources. Glossary, references, and an index are also provided.

Table 1-1

Major Permits and Approvals Required for the Copper Flat Project

Permit/Approval	Granting Agency
FEDERAL	
Approval of Plan of Operations	Bureau of Land Management
Nationwide Dredge and Fill Permit (Section 404)	Army Corps of Engineers
FCC License	Federal Communications Commission
MSHA Registration	Mining Safety and Health Administration
Stormwater Disposal Permit (NPDES)	Environmental Protection Agency
STATE	
Mining Permit	New Mexico Energy, Mineral and Natural Resources Department-Mining Act Reclamation Bureau
Water Pollution Control Permits	New Mexico Energy, Mineral and Natural Resources Department, Mining Act Reclamation Bureau Environmental Protection Agency
Surface Disturbance Permit (Air Quality)	New Mexico Environment Department - Air Quality Bureau
Permit to Construct (Air Quality)	New Mexico Environment Department - Air Quality Bureau
Permit to Operate (Air Quality)	New Mexico Environment Department - Air Quality Bureau
Permit to Appropriate Water	New Mexico State Engineer's Office
Permits for Dam Construction and Operations	New Mexico State Engineer's Office
Approval to Operate a Sanitary Landfill	New Mexico Environment Department-Solid Waste Bureau
Tailings Discharge	New Mexico Environment Department-Groundwater Bureau
Radioactive Material License	New Mexico Environment Department Hazardous and Radioactive Bureau-Radiation Licensing and Registration Section, (RLRS)
Cultural Resources Clearance	State Historic Preservation Office

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 INTRODUCTION

This chapter provides a description of Alta Gold Company's Proposed Action to reinitiate copper mining activities in the Hillsboro Mining District, reasonable alternatives to the Proposed Action and alternatives considered but dismissed from detailed analysis.

2.2 Proposed Action

This section describes the mining operation proposed by Alta Gold Company (Alta) at their Copper Flat Project near Hillsboro, New Mexico. The following is a detailed summary of the Proposed Action as described in the Plan of Operations. Further details are available in several design reports on file with the Bureau of Land Management (BLM), Las Cruces District Office, New Mexico. Figures 1-1 and 1-2 illustrate the general location of the Copper Flat Project.

2.2.1 Overview

Alta proposes to rebuild the Copper Flat mining facility essentially as it existed in 1982 (see Chapter 1.0, Section 1.2). This would consist of unearthing existing foundations, and reconstructing and operating ore crushing facilities, copper and molybdenum concentrators, and a mill tailings impoundment facility. The Proposed Action would also include expanded use of existing waste rock disposal areas, expansion of the pit area, reconstruction and operation of a tailings slurry pipeline and 115-kV transmission and 25-kV distribution lines, repair and grading of plant site roads and general use areas, and installation of an above-ground waterline along and between the tailings impoundment and the mill site. The construction phase of the project is expected to take approximately 12 to 18 months. Reconstruction would involve utilization of existing foundations and previously disturbed land. Alta's goal is to limit project disturbance primarily to the areas that were impacted by the previous operation from 1980 through 1986. New land disturbances would be kept to a minimum. The surface disturbances associated with reconstruction are detailed on Table 2-1.

The mine permitting and licensing process is underway; major permits that are required are summarized on Table 1-1. No reagents employed in the Copper Flat milling operation would require special permitting, nor are they considered hazardous materials by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) definition. A Radioactive Materials License is required for density and level measuring instruments which contain small amounts of radioactive isotope sources.

Power would be supplied to the project by Sierra Electric Co-op via existing 115-kV transmission lines and equipment. Water would be supplied from four existing wells located 8 miles east of Copper Flat. The water would be transported through an existing 20-inch diameter buried pipeline; two booster pump stations would be reconstructed along the pipeline. Electric power would be supplied to the wells and pump stations by Sierra Electric via existing 25-kV distribution lines. Access to the site is via New Mexico State Highway 152

Table 2-1

Copper Flat Project
Total, Redisturbed, and New Surface Disturbance (in acres)

Disturbance Type	Public Lands	Private Lands	Total
Tailings Impoundment Area			
Redisturbed Land	78	163	241
New Disturbance	45	169	214
Total Disturbance	**123**	**332**	**455**
Tailings Impoundment Area Soil Stockpiles			
Redisturbed Land	9	0	9
New Disturbance	9	21	30
Total Disturbance	**18**	**21**	**39**
Open Pit			
Redisturbed Land	11	90	101
New Disturbance	0	10	10
Total Disturbance	**11**	**100**	**111**
East Waste Rock Disposal Area			
Redisturbed Land	8	0	8
New Disturbance	105	17	122
Total Disturbance	**113**	**17**	**130**
East Waste Rock Disposal Area Soil Stockpiles			
Redisturbed Land	2	0	2
New Disturbance	5	0	5
Total Disturbance	**7**	**0**	**7**
West Waste Rock Disposal Area			
Redisturbed Land	15	0	15
New Disturbance	1	0	1
Total Disturbance	**16**	**0**	**16**

Table 2-1 (Continued)

Disturbance Type	Public Lands	Private Lands	Total
North Waste Rock Disposal Area			
Redisturbed Land	10	5	16
New Disturbance	11	17	28
Total Disturbance	**21**	**22**	**43**
Lean Ore Stockpile			
Redisturbed Land	1	20	21
New Disturbance	0	0	0
Total Disturbance	**1**	**20**	**21**
Plant Facility[1]			
Redisturbed Land	74	0	74
New Disturbance	0	0	0
Total Disturbance	**74**	**0**	**74**
Haul Roads			
Redisturbed Land	34	8	42
New Disturbance	3	1	4
Total Disturbance	**37**	**9**	**46**
Access Roads			
Redisturbed Land	7	33	40
New Disturbance	0	0	0
Total Disturbance	**7**	**33**	**40**
Diversion Structures			
Redisturbed Land	19	12	31
New Disturbance	0	0	0
Total Disturbance	**19**	**12**	**31**
Miscellaneous Areas[2]			
Redisturbed Land	86	0	86
New Disturbance	0	0	0
Total Disturbance	**86**	**0**	**86**

Table 2-1 (Continued)

Disturbance Type	Public Lands	Private Lands	Total
Freshwater Storage Facility and Access Road			
Redisturbed Land	4	0	4
New Disturbance	0	0	0
Total Disturbance	**4**	**0**	**4**
Total Area Disturbed			
Redisturbed	358	331	690
New Disturbance	179	235	414
Total	**537**	**566**	**1,103**

[1]Mill plant sites, substation, reagent building, primary crusher, process water storage, concentrate storage, thickener facility, coarse ore stockpile, administration building, offices, shops, storage, assay lab, septic system.

[2]Outlying areas around pit, plant area, and waste rock disposal areas.

Minor difference in totals due to rounding.

and an existing county road (see Figure 1-2). No new disturbance would be associated with power, water, or access components of the project. Additional information can be found in Alta's Plan of Operations (POO) and Hydrogeological Study Report, which are on file at BLM's Las Cruces District office.

2.2.2 Land Status And Disturbance

The re-establishment of the Copper Flat Mine would affect 690 acres of previously disturbed and 414 acres of newly disturbed land (Table 2-1). Overall, the Copper Flat Project would affect approximately 537 acres of public land and 566 acres of private land (Figure 2-1, Table 2-1). Approximately 63 percent of the area needed for the Proposed Action has been disturbed by prior operations, and approximately 90 percent of the ore would be mined from privately-owned land.

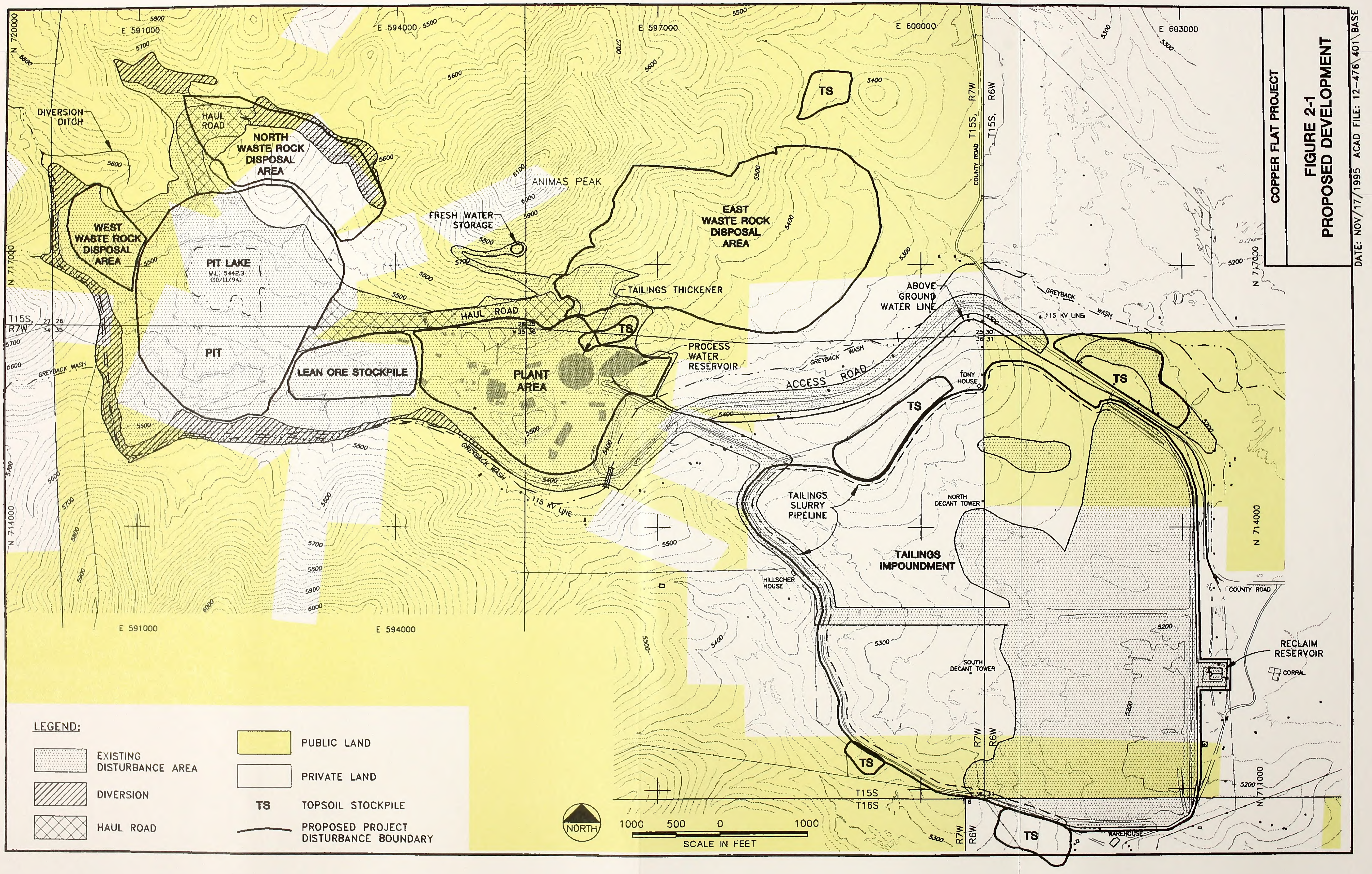
Portions of the waste rock disposal areas, and the crushing facility and the mill facility would be located on public land. Approximately 27 percent of the tailings impoundment and 10 percent of the open pit would be located on public land.

2.2.3 Mining Operation

The mining of new ore would entail expansion of the existing pit. The ore body at Copper Flat is exposed at the surface and would be mined by conventional front-end loader and shovel open-pit methods in a manner similar to the previous operation. The mine would operate on two 10-hour shifts, 5 days per week, 50 weeks per year. Over the life of the project, the mine would produce approximately 60 million tons of copper ore, 51 million tons of overburden, and 11 million tons of low grade copper ore (less than 0.18 percent copper). If economically feasible, the low grade ore would be processed during operations or at the end of the mine life. The operation would process 16,500 tons per day of ore through the copper sulfide flotation mill using standard technology similar to that of the previous operation.

The mining operation would produce an estimated 5.76 million tons of copper ore and 1 million tons of low grade copper material annually. Overburden and tailings production is estimated to be 6.5 million and 5.7 million tons per year, respectively. An operational life expectancy of approximately 11 to 13 years is projected at this time.

Pre-production stripping of overburden was completed in 1982 during the previous operation. Approximately 3 million tons of overburden were stripped and over 1.2 million tons of ore were mined from the existing pit during previous mining operations. Under the Proposed Action, the Copper Flat ore body would be mined by a 20-foot high, multiple bench, open pit method. The existing pit would eventually be enlarged to 2,400 feet by 3,000 feet with an ultimate depth of 800 feet. The area of the pit would be expanded from 101 acres to 111 acres. The existing diversion of Greyback Wash south of the pit would not be altered with the proposed pit expansion. The working slope of the pit walls would average 1.0 horizontal:1.0 vertical (1H:1V). Safety benches would remain at 80-foot intervals, and the overall final pit slope would be about 1.1H:1.0V. There is no plan to backfill the pit, although some of the overburden would be used for pad preparation, plant site development, and in connection with the reclamation of disturbed area.



COPPER FLAT PROJECT

FIGURE 2-1
PROPOSED DEVELOPMENT

DATE: NOV/17/1995 ACAD FILE: 12-476\401\BASE

Material from the pit would be drilled and blasted, loaded, and hauled to the primary crusher, and then conveyed to the process mill, where the mineral values would be removed by conventional flotation processes. Overburden would be placed on the ground surface as discussed in Section 2.2.5, Waste Rock Disposal and Lean Ore Pad.

Blasting would be limited to daylight hours and monitored by licensed blasters. Vehicular traffic on adjacent roads would be halted during blasting. Rotary diesel-driven drills would be used for blast hole drilling. A small, rubber-tired, compressed-air operated wet drill in conformance with Mining Safety and Health Administration (MSHA) requirements would be used for secondary breakage when required. Safe seismic disturbance and air blast limits would be established to prevent damage to buildings.

Blasting agents would be stored in a secured area in compliance with applicable MSHA regulations. Ammonium nitrate and diesel fuel would be stored on-site in bins and tanks. Detonators, detonating cord, boosters, caps and fuses would be stored apart from the batch plant area in secured separate magazines in accordance with the MSHA regulations for explosives. The storage location for each of these facilities would be in previously disturbed areas between the plant site and the pit; safety and security would be the main factors considered in their final location.

Rock samples would be taken from blast holes. Based upon the assay values of these samples, the broken rock in the pit would be classified as "ore" or "waste." It would be loaded onto end-dump haul trucks for transport to either the primary crusher, low grade stockpile, or waste rock disposal area depending on the assay classification.

Loading of both ore and overburden would be accomplished by using diesel-powered hydraulic shovels or front-end loaders. During the first years of operation, ore and overburden haulage would be handled by a fleet of 7 end-dump, diesel-powered haulage trucks of 85-ton capacity. Additional units would be added to the fleet as the pit is deepened.

Noise from the mine equipment would comply with and would be regulated under MSHA. Mining equipment would be fitted with mufflers, spark arresters, and engine enclosures to reduce noise and fire potential.

A 12.8-acre lake currently is located in the existing pit. The pit bottom was at about a 5,380-foot elevation at closure in 1986. Original ground surface elevation at the pit was approximately 5,580 feet. The water level elevation in the pit lake is about 5,420 feet, therefore, pit dewatering would be necessary prior to mining and continuously throughout the life of the mine. Minor underground work in 1976 indicated that groundwater in the pit area is localized in larger fractures. Inflow to the pit during the previous operations ranged from 50 to 75 gallons per minute (gpm). As a result of seasonal precipitation, the pit water level would fluctuate by 1 to 5 feet per year, however the water in-flow into the pit of approximately 75 gpm would be used for recharging the plant water system and dust suppression on the roads and dumps, thereby reducing pit water levels overall. If necessary, pit water could be temporarily stored in a reservoir in the plant area. Water removal from the pit would continue over the operational life of the mine at an approximate rate of 75 gpm through a sump or series of sumps located within the pit. Water removal would end once mining of the pit was completed.

The quality of the water currently collecting in the pit appears to be impacted by oxidation of minerals exposed in the pit wall through contact with water. Pit water samples collected between 1991 and 1994 exhibited variable pH in the range of 4.4 to 7.8 and sulfate concentrations between 2,390 and 2,857 mg/l. Concentrations of sulfate, fluoride, calcium, cadmium, and manganese were elevated.

Sampling of the pit water quality after mine closure would be a part of any ongoing monitoring program. Analytical sample results from early mining activity and recent studies would be used to calculate predicted background water quality. Pit wall materials have been collected for static acid base accounting tests and kinetic testing.

The ultimate depth of the pit is estimated at 800 feet at an elevation of 4,780 feet. After pit dewatering activities end, a lake would reform as recharge refilled the local cone of depression developed from dewatering. The pit lake would eventually be approximately 640 feet deep and cover about 75 surface acres. The size of the lake would fluctuate depending on precipitation and evaporation rates. At an average evaporation rate of 65 inches per year, the maximum water loss from the pit lake would be about 600 acre-feet per year. Refilling of the pit would proceed over a number of years at a predicted recharge rate of 50 to 75 gpm or 80 to 120 acre feet per year. Approximately 140 years would be required for groundwater levels to achieve pre-mining levels.

2.2.4. Haul Roads and On-Site Service Roads

For the most part, existing haul roads would be utilized to haul material to the crusher, stockpiles, and waste rock disposal areas. Some minor realignment of these roads may be necessary and road widths would vary. However, haul roads are not expected to create new disturbances, as they would be constructed on previously disturbed land. The on-site roads would be designed for easy access and traffic movement within the operations area. Waste rock and ore would be hauled to the disposal areas and mill using 85-ton (net load) haul trucks.

During operation of the Copper Flat Project, water trucks would be used, as needed, to control emissions of fugitive dust from the haul roads, as well as other roads within the project area. Wetting agents and binding agents, such as magnesium chloride, also may be used, if conditions warrant, to further control dust emissions.

2.2.5 Waste Rock Disposal Area and Lean Ore Pad

Overburden and interburden disposal areas would be located west, east, and north of the pit area in areas used for waste rock disposal area during the previous mining operation (Figure 2-1). These dumps would be expanded under the Proposed Action to disturb approximately 210 acres. Prior to the expansion of existing dumps into previously undisturbed areas, reclamation materials would be removed and stockpiled for future use in reclamation. Since a large portion of the dump expansions would occur on previously disturbed areas, the amount of reclamation materials available for prestripping in these areas may be limited. Water erosion controls, such as berms and diversion ditches, would be installed to divert runoff away from waste rock disposal areas. Water diversion ditches would also be used to control water inflow onto waste rock disposal piles containing partially oxidized and unoxidized material.

By the end of the mine life, the height of the largest disposal area, the East Waste Rock Disposal area, would be 80 feet higher than present at an elevation of 5,640 feet above sea level. Waste rock disposal areas would be designed to facilitate regrading during reclamation, however other constraints may require that portions of dumps be constructed in lift heights other than those corresponding to the vertical separation between slope breaks on the final slope faces. The dumps would be regraded and surface runoff velocity dissipaters would be constructed to reduce velocities and minimize undue erosion and soil loss. Exact design parameters which are specific to the site climatology and soil conditions would be ascertained during revegetation testing and concurrent reclamation activities. Final determination of lift heights will be based on final approval of the Reclamation Plan by NMMARD. Total material contained in the disposal areas at the end of the expected life of the project would be approximately 51 million tons.

The lean ore pad where low grade ore would be stored prior to processing would be located immediately southeast of the open pit and include about 11 million tons of rock assaying less than 0.18 percent copper. This low-grade ore stockpile is expected to be milled at the end of the mine life.

Particulate dust from the waste rock disposal areas and lean ore stockpile would be controlled by wetting the area down as prescribed by MSHA, NMED - Air Quality Bureau, and State Mine Inspectors Office (MIO) regulations.

Total surface runoff from the waste rock disposal areas using a 25-year storm, 24-hour precipitation of 2.9 inches was estimated (Sergent, Hauskins & Beckwith [SHB] 1981). Runoff from the waste rock disposal areas and the lean ore pad would be controlled by diverting the runoff water into a collection ditch and then recycling it into the process water system. No discharge is expected to occur. The final grading plan for the dumps would be designed to eliminate surface water run-on, enhance runoff, reduce infiltration, reduce visual impacts, and facilitate revegetation through back-grading or crowned grading. Small 10-foot wide catch benches would be left in place to interrupt surface sheet flow.

Under the Proposed Action, the partially oxidized (transitional materials) from the pit would be segregated into areas to the west and north of the pit (see Figure 2-1). The dump to the east of the pit area would contain only unoxidized waste rock. To minimize oxidation potential, waste rock disposal areas would be capped with a layer of compacted material and suitable reclamation materials, revegetated.

Two additional monitoring wells would be installed along the toe of the East Waste Rock Disposal area to monitor groundwater quality downgradient of the area.

2.2.6 Ore Processing

Ore from the pit would be trucked to the plant area located to the east of the pit (Figure 2-1). The ore would be crushed and ground, and organic reagents would be added to create a froth and cause the copper minerals to adhere to the bubbles (see Table 2-2 for a list of reagents used). The copper-laden froth would

Table 2-2

Copper Flat Project Materials Management

Reagent	Chemical Composition	Chemical Abstract Service (CAS#)	Type	Use	Annual Quantity (lbs)	Storage[1]
Lime	CaO	1305-62-0	Caustic powder; Non-Combustible solid; incompatible with acids	pH Control	15,700,000	Area 1
Xanthate Z-11/Z-200	NaROC(S)SH	140-93-2	Fugitive dust potential	Flotation Reagent	58,000	Area 1
AEROFLOAT 238 (Sodium Hydroxide)	NaOH	001310-73-2	Caustic alkali liquid; corrosive; incompatible with strong oxidizing agents and mineral acids	Flotation Promoter	116,000	Area 1
MIBC (Methyl isobutyl carbinole)	$(CH_3)_2COOCH\text{-}(CH_3)CH_2CH(CH_3)_2$	108-11-2	Class II combustible liquid	Moly. Frother	116,000	Area 3
Ammonium Sulfide[2]	$(NH_4)_2S$	12135-76-1	Poison, corrosive, flammable liquid; incompatible with numerous chemicals[3]	Flotation Reagent	1,400,000	Area 2
Unnamed Flocculent (similar to SUPERFLOC polyacrylamide or acrylamide-acrylic)	$(CH_2CHCONH_2)_x$	--	Organic Polymer	Flocculent Thickener	17,400	Area 1
AERODRI 100 (Ethanol, Sodium dioctyl sulfosuccinate, 2-Ethylhenanol)	C_2H_5OH $C_8H_{17}OOCH_2$-$CH(SO_3Na)COOC_8H_{17}$ C_2H_5-Henanol	000064-17-5, 000577-11-7, 000104-76-7	Flammable liquid; incompatible with strong acids, alkalines, and strong oxidizing agents	Filter Aid Dewatering Aid	92,800	Area 1
Sodium Hydrosulfide[3]	NaSH.2HOH	16721-80-5	Highly corrosive; incompatible with chemicals listed for ammonium sulfide	Flotation Reagent Depressant, Cation Exchange	1,400,000	Area 2

Table 2-2 (Continued)

Reagent	Chemical Composition	Chemical Abstract Service (CAS#)	Type	Use	Annual Quantity (lbs)	Storage[1]
Fuel Oil (Diesel #1) Dryer Fuel (Diesel #1)	C_xH_{2x+2}	8008-20-6	Flammable liquid	Moly. Collection, Truck Operation	150,000	Area 3
Sulfuric Acid	H_2SO_4	7664-93-9	Strong Acid	Lab Use	<100	Area 4

[1]Storage areas are segregated according to chemical groups and compatibility requirements:

Storage Area 1 would contain lime, xanthates, Aerofloat 238, and flocculants; Storage Area 2 will contain ammonium sulfide, and sodium hydrosulfide; Storage Area 3 would contain Flammables, Aerodri 100, MIBC, fuel oil (Diesel #1), and Diesel #2; and Storage Area 4 would contain laboratory chemicals.

[2]Either ammonium sulfide or sodium hydrosulfide would be used as a flotation reagent.

[3]Chemicals include acids, alcohols, carbonates, esters, halogenated organics, ketones, organic sulfides, aldehydes, amides, combustibles, flammables, hydrazine isocyanates, organic peroxides, phenols, nitrites, organic nitro compounds, organophosphates, explosives, polymerizable compounds, epoxides, and oxidizing agents.

be collected and filtered to form a concentrate. The proposed plant would be a sulfide-flotation plant similar to that originally constructed at the site by Quintana Minerals (Copper Flat Partnership) in 1982 and would be typical of plants used at other similar deposits. No leaching processes, including cyanide leaching, would be used.

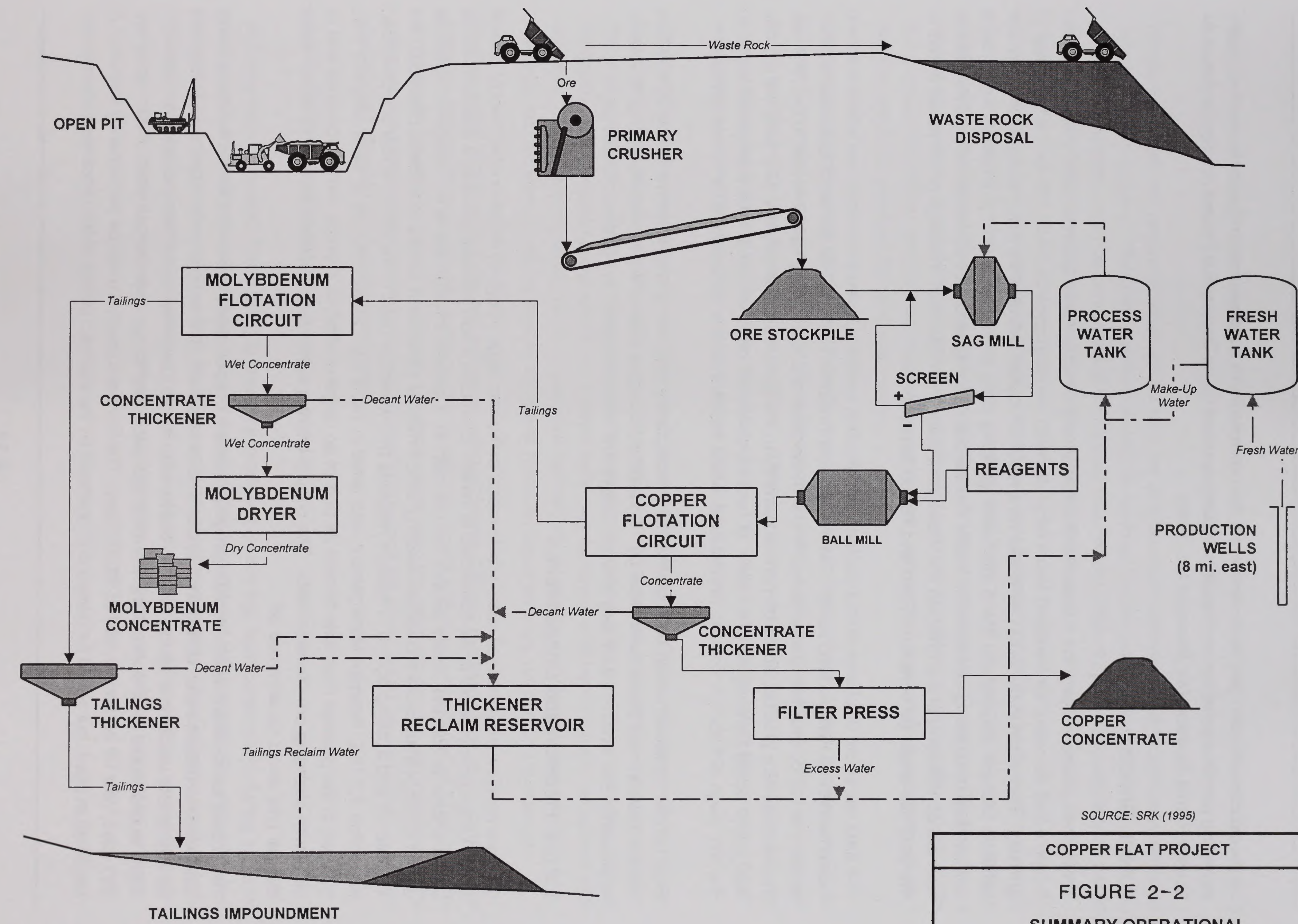
The plant facilities would be constructed at the site of the original plant and are expected to use most of the original foundations. The plant site would occupy approximately 74 acres and would be located between the open pit and the tailings impoundment area (Figure 2-1). The plant site area would incorporate the following primary structures:

- Primary Crusher
- Coarse Ore Stockpile
- Concentrator Building
- Thickener Facility
- Process Water Storage Area
- Reagent Building
- Electrical Substation
- Administration Office
- Mine Office/Change House
- Assay Office
- Truck Shop/Warehouse
- Small Vehicle Shop
- Gatehouse

The sulfide flotation plant would be designed to process between 5.2 and 5.8 million tons of ore per year at a nominal throughput of between 15,000 and 16,500 tons per day. The flowsheet of the mill circuit is included as Figure 2-2. Scheduled operating time for the mill would be three 8-hour shifts per day, 7 days per week, for 350 days/year. Salable products would be copper concentrate and molybdenum concentrate. The copper concentrate would be shipped by truck to a refinery. Gold and silver would be recovered as by-products of the hydrometallurgical refining process at the refinery. Molybdenum concentrate would be filtered, dried, packaged in drums, and shipped directly in trucks to purchasers for further refining.

2.2.6.1 Primary Crushing Facilities

The primary crusher would be located about 2,500 feet east of the pit. Ore hauled from the pit would be dumped into a 42- x 65-inch gyratory crusher that would crush the mine run rock to a nominal size of less than 8 inches in diameter. Truck dumping would be controlled by a primary crushing station operator, who would view the crushing chamber from an elevated control room adjacent to the dump hopper. A control light standard and alarm, which would advise truck drivers of dumping conditions, would be installed. Crusher discharge would be fed by apron feeder onto a belt conveyor for transport to the coarse ore stockpile located near the mill. Delivery of ore by truck would be on a 3-shift-per-day, 7-day-per-week schedule with extra delivery from a nearby surge stockpile with a front-end loader. Storage capacity of the coarse ore stockpile would be about 35,000 tons. The crusher would be located below ground level to limit



SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE 2-2

SUMMARY OPERATIONAL FLOW CHART

DATE: OCT/26/1995

noise and contain dust. Dust emissions would be controlled with suppressants and water to meet air quality operating permit stipulations and health standards as cited in the Copper Flat Project Application for an Air Quality Permit Revision (Air Sciences Inc. 1995).

2.2.6.2 Grinding

Three draw chutes beneath the coarse ore stockpile would direct ore onto apron feeders which would feed it onto a belt conveyor for transport into a large diameter semiautogenous (SAG) mill for the first stage of grinding. Reduction in the SAG mill would be a result of impact between the ore chunks themselves and between the ore chunks and the 5-inch steel grinding balls used in the mill. Reduction would be a combination of crushing and attrition. Water and various reagents would be added to the SAG mill feed to start the conditioning of the ore pulp for subsequent stages of treatment. Tonnage of the primary feed to the SAG mill would be between 15,000 and 16,500 tons per day.

The SAG mill would discharge onto a double deck vibrating screen. Undersize crushed ore from the screen would report to a cyclone feed sump. The oversize ore would be taken by belt conveyor to a cone crusher, where it would be crushed to less than 0.75-inch in diameter and returned by belt conveyor to the SAG mill. Intermediate size product would be returned directly to the SAG mill by conveyors. Ore from the cyclone feed sump would be pumped to a cluster of hydrocyclones for material sizing. The fines would report to the first stage of flotation, and the oversize ore would report to two large ball mills for further grinding.

Dust control measures would be implemented in compliance with the air quality permit issued by the New Mexico Environment Department (NMED). Control technologies utilized would vary according to specific applications but would include bag houses, sprays and mists, foggers, and enclosed buildings.

2.2.6.3 Flotation and Concentration

Cyclone overflow from the feed sump would report to the first stage (rougher) flotation which would consist of ten 1,500-cubic-foot cell tanks connected in series. Each tank would be equipped with a mechanism that would agitate or stir and induce air into the ore pulp as it passed through the tank. Reagents would be added to the pulp to cause the copper-bearing sulfide mineral particles to adhere to bubbles created by the induced air and frothing agents. Flotation reagents that would be used in the concentrator are described in Section 2.2.12.2, Reagent Management, and listed in Table 2-2. Small amounts of other reagents may be used in the process from time to time as part of an ongoing effort to improve metal recoveries and to cope with changing ore characteristics. The copper-bearing sulfide-laden bubbles would rise to the top of the cell and would be skimmed off.

The copper concentrate, which would average 28 percent copper, would be de-watered in a settling facility (thickener) to decant water, disk-filtered, and stored for shipment. The copper concentrate would be loaded by a front-end loader into 25-ton covered trucks with 10-ton towed trailers for transportation to a smelter. Eight trucks would haul concentrate from the site each day for an approximate total of 271 tons/day, 350 days/year for an annual total of 98,000 tons. The front-end loader would be permanently stationed at the filtration plant, but would be owned and operated by the contract carrier of the processed concentrate.

Tailings from the copper flotation circuit would continue through the molybdenum flotation circuit where it would undergo a flotation process similar to that described for the copper flotation circuit.

Filtrate from both the copper flotation circuit and the molybdenum flotation circuit would be returned to concentrate thickeners. Thickener overflow would be returned to the plant reclaim water system. No smelting or refining would be conducted at the Copper Flat Project. The molybdenum concentrate would also be dried prior to packing into 55-gallon drums for shipment.

The crushing and concentrating plant complex would also include ancillary buildings such as offices, a truck shop, a substation, and a gatehouse. The ancillary buildings would all be prefabricated, standard, rigid-framed structures. The administration building would be approximately 60 feet by 120 feet with a 12-foot eave height. The building would have central heating and air conditioning and would accommodate the plant administration, engineering, accounting, secretarial, and clerical personnel. Appropriate sanitary facilities would be provided for men and women.

The assay and laboratory offices would be 32 feet by 126 feet. Appropriate sanitary facilities would be provided. A small air compressor would be mounted on an exterior concrete pad for furnishing service air to the building. The gate house building would be 8 feet by 12 feet. A parking area for employee vehicles would be located adjacent to the main plant entry gate. The shop and warehouse building would be an equipment-servicing facility. The reagent building would be a 60-foot by 72-foot building.

All mechanical, civil, structural and architectural designs would be in accordance with applicable standards and codes. The criteria used for design, equipment selection, layouts and construction were derived from the prior operation of Quintana Minerals and information from vendor and consultant recommendations. Equipment and fabricated items would be furnished with manufacturers' standard finish and retouched after erection. Safety painting would be in accordance with MSHA standards and New Mexico mining codes. Buildings and facilities would be painted in neutral colors to blend with the surrounding landscape.

Surface runoff at the project site was estimated using a 25-year, 24-hour duration storm of 2.9 inches. The plant site surface drainage has been designed to contain or control a 24-hour precipitation of 2.6 inches with a maximum 1-hour intensity of 2.0 inches. Surface runoff from the area around the administration/mine office, concentrator, assay building, reagent storage and tailings thickener would be controlled by surface grading and directed to a containment pond.

2.2.7 Tailings Impoundment

Alta proposes to expand the existing tailings impoundment facility that was constructed during previous mining operations (Figure 2-1). Tailings would be transported from the mill via slurry pipeline and deposited in the existing impoundment. Ancillary facilities associated with the tailings impoundment facility would include a tailings slurry delivery system, a tailings solution reclaim and recycling system, an embankment seepage return system, groundwater monitoring wells, and an embankment stability monitoring system.

A total of 69 million tons of tailings (including tailings from 11 million tons of low grade ore) are expected to be impounded over the life of the project. Tailings deposition would be at the rate of approximately 16,300 dry tons per day at a density factor of approximately 50 percent solids by weight. During progressive settlement, water would be decanted from the tailings impoundment and returned to the process circuit. The expected water recovery by reclaim systems would be 70 percent.

2.2.7.1 Tailings Impoundment Design

A tailings impoundment facility was constructed by Quintana Minerals to serve their 1982 mining operation. The impoundment received 1.2 million tons of material and was reclaimed in 1986. The tailings impoundment remains in place and is located southeast of the plant (Figure 2-1). The first phase tailings dam is also currently in place and permitted. The present disturbance in the impoundment area from previous mining activity totals 207 acres and gradually would be expanded over the life of the operation to approximately 454 acres. Prior to deposition of tailings, soils, and subsurface alluvial materials in the impoundment area would be removed and stockpiled for use during reclamation. Stockpiles would be graded and seeded with an interim seed mix to minimize erosion. Stockpile locations are shown on Figure 2-1. The embankment is constructed of relatively impermeable fill materials borrowed from within the impoundment area. A rolled-earth divider dike, trending east-west, separates the disposal area into two nearly equally-sized ponds.

The New Mexico State Engineers Office has the responsibility for the issuance of permits to construct and operate the tailings impoundment, along with approval to appropriate surface water within the impoundment. As designed, the tailings impoundment and tailings process is a permitted, non-discharge system. The existing permit for the existing dam would be revised and amended to provide for a total, new dam height of 200 feet necessary for the Proposed Action. As part of the revised permit, the dam's stability, drainage, and seepage collection system would also be improved.

The existing starter dam is about 6,600 feet in length and 50 feet high, and would be raised by 5 additional 30-foot raises. A 10- to 12-inch deep layer of alluvial material, locally sourced, would be placed over the front face of the lift and vegetated to provide erosion protection and additional stability, reduce fugitive dust, and provide conditions conducive to vegetation establishment. The surface of the tailings area would be kept wet by cyclone or spigot rotation and, if necessary to control dust, by sprinkling.

The facility is designed to contain at least 59 million cubic yards (69 million tons) of tailings and would be raised above the initial starter embankment by upstream construction methods using tailings material to a total height of 200 feet. This would involve the use of the coarser particles of tailings separated by deposition along the upstream beach of the impoundment. The tailings, consisting of the ground host rock of the mineralized zone and residual process reagents, would be a silty sand with some 55 percent fines. The solid fraction of the tailings is principally of a quartz monzonite and contains residual pyrite mineralization of about 2 to 5 percent, similar to ore levels.

The surface gradient of the impoundment is away from the dam. Surface runoff in and around the tailings facility would be contained by the impoundment. The runoff would become part of the reclaimed water

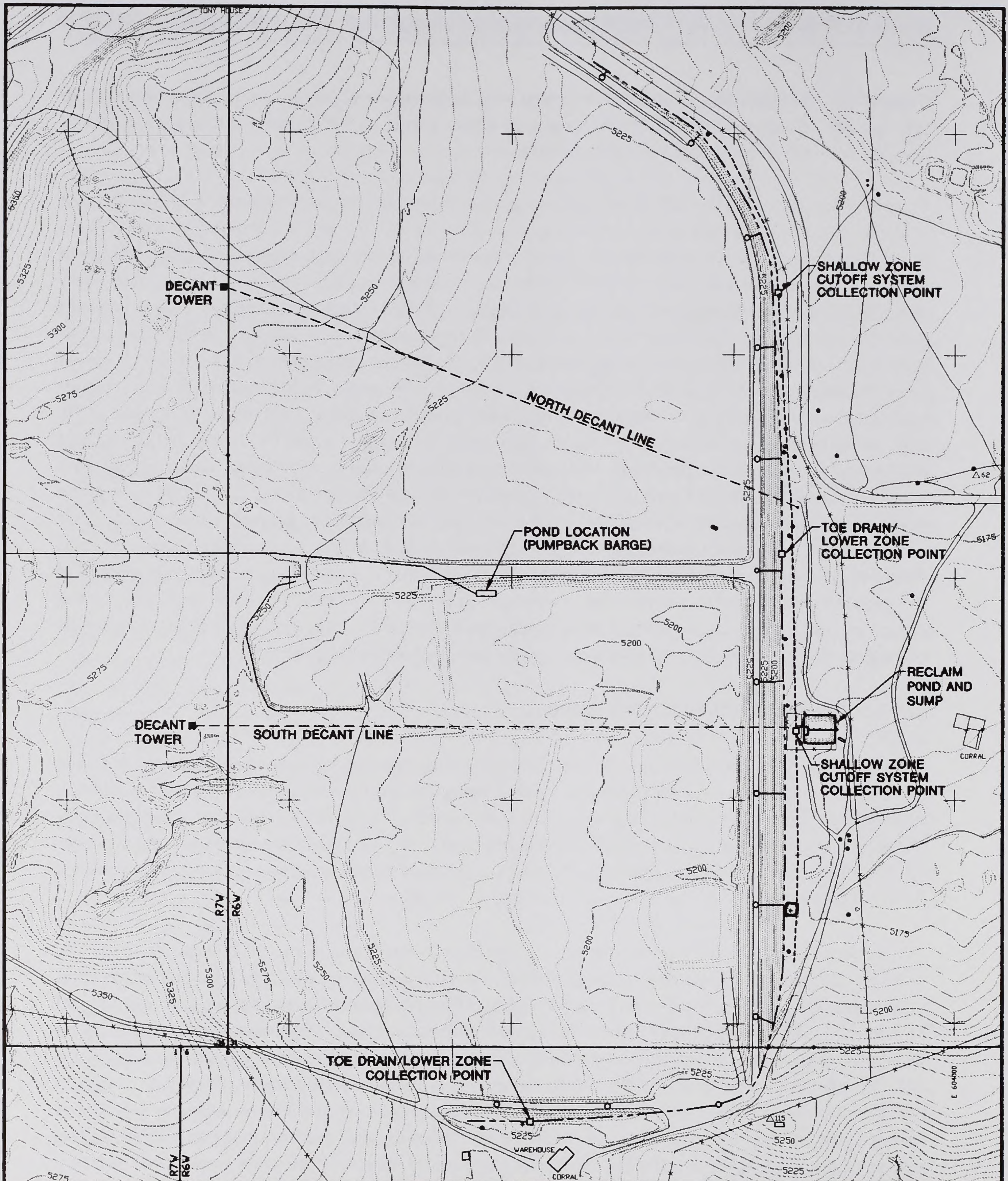
(Figure 2-3). Surface water pooled in the tailings impoundment would be removed using a barge pump arrangement. This water would be discharged by pipeline to a collection pond in the plant area and pumped back to the plant process water circuit.

To control seepage from the tailings impoundment, a series of collection wells and trenches would be put in place. A shallow recovery system of wells spaced every 50 to 100 feet along the eastern and portions of the northern boundaries of the existing starter embankment would intercept seepage within the upper seepage zone and recycle it back into the facility. Groundwater recovery wells would be installed every 250 to 500 feet along the east, north, and south boundaries of the existing starter embankment to intercept seepage recharging the lower zone (see Figure 2-4). The lower zone wells would be installed either on top of or at the toe of the starter embankment and would be constructed with a minimum of 100 feet of screen below the clay layer. Wells would be spaced closer together if necessary, to account for potentially higher seepage flows in portions of the impoundment as determined from monitor wells placed to the east of the dam. A lined drainage trench along the eastern base of the tailings dam would be constructed to intercept and control seepage under the dam. This facility may also be used for routing of flows pumped from interception wells to the pool area for recycling back through the mill operation. The pumpback system would intercept seepage infiltrating into the ground. Recovery of tailings water seepage would recycle water and decrease the amount of water pumped from the well field. Pumping would create an artificial head which would enhance the rate of tailings moisture drawdown and consolidation and allow final closure of the impoundment surface to occur earlier. Pumpback wells would also serve as monitoring wells and the system can remain in place following closure for long-term monitoring and water recovery. The final design of the collection system would be based upon water permit approval requirements.

2.2.7.2 Tailings Impoundments Process

Following the flotation process (Section 2.2.6.3, Flotation and Concentration), the remaining slurry, consisting primarily of non-valuable minerals, pyrite, and miscellaneous unfloated minerals, along with water, would flow into a tailings thickener for partial dewatering. The slurry would enter the tailings thickener at approximately 30 percent solids by weight, water would be removed by decanting, and the tailings would exit the thickener at 50 percent solids. Approximately 57 percent of the process water would be recovered in the tailings thickening operation.

The thickened tailings would then flow by gravity through a 24-inch pipeline into the tailings impoundment, which is currently divided into two storage ponds. To contain spills or leaks, the tailings impoundment pipeline would be constructed between earthen berms. The pipeline foundation materials and berms would be sloped to direct any spillage or leakage to the tailings impoundment. Thickened tailings slurry would be distributed around the periphery of the impoundment by numerous spigots feeding hydrocyclones, which separate coarse material from the fines in the slurry. The coarse material would be used to construct embankment raises in an upstream direction from the existing starter embankment, while the fine silt and slimes would be discharged from the upstream face of the upstream raise from multiple spigots. As this portion of the slurry flows into the impoundment, gravitational settlement of solids would form beaches. Supernatant solution and precipitation run-off would flow towards the impoundment low point formed by the beaches to form the free pool. Tailings deposition would be managed to force the pool away from the



LEGEND:

o LOWER ZONE PUMPBACK WELLS
- - - - TOE DRAIN AND PUMPBACK COLLECTION
-------- SHALLOW ZONE CUTOFF TRENCH

NORTH

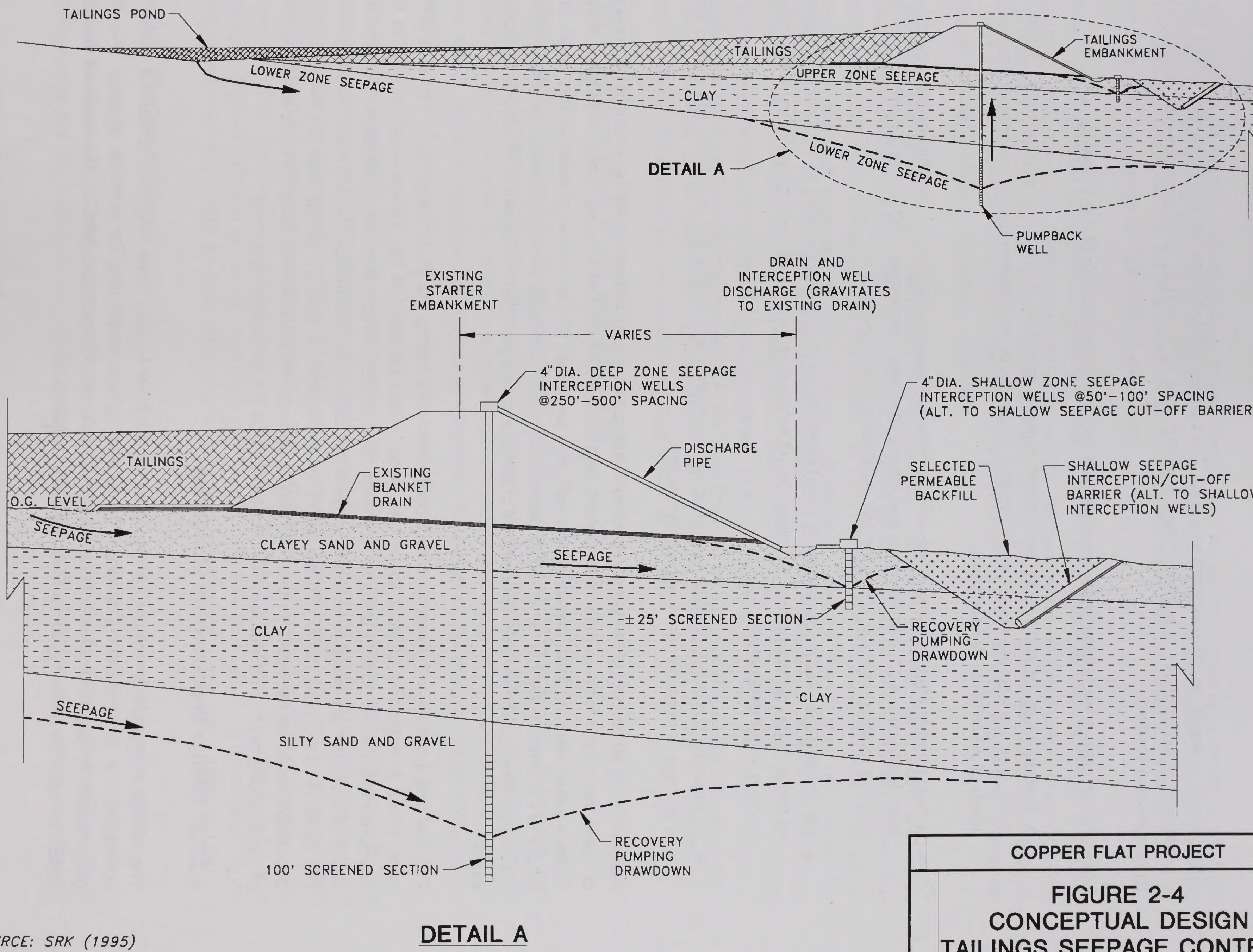
NOT TO SCALE

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE 2-3
TAILINGS IMPOUNDMENT DESIGN

DATE: NOV/17/1995 ACAD FILE: 476\401\SEEPSYS



SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE 2-4
CONCEPTUAL DESIGN
TAILINGS SEEPAGE CONTROL

DATE: NOV/1/1995 ACAD FILE: 476\SEEP-CON embankment towards an ultimate pool location. The tailings used to form the initial beaches would have a coefficient of permeability of approximately 0.000001 (1×10^{-6}) cm/sec, after consolidation occurs, due to progressive loading.

Measures proposed for tailings water management include a combination of the following:

- A floating barge/pump facility and return pipeline capable of pumping approximately 1,500 to 2,750 gpm back to the plant. Initial location would be in the western half of the original borrow pit south of the original divider berm.

- A fixed pumping facility to recycle externally collected seepage water back into the impoundment, i.e., from seepage cut-off, blanket drain and interception well discharges (500 to 1,000 gpm). Use of the existing reclaim reservoir sump for this application is proposed.

- Maintaining the existing decant towers and pipelines as emergency facilities, to be used in the event of barge pump power outage or failure during extreme storm periods, and possibly as post-closure surface water dissipators.

- Maintaining the existing reclaim pond as an emergency spill facility, i.e., non-lined, to be used only if spillage is essential for impoundment safety.

Approximately 66 percent of the water reporting to the tailings impoundment would be decanted off the pool of water that would form in the impoundment, and returned to the mill process water system for reuse. Surface water resulting from precipitation could also contribute to the volume of water in this pool. The height of the embankment is designed to contain the normal operating volume of water completely within the impoundment, combined with the amount of surface water runoff from the 24-hour, 100-year precipitation event.

The size and location of the impoundment pool would vary during the life of the project. The size of the pool, which is expected to be 5 to 10 feet deep, would be affected by predeposition grading in the impoundment, the amount of tailings deposited, precipitation, evaporation rates, seepage rates into the designed embankment seepage collection system, infiltration into underlying soils, and water recycling rates. The location of the pool would migrate within the impoundment area as tailings beaches form. Tailings deposition would be managed to force the pool away from the embankment toward the upstream reaches of the impoundment. The impoundment area would be fenced to restrict access.

2.2.7.3 Tailings Impoundment Monitoring

The tailings impoundment would be regulated by the New Mexico State Engineers Office for safety of operations. A Groundwater Discharge Permit that entails monitoring for possible seepage into the groundwater is required from the New Mexico Environment Department (NMED), Groundwater Bureau; NMED is currently reviewing Alta's Discharge Plan application.

The design and operation of the tailings impoundment dam would be subject to approval of the State Engineers Office including the closure inspection. The State Engineers Office requires monthly reports of the tonnages deposited into the impoundment along with readings of the piezometers, settlement devices, and settlement monuments that indicate movement.

The Groundwater Bureau of NMED requires a monthly report of tonnages of tails discharged along with analyses of the tailings to identify possible contaminants. Samples of water from a group of monitor wells downstream of the tailings dam would be analyzed monthly and the results sent to the Groundwater Bureau. These samples would identify any seepage from the tailings pond. Abatement plans would be implemented should leakage and contamination be detected.

Since late 1991, the wells and intermittent surface water sources along Greyback Wash, along with the pit and tailings decant seepage have been sampled at least quarterly. Results from these tests have been forwarded to the Groundwater Bureau of NMED. In 1993, numerous water samples were collected for expanded chemical analyses by Inter-Mountain Laboratories, Inc., of Farmington (Shomaker and Newcomer 1993). The analytical results were incorporated into a recent hydrologic assessment and have been forwarded to NMED. SRK also implemented a series of testing programs associated with the pit and tailings impoundment areas, including the installation of additional monitoring wells and additional pump tests. The results of this work are contained in the 1995 Copper Flat Mine Hydrogeological Studies report that is available at the BLM office in Las Cruces, New Mexico, and is summarized in Chapter 4.0 - Section 4.1.2, Water Quantity and Quality, and Appendix A of this EIS.

2.2.8 Project Work Force and Schedule

The construction phase of the project is expected to take approximately 12 to 18 months. During this time, the work force for development of the Copper Flat mine would average about 120 to 130 persons per day over the 12- to 18-month construction schedule and would generate a payroll of approximately $300,000 per month. Local procurement of construction materials and services would be in the order of $75,000 per month.

The estimated operational life required to recover the proven minerals (copper, molybdenum, gold, and silver) is 11 to 13 years. The maximum work force would be 170. Approximately 80 to 100 people would be employed in the office and mine; 40 to 70 people would be employed in the mill. The reclamation workforce would consist of up to 20 employees. Alta anticipates hiring over 70 percent of the work force from local communities within a 75-mile radius of the mine. Work would be conducted for 350 days per year with two 10-hour shifts per day at the mine (from 0600 to 1600 and 1600 to 2400), three 8-hour shifts at the plant, and one 8-hour (0800 to 1600, 1600 to 2400, and 2400 to 0800) shift in the office (0800 to 1700).

2.2.9 Electrical Power

Power for the project would be furnished by the Sierra Electric Cooperative by means of an existing 115-kV transmission line that runs from the Caballo switching station near the junction of Interstate 25 (I-25) and

Highway 152, and terminates within 300 feet of the mill facility at the site of the proposed mine substation (Figure 1-2).

The 115-kV line was installed for the 1982 mine due to the limited capacity of the existing lines in the area, which supplied the community of Hillsboro and the surrounding rural areas. The existing 115-kV line is a wood-pole, H-frame construction and would be in full accordance with State and Federal electric codes. Plains Electric owns the line and is responsible for maintenance. The substation would be reconstructed in the same area as it was in 1982, and fenced and constructed in accordance with BLM stipulations. Alta would own the substation equipment and would be responsible for construction and maintenance. From the substation, the voltage would be stepped down by primary transformers and distributed throughout the mine site via an existing buried conduit system.

An existing 25-kV distribution line provides power to the production wells located east of the mine, booster stations on the fresh water pipeline, and the reclaim water pump stations at the tailings dam. Sierra Electric owns this line and is responsible for maintenance. The plant electrical load requirement is tabulated below:

	Demand (kilowatt-hours/ton)
Primary Crushing	0.25
Total Grinding	16.48
Total Copper Flotation	1.74
Molybdenum Flotation	0.27
Thickening	0.05
Reagent Handling	0.05
Water System	2.05
Ancillaries	0.65
	21.54

Because the configuration and size of the 25-kV distribution line would increase the potential for raptor electrocution in the mine area, standard raptor-proof protective designs would be incorporated into the line design and line upgrade, as presented in the Rural Electrification Administration guidelines and in the measures developed by Olendorff et al. (1981). This design would be used for the entire length of the distribution line within the mine area.

2.2.10 Water Supply

The total water demand for the project would be approximately 6,000 gpm with the majority of the water used in the mill operation. Of this, about 4,000 gpm would be obtained from pit dewatering, reclaimed process water and pumpback system water from the tailings impoundment, and approximately 2,000 gpm would be fresh water makeup from the production wells.

The freshwater supply for the mine would come from four existing high capacity production wells located about 7 miles east of the plant site on BLM land. These wells were drilled to depths of between 957 feet and 1,005 feet. All were 26 inches in diameter and were cased with 16-inch casing with the annular space packed with minus 3/8-inch washed gravel. The projected long-term capacities of the three production wells ranges from 1,000 to 1,800 gpm (Green and Halpenny 1976). These wells would be equipped with 400-horsepower, 6-stage vertical pumps that would discharge to the first of three booster stations. The wells would be operated in rotation with, normally, two on line at the same time. They would be operated by radio signals triggered by level sensors in the existing process water reservoir at the plant site which currently is buried to the east of the tailings thickener (Figure 2-1). The process reservoir was built during the previous mining operations and was buried during reclamation. It would be uncovered as part of the proposed project.

An existing 20-inch welded steel pipeline would transport the water from the booster stations. The pipeline is buried a minimum of 2 feet deep from the well field to the point of entry to the project area. Inspection in February 1990 found the line to be in excellent condition.

During the four months of operation in 1982, the total fresh water pumped to the plant from the wells was 265,578,200 gallons. Fresh water makeup demand was 792 gallons per ton of ore processed for the start-up month, and 167 gallons per ton for the remaining months of operation. Based on similar requirements, fresh water demand would be expected to be about 2,000 gpm for the Proposed Action.

Dewatering of the pit and reclaim water from the tailings impoundment is expected to provide about 400 to 800 gpm of the project's water requirements and reduce the amount of water withdrawn from the production wells. This water will generally be reused in processing and in dust suppression. The majority of the water from the pit would be used during construction for dust suppression and during operation to supplement run-off to Greyback Wash for riparian area maintenance, and would have little contact with acid-generating rock. Reclaim and pit water would be monitored during operation to verify that it meets all State and Federal requirements. If any problems are identified, use would be discontinued. Pump station #3 is located at the process water reservoir located below the tailings thickener. This station can deliver water to the process water reservoir or to the freshwater storage tank as needed. The process water reservoir is fed by the tailings thickener overflow, reclaim water pumped back from the tailings barge pump system, and fresh water makeup as needed. It is pumped from the reservoir to a steady head tank and flows by gravity back to the grinding circuit. The process water would be comprised of about 4,000 gpm of reclaim water and about 2,000 gpm of freshwater makeup. A sump and pumping installation would be advanced with the pit excavation to remove infiltrated and surface runoff water collected within the pit. This water would be used in either pit operations or the concentrator.

The area encompassing the mine, mill, tailings impoundment, and water supply wells is within the Lower Rio Grande Underground Water Basin. Water rights are described in declarations and supporting documents, under State Engineers Office File #LA-128, LRG-4648 through LRG-4652-S-17, and LRG-4654.

Water quality monitoring samples have been collected in the mine area from both surface and groundwater sources since 1976 and would continue to be collected throughout the life of the operation, during closure, and for a post-closure period defined in the groundwater discharge permit. Hydrologic data are available for examination at BLM and NMED offices.

2.2.10.1 Stormwater

Alta has filed a National Pollution Discharge Elimination System (NPDES) (stormwater) permit application with the Environmental Protection Agency (USEPA) as part of the American Mining Congress group permit application. The mining and concentrating process would not involve any discharge to surface water courses. Surface runoff (stormwater) from the mine and plant site area would be collected in containment (settling) ponds and recycled into the process water system. Stormwaters outside the plant and mine site would not come in contact with the proposed operation due to existing diversion ditches, dams, and berms.

Sediment control in the mine area would be achieved by the use of seeding and mulching, silt fences, straw bale dams, diversion ditches with energy dissipators, and rock check dams at appropriate locations during construction and operation. All sediment control structures would be monitored and maintained on a regular basis.

2.2.10.2 Groundwater

In 1982, the NMED, Ground Water Bureau, approved Ground Water Discharge Plan, DP-001. On June 26, 1992, the Ground Water Bureau confirmed the need to amend the permit, DP-001, in order to more closely define compliance and remedial actions.

Open well piezometers, which would monitor the stability of the tailings dam, are located downslope from the tailings impoundment and within the unsaturated zone to sample any possible seepage prior to reaching the groundwater. Groundwater monitoring would be conducted as required by the state. Monitoring stations have been installed at 500-foot intervals near the toe of the starter dike (Figure 2-3). In addition, existing wells downslope from the dam can be used as monitor wells. Any additional requirements for groundwater monitoring as required by NMED would be met. The surface and groundwaters of the Copper Flat area are described and analyzed in detail in the Hydrologic Assessment Report (Shomaker and Newcomer 1993).

2.2.11 Transportation

Vehicular access to the site is along State Highway 152 to the mine turnoff located about 10 miles west of I-25. Traffic associated with reestablishment of the Copper Flat Project would be broadly grouped as follows:

- Concentrate Shipments - Shipment of concentrates by trucks to smelters in El Paso, Texas, or in Hurley, New Mexico. Trucks would be hydraulic dump trucks with 25-ton capacity towing 10-ton trailers. Tonnage of concentrate produced yearly is expected to be 98,000 wet tons. At a 35-ton concentrate capacity per trip, this would require 8 trips per day on a 350-day production year. Concentrate loading stations would be constructed on the project site near the concentrator building. The concentrate loading station would be designed to minimize the emission of fugitive dust from concentrate transfer operations with the use of water and surfactants. Truck traffic would use I-25 and Highway 152 to access the mine site. Concentrate haul trucks would use Highway 152 and I-25 to transport concentrate to El Paso, Texas, or Highway 152, I-25, State Highway 26, and US Highway 180 to Hurley, New Mexico. No traffic would be routed through Hillsboro. The potential routes for truck traffic are rated to handle the number and weight of the vehicles that would be used. Truck transport on any of these routes would comply with all applicable safety, environmental, and other requirements imposed by the State of New Mexico and U.S. Department of Transportation (DOT).

- Incoming Supplies - An average of 10 to 15 trips per day by trucks of vendors and equipment and service suppliers. Most deliveries, which would include equipment parts, reagents, oil, and miscellaneous office supplies, would be made during the day shift. Title 49 Code of Federal Regulations (49 CFR) regulates the transportation of hazardous materials in commerce. Anyone who offers for transportation, transports, packages, loads, unloads, or in any way assumes responsibility for marking, labeling, or handling of any regulated hazardous materials must comply with 49 CFR. In addition, carriers must comply with the Federal Motor Carrier Safety Regulations of the DOT (parts 383, 390-397, and 399). Hazardous materials required for operation of the Copper Flat Project include gasoline, diesel fuel, propane, and other petroleum products, explosives, solvents for degreasing of machinery and equipment, and laboratory chemicals. These materials would be purchased from various vendors and brought to the site by truck. Alta would ensure that the Hillsboro volunteer fire department and the Sierra County fire district are aware of the nature of the materials routinely being transported to the site, and that they have appropriate response training in the event of a spill or other accident involving hazardous materials.

- Employees and Visitors - It is expected that full operations would start up with 170 employees. The majority of employees are expected to commute from Truth or Consequences or Hillsboro. An additional 15 to 20 trips could be expected by visitors and sales representatives. Alta will encourage employee car pooling.

There are no present plans for a company-operated employee transportation system. No railroad access or facilities, airstrips, or helicopter pads are planned in connection with the mine development or operations.

2.2.12 Materials and Waste Management

Copper operations at the Copper Flat Project would result in the generation of nonhazardous and hazardous waste. The majority of waste would be "mine waste," including mill tailings and waste rock. The management of these wastes has already been discussed in Section 2.2.5, Waste Rock Disposal and Lean Ore Pad. The management of solid and hazardous waste is discussed in the following sections.

2.2.12.1 Sanitary and Solid Waste Disposal

Nonhazardous solid wastes that would be generated at the site include waste paper, wood, scrap metal, used tires, and other domestic trash. These materials would be disposed of in a permitted on-site Class III sanitary landfill on private land, which would be approved by the State of New Mexico, or by other methods approved by the State and Sierra County.

Sanitary liquid wastes would be handled and disposed of through two existing septic tanks/leach fields permitted by NMED. The septic systems would be slightly modified for the Proposed Action, including enlargement of the leach fields and placement of larger septic tanks. The washing facility for the mobile equipment would be equipped with a water/oil separator system. Waste oil and lubricants would be collected and transported off-site by a buyer/contractor for recycling. Reagent drums would be recycled by the reagent supplier. Scrap metal would be sold to a dealer and transported off-site.

Nonhazardous solid wastes from the laboratory would be disposed of in the landfill. Other wastes from the laboratory that exhibit a hazardous waste characteristic, including off-specification commercial chemicals and assay wastes, would be managed as hazardous waste (see Section 2.2.12.4, Hazardous Materials Management).

2.2.12.2 Reagent Management

Reagents used as part of the copper/molybdenum concentrating process would include frothers, flotation promoters, flotation collectors, flocculants, flotation reagents, pH regulators, and filter and dewatering aids (see Definitions, Abbreviations, and Acronyms section for definitions). These reagents would be delivered by truck from commercial sources to the mine site where facilities would be provided for off-loading, storing, mixing, handling, and feeding. A list of the types, use, and amounts of the reagents used on the site as part of the copper/molybdenum concentrating process is included on Table 2-2. Reagents that are received dry would be mixed in agitation tanks and pumped to either outdoor storage tanks or liquid storage tanks inside the mill building from which they would be metered into the concentrating process.

Residual reagent concentrations in the tailings and reclaim water streams are expected to be present at very low levels since they would be added to water in amounts resulting in concentrations of approximately 3 parts per million (ppm). Also, normally 95 percent of the reagents would be adsorbed onto the copper or molybdenum mineral surface and floated off in the mineral froth. The reagent would then be subsequently consumed in the off-site smelting process. Assuming 95 percent of the reagents are adsorbed, the residual reagent reporting to the tailings stream drops to less than 0.15 ppm. Monitoring of the tailings will be conducted by Alta as specified in the Groundwater Discharge Permit.

Frother reagents to be used at the mine include methyl isobutyl carbinol (MIBC). MIBC is biodegradable in low concentrations. The dosage rate would be 0.02 pound per ton of mill feed. The bulk of this reagent would report to the concentrate fraction and end up at the smelter. The reagent would be received in 20-ton capacity trucks and stored in a 16,000-gallon tank.

Lime used in alkalinity control in the flotation circuit would be received in pebble form in bulk by 20-ton capacity trucks and stored in a 200-ton capacity storage silo. The lime would then be slaked with water in a small mill and the resulting "milk of lime" would be pumped to the addition points in the grinding and flotation circuits for use as a pH regulator. Lime would be used at a rate of 2.7 pounds per ton of mill feed to control pH of the flotation circuit. During the milling process, most of the lime would react with sulfide minerals to form gypsum.

Either sodium hydrosulfide (NaSH) or ammonium sulfide would be added to the circuit process as a flotation collector and depressant to affect the copper molybdenum separation. These reagents are rapidly oxidized through contact with copper minerals and air bubbles entrained in flotation pulp and would be received in 500-pound drums either in liquid or dry pellet form. Pellets would be mixed with water and stored in tanks. Approximately 2,800 gallons of these reagents would be stored on-site at a time.

AEROFLOAT 238, used in flotation promoting, would be received in 50-gallon drums and have a plant storage capacity of 2,800 gallons. Flotation reagent Xanthate Z-11/Z-200 would also be used in the flotation process.

Number 1 diesel fuel would be used as a molybdenum collector and stored in one 5,000-gallon bermed above-ground tank located onsite. AERODRI 100, used as a filter and dewatering aid, would arrive onsite in 500-pound drums. The reagent would be fed directly from the drums into the milling process. Use of small amounts (<100 pounds) of sulfuric acid would be limited to the laboratory.

Potential reagent spills would be contained by curbs in the reagent mixing and storage areas. A floor sump pump would be used to return the spilled material either to the storage tank or into the milling process as necessary. Material Safety Data Sheets (MSDS) for the reagents to be used would be on file at the site.

2.2.12.3 Health and Safety and Emergency Response

The development of the Copper Flat ore body would comply with environmental, and health and safety regulations of all governmental agencies including Mining Safety and Health Administration (MSHA) and the recently enacted New Mexico Mining Act (1993). The State agencies primarily involved are the NMED, the State Mine Inspectors Office (SMIO), New Mexico Department of Energy, Minerals, and Natural Resources - Mining and Minerals Division (MMD), and the New Mexico State Engineers Office.

NMED has jurisdiction over ambient air quality, discharges to groundwater, surface water impacts, solid waste disposal, liquid waste disposal (sanitary facilities). The SMIO and MSHA have jurisdiction over health and safety within the mine; the State Engineers Office is concerned with the tailings dam construction, and operation, and water rights. The MMD is responsible for issuing a mining permit and is concerned with all issues related to the mining operation and reclamation.

As specified under SMIO and MSHA regulations, appropriate dust collection and noise abatement equipment would be installed at the mine. Noise levels in both the mine area and process area would also be subject to MSHA regulations.

All drinking water storage vessels would be enclosed in order to preserve the water's potable quality. Within the mine and mill area and the tailings impoundment, vehicular traffic and human movement would be controlled through the use of fences, locked gates, signs, and supervisory personnel. Fencing would also discourage access by cattle. Livestock grazing is currently permitted in adjacent areas at the permit holder's risk and would continue during mine operation in adjacent areas.

Air Emissions

The Copper Flat Project would be designed to control both gaseous and particulate emissions and to meet all regulatory standards (summarized in Chapter 4, Table 4-4). Combustion emissions would result from the mobile mining machinery and support vehicles. All combustion equipment emits nitrogen dioxide (NO_2) and carbon monoxide (CO). The mobile mining equipment is diesel-fueled and also would emit particulate matter. Combustion emissions would be controlled by original equipment manufacturer pollution control devices.

Fugitive emissions from ore and the flotation equipment are expected to be very small due to the low volatility of the sulphur compounds present in the concentrate. Emissions would not result in violations of national or State ambient air quality standards or of any applicable Prevention of Significant Deterioration (PSD) increments established pursuant to the Clean Air Act of 1977. NMED Air Quality Permit No. 365-M-1 was issued on December 6, 1991. A revision to the permit was filed by Alta in April 1995 and is still in the approval process.

Drilling operations would be done wet or with other efficient dust control measures as set by MSHA and NM Mine Inspection regulations. Air Quality Permit No. 365-M-1 specifies that haul roads, waste rock disposal areas, and ore transfer points are to be wetted down on a regular basis to minimize dust emissions. Dust abatement at the primary crusher, coarse ore stacker, and coarse ore reclaim feeders would utilize NMED and MSHA-approved Sonic Misting Systems (Best Available Control Technology).

The lime storage would be fitted with a baghouse for capture of fugitive dust during loading of the lime bin. The sample preparation lab would be equipped with fans and filters.

Deposition of tailings would be by spigot cyclone discharge which would build the dam on a continuous basis. By this procedure, the surface would be wet, thereby eliminating or reducing fugitive dust. As necessary, control of fugitive dust in the vicinity of the tailings pond would be attained by watering, sprinkling, and vegetation. No gaseous contaminants above allowable standards are expected to be emitted to the atmosphere from the proposed operations.

Fire Protection

As specified by MSHA, Alta would institute a fire protection training program and have a rehearsed fire suppression plan. A fire protection system would be installed that would incorporate Sierra County Code requirements in the administration and warehouse complexes, truck shop, crushing plant, and process plant. Hydrants would be located near all buildings. A 100,000-gallon fire water reserve would be stored in a water storage tank located sufficiently above and near the mill and crushing area to provide adequate water pressure. A fuel break would be constructed around the facilities. A fire truck and water trucks, used for dust suppression, would be available in the event of a fire. An ambulance would be located on-site in the event emergency transportation is required.

Alta would promptly comply with any emergency directives and requirements of Sierra County and the BLM pertaining to industrial operations during the fire season.

2.2.12.4 Hazardous Materials Management

The term "hazardous materials" is defined in 49 CFR 172.101; hazardous substances are defined in 40 CFR 302.4 and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) Title III. Hazardous materials and hazardous substances that are transported, stored, or used on-site or disposed of as part of the Copper Flat Project in quantities greater than 10,000 pounds per year are summarized in Table 2-2. Hazardous materials would be transported to the Copper Flat Mine by DOT-regulated transporters and stored on-site in DOT-approved containers. Spill containment structures would be provided for storage containers. Hazardous materials would be managed in accordance with regulations identified in 40 CFR 262 *Standards Applicable to Generators of Hazardous Waste*.

Hazardous materials and substances that may be transported, stored, and used at the Copper Flat Mine in quantities less than the Threshold Planning Quantity (TPQ) designated by SARA Title III for emergency planning would include blasting components, petroleum products, and small quantities of solvents for laboratory use. Small quantities of hazardous materials not included in the above list may also be managed at the Copper Flat Project; such materials are contained in commercially produced paints, office products, and automotive maintenance products.

Blasting components, including ammonium nitrate and diesel, would be stored onsite in bins and tanks, respectively. Detonators, detonating cord, boosters, caps, and fuses would be stored away from the batch plant in compliance with MSHA and New Mexico State Mine Inspectors regulations. Exact locations for these facilities have not been selected, however, safety and security would be the main factors considered in their locations.

Management of hazardous materials at the Copper Flat Project would comply with all applicable Federal, state, and local requirements, including the inventorying and reporting requirements of Title III of CERCLA, also known as the Emergency Planning and Community Right-to-Know Act.

All petroleum products, kerosene, and reagents used in the mill would be stored in above-ground tanks within a secondary containment area capable of holding 110 percent of the volume of the largest vessel in the area. A Spill Prevention, Control, and Countermeasure (SPCC) Plan addressing the general topics presented below would be prepared for all stored materials. The SPCC Plan would be reviewed and updated at a minimum of every 3 years and whenever major changes are made in the management of these materials. Inspection and maintenance schedules and procedures for the tanks, as well as all piping connecting the facility with the tailings pond, would be set forth in sections of the SPCC Plan addressing hazardous materials and petroleum products.

Hazardous wastes other than those from the laboratory would also be managed in the short-term storage facility prior to their shipment to an off-site licensed disposal facility. These materials may include waste paints and thinners. Spent solvents and used oils would be returned to recycling facilities. Waste oil and lubricants would be collected and hauled offsite by a buyer/contractor for recycling. Solvents would be collected by a subcontractor and recycled offsite.

An ongoing inventory of all materials used at the mine site and mill would be provided on a monthly basis to the appropriate Federal, State, and local regulatory agencies. The local fire department would be kept informed about materials stored onsite and appropriate emergency response.

2.2.12.5 Spill Prevention and Containment

Alta has developed a general Emergency Response Plan (as part of the POO) to prevent and minimize the impacts of a reagent or fuel spill. This plan describes the reporting and response that would take place in the event of a spill, release, or other upset condition. Alta would also develop a detailed SPCC Plan for the facility describing procedures for cleanup and disposal. Both plans would be posted and distributed to key site personnel and would be used as guides in the training of employees. Also, the plans would address mitigation of potential spills associated with project facilities as well as activities of on-site contractors. The use, transportation, and storage of reagents and fuels would be covered in the plans. The emergency reporting procedures would be posted in key locations throughout the project area. Containment structures designed to prevent the migration of a spill are included in the design of the facilities. Alta would be responsible for events at the mine site, while contract haulers (i.e., trucking companies) would be responsible for accidents and spills along the transportation routes.

Fuel and oil for the diesel and gas-powered equipment would be stored in above-ground, sealed tanks in the processing facilities area. The tanks would be installed on lined pads and surrounded by berms to contain the volume of the largest tank in the event of rupture.

Reporting spills or releases of certain materials to the environment may be divided into four categories: 1) those requiring internal notification only; 2) those also requiring notification to the State of New Mexico; 3) those also requiring notification to the National Response Center (NRC) and the local Emergency Planning Committee pursuant to CERCLA or Superfund; and 4) those subject to Clean Water Act requirements only. Determining which of the above categories is appropriate for any particular spill or release depends on the material spilled or released, the amount spilled or released, and the circumstances of the spill or release.

2.2.13 Closure and Reclamation

2.2.13.1 Overview

This section describes the measures that would be taken to reclaim the individual facilities associated with the proposed project. The Hillsboro Mining District includes extensive historic surface disturbances that would not be part of the Copper Flat Project. The Proposed Action would result in new disturbance of approximately 179 acres of public land and 235 acres of private land and in the reclamation of 229 acres of previously disturbed private land and 328 acres of previously disturbed public land. See Table 2-1 for a summary of disturbance by ownership and mine component. The reclamation plan submitted by Alta to the New Mexico Energy, Minerals and Natural Resources Department and BLM would address reclamation of those areas. Disturbances related to various infrastructures such at the Greyback Wash diversion structures, the production well pipeline, and transmission lines would be included in the reclamation plan only to the extent that redisturbance of those areas occurs. Alta is currently in discussion with the State of New Mexico and BLM on finalization of a reclamation plan.

If copper mining operations begin in 1997, and the current estimate of the life of the deposit is accurate, then closure of the site would be initiated some time in 2007. Mining and milling activities would cease when ore reserves have been exhausted. Closure of concentrating facilities could be deferred to some point in the future. Also, milling could continue for up to 2 years after completion of mining to consume and process stockpiled low-grade ore; however, it is more likely that about four to nine months of additional processing would be required.

The goal of the Copper Flat reclamation program is to minimize disturbance to the environment and to restore disturbed areas to sustaining plant communities and surface conditions similar to those that are currently present on-site and on adjacent undisturbed lands. Reclamation of disturbed areas would be in compliance with Federal and State regulations. Under the Federal Land Policy Management Act (FLPMA), the BLM is responsible for preventing undue or unnecessary degradation of BLM lands which may result from operations authorized by the mining laws (43 CFR 3809). Reclamation would be conducted concurrently with mining operations where feasible. At closure, final reclamation would be accomplished by a small "close out" work force.

The objectives of the Copper Flat reclamation program are as follow:

- To minimize erosion damage through careful control of surface water runoff. This involves the use of contouring, water bars, revegetation, and riprap where needed.
- To protect the quality of surface and groundwater resources by minimizing pollutant formation, and on-site containment of any unavoidable toxicity problems.
- To establish surface soil conditions most conducive to regeneration of a stable plant community through stripping, stockpiling, and reapplication of alluvial or soil material.

- To revegetate disturbed areas with a diverse mixture of plant species, including native and introduced species, in order to establish long-term productive plant communities compatible with planned future uses.

- To stabilize plant communities with the use of accepted conservation practices.

- To maintain public safety by stabilizing, removing, or fencing land forms that could constitute a public hazard.

- To meet or exceed State and Federal reclamation regulations.

The proposed reclamation plan would consist of the following key measures. Final techniques used in reclamation would be approved by the State of New Mexico as described in the Copper Flat Reclamation Plan that would be on file at the BLM office in Las Cruces, New Mexico:

- Top surfaces of the waste rock disposal areas, lean ore stockpile (if it remains), and tailings impoundment facility would be constructed or graded to configurations that promote stability and prevent ponding of surface runoff to protect waters of the State. Waste rock disposal areas and any remaining portion of the lean ore stockpile would be constructed to conform with the mining reclamation permit as approved by the NMMARB. Waste rock disposal areas would be designed to facilitate regrading during reclamation, however other constraints may require that portions of dumps be constructed in lift heights other than those corresponding to the vertical separation between slope breaks on the final slope faces. The dumps will be regraded and surface runoff velocity dissipaters constructed to reduce velocities and minimize undue erosion and soil loss. Exact design parameters that are specific to the site climatology and soil conditions would be ascertained during revegetation testing and concurrent reclamation activities.

- Waste rock areas, remaining portions of the lean ore stockpile (if any), and the tailings impoundment area would be constructed or modified to slopes of not greater than 2.5H:1V as possible, and broken by horizontal erosion control features as needed to minimize soil loss to within acceptable soil loss requirements as defined by the Universal Soil Loss Equation. Slopes would be worked to enhance vegetative growth and erosion control.

- Grading and contouring in the plant area would be done in a manner that approximates the original topography in an attempt to recreate existing drainage patterns into the Greyback Wash area east of the plant area.

- Revegetation of the tailings dam and impoundment surfaces, the waste rock disposal areas, remaining portions or the lean ore stockpile, if any, and the mill site would be accomplished on a reclamation materials of alluvial material stockpiled during construction of the tailings impoundment. Where soil materials can be stripped prior to dump expansions, the materials would be used first in reclamation of the dump top and benches.

- Erosion control measures other than vegetation would be implemented, where necessary, to prevent sedimentation of surface drainages.

- Surface facilities, equipment, and buildings related to the mining project would be removed, foundations covered, and the plant site returned to conditions similar to those present before rebuilding of the proposed operation of the mine. The topography, slopes, and aspects of the disturbed and reclaimed areas would be developed to blend in with the present, existing physiographic forms of the Copper Flat area, as feasible.

Overburden and interburden removed during mining would be used in physical reclamation. Texture and surface diversity would be attained by using a wide variety of materials available (sized rock, boulders, alluvium, overburden, topsoil, etc.). An attempt would be made to favor initial revegetation on north and east aspects of gentle slopes to obtain additional moisture availability. A limited number of slopes might exceed a 2.5H:1V condition, but most slopes would be restructured to resemble existing topography. The steeper slopes would be stabilized by physical media (boulders, alluvium, rock) as well as vegetative means to add to general diversity and stability.

The topography of the reclaimed mine and process facility sites would be consistent with the anticipated post-mining land uses, which would be rangeland, wildlife habitat, and dispersed recreation for public lands, and industrial uses for private lands. These land uses are in conformance with the White Sands Resource Management Plan. All project roads not required for long-term access and maintenance would be recontoured to the extent possible. Sites that may have buildings or other ancillary facilities removed would also be recontoured to blend with the existing topography to the extent practicable. All recontouring would be completed in a manner that would facilitate free drainage of the reclaimed sites.

Reclamation of areas affected by past mining activities would provide additional environmental benefit beyond restoration of productive land uses. In several cases, the planned reuse and subsequent reclamation of existing waste rock dumps would result in a more environmentally protective closure of these units. Proposed reclamation of the site should result in a successful program to restore the area to the proposed land uses. It is anticipated that the project area would support a greater variety of species following closure due to the additional habitat diversity created by the mining and reclamation programs.

Following closure, the pit would partially fill with water from surface runoff and sub-surface flow resulting in a permanent impoundment.

Alta has prepared an estimate of the cost to conduct all reclamation activities for the proposed project activities. A reclamation bond is required by the BLM and State of New Mexico to guarantee the completion of project reclamation. The bond amount has been determined based upon projected costs of reclamation and closure. These costs are itemized in detail in the reclamation plan (that will be on file in the BLM Las Cruces office) and provide a basis for establishing reclamation performance bonding levels for respective mine components. Financial assurances in the form of surety bonds, cash bonds, financial guarantees, corporate guarantees, or a combination of the above would be established initially and adjusted periodically throughout the life of the project to cover planned reclamation activities.

Physical reclamation would be conducted at all times of the year as an integral part of the ongoing mining operations. Land treatment for revegetation would depend upon time of year, weather conditions, and plant species. Initial reclamation would begin as soon as surfaces and facilities are available for reclamation and would continue during operations and closure.

Final reclamation of facilities would be implemented as soon as practicable after permanent closure of mining operations in any discrete area. This would normally be within 2 to 3 years. One exception to this could be the tailings impoundment, which would need to dry sufficiently prior to its reclamation.

The tailings impoundment dam would remain in place at its designed configuration of 2:1. During operations, management of the tailings facility would shape the final impoundment surfaces to allow for drainage of precipitation runoff.

The final East Waste Rock Disposal area elevation would be approximately 5,640 feet, which would increase the height of the existing dump approximately 80 feet. The West and North Waste Rock Disposal areas and the lean ore stockpile would be new modifications with final elevations different from the existing East Waste Rock Disposal area. Attempts would be made, where possible, to construct new dump faces at overall angles of 2.5H:1V. Erosion control features, such as benches, would be constructed on the slopes to reduce erosion potential. Waste rock would be placed on the tops of disposal areas to create irregular top surfaces to diminish straight lines. The top of the waste rock disposal areas would be compacted.

Modifications to the reclamation plan would only be made after consultation with and approval by the BLM or the NMDEP's Bureau of Mining Regulation and Reclamation, as appropriate.

2.2.13.2 Contemporaneous Reclamation

Ongoing reclamation of disturbed surface areas would be an integral part of the mining operation. Some of the project facilities, such as the tailings embankment, would be constructed in their final configuration. Others, such as parts of the waste rock disposal areas and possibly some roads may be decommissioned prior to final mine closure. Areas such as these would be reclaimed concurrently with the active mining operation, to the extent possible. Because concurrent reclamation reduces erosion, provides early impact mitigation, and reduces final reclamation work, Alta is committed to maximize this type of reclamation at the Copper Flat Project.

The following areas would be stabilized or reclaimed during construction and operation of the mine:

- Water supply line routes;
- The tailings impoundment (the outer face of each raise);
- Soil stockpiles, diversion channels, and temporary access routes;
- The West and North Waste Rock Disposal areas; and
- Construction-related disturbances that would not be redisturbed during operations.

Prior to construction, baseline data would be collected to characterize the existing environment. The baseline data would be used to formulate reclamation goals and to measure the effectiveness of reclamation efforts. During construction, available soils and suitable alluvial material would be removed first from major disturbance areas (mine, roads, buildings, etc.), stockpiled, protected, and used in the reclamation process. Reclamation efforts would be implemented at the earliest feasible time during operation in areas where activities would be discontinued. This would include recontouring, scarifying, placement of soil and alluvial material, revegetation, waterbarring, capping and reseeding of dumps, roads, construction sites, and the tailings dam.

Areas reclaimed during construction and operation of the facility would be monitored to determine the effectiveness of the reclamation techniques. Final reclamation efforts would be expected to be implemented within 2 years after permanent closure; the tailings impoundment is expected to require approximately 1 year to dry out sufficiently to allow reclamation work.

2.2.13.3 Interim Reclamation

There is a possibility that continuous, full-scale production might be interrupted for short periods pending economic considerations or unforeseen circumstances. In this event, interim reclamation would be initiated. Interim reclamation is discussed in the project reclamation plan to be filed at the BLM office in Las Cruces, New Mexico, and is summarized below.

- **Rights-of-Way**: The power lines and water pipeline would be inspected regularly and maintained as necessary. None of the facilities would be altered or removed. The main access road would receive regular maintenance; internal roads would receive minimal maintenance.

- **Pit**: The pit area would be protected by fencing with a locked access gate. Pit water would be monitored for quality.

- **Tailings Facility**: The tailings impoundment would be retained for potential future development. Limited care and maintenance of the reclaimed embankment face would be performed as necessary to continue stabilization of the area. Operation of the pumpback system and groundwater monitoring would be the same as that defined for final mine closure (Section 2.2.13.5, Reclamation of the Tailings Impoundment).

- **Diversion Ditches**: Diversion ditches would be inspected and maintained as necessary. Surface water runoff would be managed in accordance with the site NPDES permit requirements.

- **Buildings**: The process buildings, equipment, and support facilities would be guarded and maintained as necessary. None of the buildings would be destroyed or modified.

2.2.13.4 Growth Medium and Revegetation Management

Prior to and during soil salvage operations, woody plants and herbaceous vegetation would be removed from the area to be disturbed. The herbaceous material would be stored with the growth media to increase organic matter content and seed bank potential of the growth media.

There is very limited suitable soil material available for reclamation from the former mine site, overburden, and proposed tailing impoundment area. Reclamation material (alluvial material suitable for reclamation materials) was stockpiled during the 1982 operation and used for reclamation of the tailings impoundment and plant areas in 1986 and 1987. Efforts would be made to carefully strip, stockpile, and improve the remaining growth media available on the site. No areas unaffected by mining would be disturbed to obtain reclamation materials.

The goal at Copper Flat is to salvage sufficient soil material to provide up to a 6- to 12-inch soil cover on disturbed sites prior to reclamation seeding. Growth media stripping would be performed using dozers, scrapers, trucks, and loaders. Stripping operations would proceed concurrently with various mining operations over the life of the project.

Where salvageable soil exists, on both undisturbed or previously reclaimed areas, Alta would salvage as much material as can be safely and practically recovered. However, the lack of reclamation materials available from previously disturbed areas and the poor development of topsoil at the site requires the evaluation of alternative sources and types of materials for use as reclamation materials. As part of the Proposed Action and Reclamation Plan, Alta plans to salvage near-surface alluvial materials from within the limits of the tailings impoundment. These materials are part of the Santa Fe formation gravels and alluvial basin fill and were used in the construction of the starter embankment.

Several borrow areas currently existing within the limits of the tailings impoundment would be the source of the excavated materials. Mine haul trucks and front end loaders would excavate the required materials during the construction period. The material would be stockpiled in locations surrounding the tailings impoundment. The piles would be constructed with slopes varying from angle of repose to 2.5H:1V and to heights up to 40 feet. The different aspects and slopes of the stockpiles would be used in the test revegetation program to evaluate slope revegetation methods. Existing piles of these materials north of the impoundment demonstrate an ability to retain angle of repose slopes without undue erosion or stability problems.

The soil stock pile locations were chosen to minimize haul distances and to limit exposure to wind and water erosion. The soil would be stockpiled as much as practicable in a low, broad fashion to reduce compaction and loss of microbial activity. To the extent possible, stockpiles would not be disturbed after stabilization. The stockpiles would be contoured to minimize erosion and compaction and to permit rapid establishment of protective vegetative cover. Diversion channels would be constructed around the stockpiles to minimize run-on erosion and the stockpiles would be monitored for erosion. A catchment berm would be constructed around each stockpile to contain any growth medium that may be eroded, especially prior to the establishment of vegetation. To further stabilize the growth media stockpiles, minimize erosion and maintain biological viability, the stockpiles would be seeded with an interim seed mix as recommended by the Natural Resources Conservation Service (NRCS), previously known as the Soil Conservation Service. The interim vegetation cover established on the growth media stockpiles would further reduce soil erosion while providing micro-habitats for beneficial soil organisms.

The stockpile surface would be loosened, if necessary, to provide a proper seedbed. The interim seed mixture would be drilled or broadcast-seeded onto the top and ramps of the stockpiles; side slopes would be broadcast-seeded or hydroseeded. Erosion would be minimized using appropriate techniques, such as mulching. A program to monitor the success of erosion control on soil stockpiles and embankment areas, particularly following high precipitation events, would be implemented. Inadequate erosion control would be remedied.

A special effort would be made to establish a naturally occurring and self-sustaining environment. Irrigation to promote establishment of vegetation would only be used under special conditions. Diversity of plant species on revegetated, disturbed lands may be less than on undisturbed areas. However, the seed mix would contain native plant species (grasses, forbs, and shrubs) common to adjacent areas. Revegetation success would be determined by evaluating revegetation success after two growing seasons. Noxious weed infestations in disturbed and revegetated areas would be controlled through the use of Integrated Pest Management (IPM) such as proper reclamation, judicious use of herbicides, and monitoring to identify potential problems.

Surface material surveys and analysis would be conducted for all surfaces to evaluate soil material suitability for supporting plant growth and would include the use of test plots. Alta would conduct a revegetation test plot program to determine the most effective methods to meet revegetation standards as defined in their reclamation plan. The program would be flexible enough to allow modifications of proposed methodologies and to test new techniques. Conceptually, the test revegetation program would include test plots designed to evaluate different types and thicknesses of cover material, seed mixes, planting techniques, soil amendments and mulches. The program would also include test plots on slopes of different grades and aspects.

Growth Medium Amendments

The soils of the area are deficient in nitrogen, phosphorus, zinc, and sulfur. Therefore, fertilization may be necessary. Suitable fertilizers would be utilized as necessary. Ultimately, fertilization would be prescribed based on chemical analysis of disturbed/replaced soils and test plot results.

Amendments would be applied as needed to establish vegetation on disturbed areas. Amendment materials would be placed on roughened surfaces to ensure good contact, with the amended surface lightly compacted to allow for water retention and to prevent erosion. During material application on steeper slopes, efforts would be made to create small trenches perpendicular to the slope (i.e., dozer tracking) to enhance seed catchment and reduce erosion. Amendment material would be applied just prior to seeding and in as few passes of equipment as possible to decrease compaction.

Fertilizers would be evenly distributed prior to seeding. Fertilization would be completed in the spring, and seeding would be completed between October 1 and March 15. On gentle slopes, the surface would then be disked and/or harrowed along the contour to break up large clods, prepare an appropriate seedbed amenable to drill seeding, and incorporate fertilizer into the soil. Fertilizer and mulch would be applied concurrently with seed on any steep slopes selected for hydroseeding.

Where the need for mulch has been determined, the mulch would be evenly spread over the seeded area at rates dependent on seeding method and slope. The mulch would be free of mold, fungus, noxious weed seed, or other competitive plant seed.

Seedbed Preparation

Seedbeds would be prepared after grading. Soil amendments would be added only as required, based on soil analyses. The area to be planted would be reasonably smooth and free of rills and gullies to provide the best possible soil conditions for seeding. Furrows and terraces may be created to aid in the collection and retention of rainwater. Seedbed preparation would generally include the following practices, as determined to be necessary during test plot work:

- Compacted surfaces with the exception of the waste rock disposal areas, would be loosened and left in a roughened condition through ripping, disking, or other mechanical means. Compacted areas, such as access and haul roads, would be ripped to a depth of 1 to 2 feet prior to soil amendment or further seedbed conditioning.

- Where practical, areas to be reclaimed would be scarified or tilled to a depth of several inches prior to seeding. Tillage operations on slopes would be conducted on the contour to minimize erosion.

- The addition of soil amendments, such as mulch or fertilizer, would be evaluated and applied based on an assessment of site characteristics and the test plot results.

- Loose, erodible surfaces may need to be "dozer-tracked," terraced, or deep-furrowed to prevent sloughing before amendments, seed, and mulch are applied.

Vegetation Establishment

The revegetation plan would be designed to create a stable, self-sustaining plant community with a density and diversity similar to that of areas adjacent to the disturbed land. Proposed interim and final seeding mixtures would be recommended and approved by the BLM for the reclamation plan based on known climatic and soil conditions, consultation with the New Mexico Department of Game and Fish (NMDGF) and NRCS, as well as anticipated post-mining land use requirements.

The species selected for inclusion in the mix and their application rates are expected to vary depending on seed availability and site conditions, such as aspect, slope, and nutrient conditions. As much as practical, an effort would be made to obtain seeds of native species from sources as representative as possible of the project area.

For linear features, such as access roads, slight variations in the seed mixture may be required depending on the terrains that would be crossed. Seed mixtures and application rates would be refined for the various types of reclamation sites based on an evaluation of post-mining site characteristics (slope, soil type, aspect), seed availability, interim seeding success, and results from the test plot program.

Seeding methods utilized at the site would depend on many factors including the topography, soil conditions, and seed mixture. Typically, some combination of broadcast seeding, drill seeding and hydroseeding is used for mine reclamation. It is expected that broadcast seeding, followed by harrowing to bury the seed to the proper depth would be the seeding method of choice. The presence of larger rocks and boulders in the alluvial materials to be used as reclamation materials would decrease the effectiveness of drill seeding and may preclude this method altogether. Hydroseeding may be used on steep, small areas where larger equipment cannot easily operate.

2.2.13.5 Reclamation of the Tailings Impoundment

In general, the closure process for the tailings impoundment would consist of the following activities:

- Managing final tailings deposition to aid recontouring;
- Establishing geochemical baseline for final closure design requirements;
- Disposing of process fluids; and
- Contouring and grading the tailings surface.

Samples of tailings for acid generation potential testing would be taken during the operation of the facility. These data would be provided to the State and BLM to indicate potential future impacts of the facility on surface and groundwater quality and to aid in design of the final closure plan and subsequent reclamation. The type and frequency of testing required are currently being finalized as part of the NMED Groundwater Discharge Permit.

Ancillary facilities, such as pumps, the tailings pipeline, the water reclaim pipeline, and distribution power poles, would be removed and/or disposed of in accordance with applicable local, State, and Federal requirements for solid waste management. The tailings water seepage reclaim ponds would be maintained until no flow emanates from the tailings and then filled in and regraded to prevent ponding.

Following cessation of tailings deposition, the tailings impoundment would be decommissioned by removing the water from the surface of the impoundment, allowing the tailings to drain and consolidate, regrading to promote surface water runoff, covering with salvaged alluvial material, and revegetating the surface of the impoundment.

The water remaining on the pool would be evaporated, or possibly pumped into the pit by extending the pumpback pipeline to the pit area. Rapid removal of this water would accelerate drain down and consolidation of the tailings surface.

Once the surface of the tailings has consolidated sufficiently to allow earthmoving equipment to work on it, the surface of the impoundment would be regraded to minimize ponding and encourage surface water runoff. Following regrading and dozer compaction, alluvial material previously removed from the impoundment area would be spread on the surface to an average depth of 6 to 12 inches, as defined in the approved Reclamation Plan. Infiltration modeling preformed to date by Alta indicates that placement of cover without compaction should be sufficient to limit infiltration into the waste rock dumps to negligible levels. Additional data, such as compaction tests, would be collected during the test plot program.

The surface of the waste rock disposal areas would be revegetated according to the methods defined in the approved Reclamation Plan and modified as appropriate based on the results of the revegetation test program. Monitoring of the revegetation would continue until the results have been approved by the BLM and NMED.

Following reclamation, monitor wells east of the impoundment and the pumpback system wells would remain open to monitor the condition of groundwater beneath the impoundment. The pumpback system would continue to operate until all of the conditions of the Groundwater Discharge Permit issued by the State are met. Water extracted from the pumpback system after the cessation of tailing deposition would either be evaporated or pumped back into the pit. Monitoring of the groundwater would continue until the monitoring conditions of the Groundwater Discharge Permit are met.

It is anticipated that the beach areas of the tailings impoundment would be sufficiently dry to allow heavy equipment and soil placement during the first one to two years following tailings deposition. The diversion structure would remain in place following reclamation. The tailings water seepage collection ponds would be maintained until no flow emanates from the tailings and would then be filled in, regraded to prevent ponding, covered with stockpiled alluvial materials stripped from the area during construction, and revegetated.

Reclamation of the impoundment would also include removal of surface facilities and revegetation of ancillary disturbances. The tailings distribution system, cycloning facilities, reclaim water lines, powerlines and electrical switchgear, and the reclaim booster pump stations would all be removed and sold or otherwise disposed of according to applicable State and local requirements. Surface disturbances created by these facilities, as well as by such other ancillaries as access roads, would be regraded, ripped, and seeded.

2.2.13.6 Reclamation of the Open Pit

Access to the pit would be controlled by fences, blocked roads, and locked gates. Warning signs in English and Spanish would be posted. The pit walls would be stabilized by blasting potentially unstable areas and the pit area would be appropriately fenced and posted according to MSHA and SMIO regulations. Monitoring of the highwalls would continue during the reclamation monitoring period as defined in the approved Reclamation Plan. Over time, the pit would partially fill with water resulting in a permanent impoundment.

2.2.13.7 Reclamation of the Waste Rock Disposal Areas

The waste rock disposal areas would be regraded and reclaimed to blend into the surrounding topography to the extent practical and to establish proper drainage. Horizontal surfaces would be contoured and/or water barred, compacted, covered with alluvial material up to 12 inches deep, and seeded. Necessary soil amendments, as identified by the test plot program, would be applied as needed. The slopes would be regraded and have growth media placed on them prior to revegetation as described in the reclamation plan.

Waste rock disposal is planned as an extension of existing dumps. Regrading of the waste rock disposal area slopes would not exceed an overall grade of 2.5H:1V, although small areas may exceed this angle, and would be undertaken during final reclamation.

Loose faces of dump slopes would be "walked" with a dozer to partially compact the surfaces prior to placement of 6 to 12 inches of reclamation materials. Compaction of the surface cover prior to placement of the reclamation materials would reduce water infiltration into the dumps. Excessively compacted surfaces would be ripped or scarified where necessary and feasible. Water bars, terraces, contour furrows, or other erosion control features would be constructed as needed into the slopes to control erosion and sediment transport. During final regrading of the waste rock dumps, efforts would be made to add small hills, loose rock piles, depressions, and other irregular features on the dumps to provide additional wildlife habitat and avoid an artificially smooth appearance. These features would be incorporated in a manner that would discourage ponding, encourage runoff, and eliminate safety hazards as outlined in the Plan approved by NMMARB and BLM.

Soil and growth medium stripped from the areas of dump expansion would be used first to cover the regraded and compacted slopes so that erosion could be minimized. The 6- to 12-inch cover would also provide an evaporative zone consisting of nonmineralized material which would also aid in preventing infiltration of water into potentially acid-generating waste rock. If any portion of the lean ore stockpile remains after closure, it will be reclaimed in the same manner as the waste rock disposal areas.

2.2.13.8 Reclamation of Roads, Buildings, and Miscellaneous Areas

Other portions of the mine facility requiring closure would include the mill and processing facilities, maintenance facilities, haul roads, the substation, offices, the lab, and the distribution lines. All surface facilities, equipment, and buildings would be removed from the area. Reagents and other milling materials would be removed from the site. Waste materials would be disposed of in compliance with Federal, State, and local requirements in effect at the time. Nonhazardous building materials of no salvage value, such as concrete building slabs, footings, and foundations, would be buried on-site or be covered in place in accordance with New Mexico State law. Any waste classified as hazardous would be disposed of in accordance with applicable Federal and State laws and regulations. Above-ground pipelines, poles, and commercial signage would be removed. Buried pipelines would be left in place.

Prior to final closure, the State and BLM would determine what roads would be left intact. These may include a road accessing a ranch, which lies to the west of the mine site or roads determined to be necessary for continued monitoring and maintenance of facilities, including those that are part of the required closure and/or reclamation of the site. Roads to be reclaimed would be ripped, contoured and/or water barred, and revegetated according to the site reclamation plan. Roads would be recontoured to the extent practicable by rounding off uphill cut and downhill fill slopes. Periodic inspections would be conducted to ensure the effectiveness of the erosion control structures. Sidecast materials, cutslopes, berms, and drainage ditches constructed as part of the project would be reclaimed during the recontouring. Roadways that do not require recontouring would be ripped and the berms bladed out.

During final reclamation, all surface facilities and structures that would not be put to a use consistent with post-mining land use would be removed as approved by the BLM. Any facilities or corridors that could serve a beneficial future use on public lands as identified by the BLM would remain in place following mining, upon approval by the appropriate regulatory agency.

The general surface area would be shaped, contoured and covered with stockpiled alluvium to conform to the surrounding topography to the extent practical. Attempts will be made to contour the area to approximate existing drainage patterns into Greyback Wash. Revegetation would occur according to the project reclamation plan that would be on file at the BLM office in Las Cruces, New Mexico.

2.2.13.9 Post-Reclamation Monitoring and Maintenance

The BLM and State agencies would set post-closure reclamation requirements. Reclaimed areas would be examined by the BLM and state-authorized officers to determine reclamation success and release of financial assurance. Areas that do not meet the required standards after 2 to 3 years would be reseeded. At Alta's option, reseeding may be conducted sooner than 3 years after initial seeding. Final design of the post-operational monitoring program would be completed prior to closure.

Vehicle traffic would be restricted within the reclaimed area. Livestock would be excluded from the area until the soils are firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Barricades erected to prevent access to open pits and structures left in place would be inspected annually and repaired as needed. The inspections would also confirm that all warning signs are intact and legible. These signs would be replaced as needed.

2.2.13.10 Standards for Successful Reclamation

The reclamation standards that Alta must comply with at Copper Flat would be developed in accordance with reclamation standard options identified in Rule 6.3(G) of the New Mexico Mining Act Rules as determined by the New Mexico Mining Act Reclamation Bureau (NMMARB). Rule 6.3(G) reclamation provides that:

> "The permit area will be reclaimed to achieve a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use. Each reclamation plan must be developed to meet the site-specific characteristics of the mining operation and the site (NMEMNRD 1994)."

Factors that would effect the applicable reclamation standard would include: 1) the post-mining land use provided in Alta's reclamation permit application and closeout plan currently being reviewed by NMMARB, and 2) assessment of site-specific conditions at the permit area.

Site specific conditions that may affect the revegetation standard include the lack of suitable topsoil due to previous disturbance. Because of this, reference areas or test plots could be used under Rule 6.3 (G)(1) that would approximate reclaimed soil conditions. Such reference areas would require several years of observation before a standard (or standards) could be established.

In cooperation with BLM and NMMD, Alta will establish reclamation reference areas and test plots with slopes, aspect, and exposed surface materials similar to those found at the waste rock disposal area locations.

New Mexico regulations state that revegetation success is achieved when a self-sustaining ecosystem consistent with the post-mining land use has been established in accordance with the general and specific conditions of the reclamation permit. Until the conditions of the reclamation permit were met, Alta would bear the responsibility to ensure that additional work required to meet said conditions were performed. Annual monitoring of the revegetation work would determine when the permit conditions are met and if any areas appeared to require additional work. NMMARB is currently in the process of reviewing Alta's reclamation permit application.

2.2.14 Summary of Environmental Protection Measures

The following list summarizes those measures incorporated into the Proposed Action that reduce the potential environmental impacts of the Project.

- Design the tailings embankment to sustain a seismic event typical for the area.

- Monitor stability of the tailings dam, waste rock disposal area, and pit walls.

- If roads are to be utilized for more than 1 year, cut and fill slopes would be seeded and mulched after disturbance to control erosion and establish vegetative cover.

- Build containment berms and ditches for the waste rock dumps and soil stockpiles. Reagent storage tanks would be located in enclosed buildings and placed in concrete-lined bermed areas in accordance with OSHA/MSHA regulations.

- Recycle water from the tailings impoundment and the seepage collection system to provide a substantial volume of water for mineral processing; reduce the amount of water that would be obtained from other sources, primarily groundwater wells; reduce the size of the pool, which in turn enhances the consolidation and structural strength of the tailings for final reclamation; reduce seepage into the embankment; and reduce infiltration beneath the impoundment.

- Use water from the pit dewatering to provide some of the project's water requirements for haul road dust suppression and process water and reduce the amount of water withdrawn from production wells.

- Seed soil materials stockpiles with interim seed mix to minimize erosion.

- Design and operate tailings impoundment to prevent discharge to surface water.

- Implement waste rock management procedures to prevent the generation of acid and acid drainage from the waste rock dump, including segregation, selective placement, mixing, covering of waste rock materials, and other preventive measures.

- Place waste rock that has acid-generating potential in disposal areas in a manner that will reduce infiltration by precipitation and air.

- Take samples of tailings and waste rock to test for acid-generating potential.

- Inspect the runoff containment system after major precipitation events.

- Construct an embankment seepage collection system and monitoring wells in proximity to the tailings impoundment.

- Inspect and maintain diversion channels to limit erosion, as necessary.

- Implement groundwater monitoring program.

- During the life of the project revise and improve, as necessary, stormwater pollution prevention practices and procedures. Contain or control runoff from disturbed areas pursuant to surface water quality standards.

- Regularly inspect pipelines, pumps, spigots, secondary containment ditches, berms, seepage collection ponds, the tailings impoundment pool, and stormwater diversion channels.

- Develop a general Emergency Response Plan.

- Use water and/or chemical additives to control fugitive dust from haul roads and construction areas.

- Stockpile available growth material from disturbed areas for use in reclamation.

- Develop a reclamation test plot program to evaluate techniques needed to achieve successful reclamation.

- During construction and operations, stabilize or reclaim the outer embankment face of the tailings impoundment, diversion channels, temporary access roads, soil stockpiles, portions of the waste rock facilities, and construction-related disturbances that would not be redisturbed during operations.

- Initiate a program to monitor the success of erosion control measures on soil stockpiles and embankment areas. Remedy any evidence of inadequate erosion control.

- Restrict livestock access to areas that have been seeded to allow for successful vegetation.

- Maintain the four-strand barbed wire fence around the tailings impoundment.

- Provide supplemental water to Greyback Wash during mine operation to support riparian vegetation and available water for wildlife use. Upon mine closure and final reclamation, recontour area surrounding Greyback Wash to recreate drainage patterns that ensure continuation of natural surface water runoff into Greyback Wash during the long-term period following closure.

- Upgrade the existing 25-kV distribution line to prevent raptor electrocution with standard raptor-proof designs, as suggested by REA guidelines and outlined by Olendorff et al. (1981) *Suggested Practices for Raptor Protection on Power Lines - The State of the Art in 1981*. These guidelines will be updated in 1995 or 1996.

- Collect and control particulate emissions from the crusher, the conveyor system drop point, and the ore reclaim systems with dust control systems.

- Cover or stabilize concentrate during transport.

- Design the concentrate loading station to minimize fugitive dust emissions from concentrate transfer operations.

- Hire as much of the work force as possible from the local and surrounding communities.

- Limit blasting to daylight hours.

- Specify to the trucking companies that Alta adheres to regulations adopted by the U.S. Department of Transportation (49 CFR 171-177; 57 FR 20944, May 15, 1992) designed to aid in reducing the potential for accidents and in mitigating releases that may occur during transport of hazardous materials. Any trucking company contracted by Alta to haul any materials to or from the site would fully comply with all applicable local, State and Federal regulations.

- Ensure that the local fire department and the Sierra County Fire District are aware of the nature of materials being transported to the mine site, and that they have appropriate training in the event of a spill or other accident involving hazardous material.

- Maintain the locked gate at the main entrance to the mine.

- Paint buildings with natural, low-contrast colors.

- Design fill slopes to be similar with the surrounding natural topography to the maximum extent practical in keeping with the Reclamation Plan.

- To the extent practical in keeping with the approved Reclamation Plan, spread soil materials excavated during construction and not stockpiled for reclamation into a cleared area and grade to conform with existing terrain.

- Reduce potential visual impacts by avoiding, to the extent possible, disturbances to foliage adjacent to the site, so that there would be maximum available screening of the site. Where possible, disturbances would be created with curvilinear boundaries instead of straight lines, and grading would be done in a manner that minimizes erosion and conforms to the natural topography.

- In reclamation of tailings and waste rock dumps, include physical surface stabilization and revegetation procedures and financial assurance to ensure completion of successful reclamation.

- Promptly revegetate areas where no further disturbance is anticipated.

- Grade in a manner that would minimize erosion and conform to the natural topography.

- Comply with State and BLM reclamation requirements.

2.3 ALTERNATIVES

Table 2-3 summarizes by alternatives the acres of disturbance associated with waste rock disposal.

2.3.1 No Action Alternative

Under the No Action Alternative, copper mining would not be reinitiated at the Copper Flat Mine and the proven ore reserves in the area would remain undeveloped. No construction of ore crushing facilities, the copper concentrator, the mill tailings impoundments facility, and other related facilities would occur.

The No Action Alternative would be a continuation of the present situation. The mine area would remain as it is now with no additional disturbance allowed. The pit would remain as is. No reclamation activities, as described for the Proposed Action, would occur.

2.3.2 Reduced Stripping Ratio Alternative

This alternative is based on a different economic analysis than the Proposed Action. This new analysis, which utilized current commodity and economic parameters, indicates that Alta could mine a lower copper ore grade with a lower stripping ratio while maintaining a reasonable profit. Total production rate would remain the same, and the amount of ore mined would be similar (65.5 million tons), but 54 percent less waste rock would be generated (23.5 million tons). Under this alternative, 54 percent of the rock that would be considered to be waste rock under the Proposed Action would be identified as ore and processed.

The only disturbance and operational differences between this alternative and the Proposed Action would be:

- The majority of the waste rock would be placed on the three dumps located adjacent to the pit (see Figure 2-5). The West Waste Rock Disposal area would be the same size and configuration as in the Proposed Action. The North Waste Rock Disposal area would expand farther to the south along the western flank of Animas Peak, and the lean ore stockpile shown in the Proposed Action would become the South Waste Rock Disposal area.

- Approximately 6 million tons of waste rock would be placed in the East Waste Rock Disposal area. This would reduce the size of the disposal area from 130 acres in the Proposed Action to 35 acres under this alternative. This area would be constructed in two lifts, a lower one with a crest elevation of approximately 5,560 feet and an upper one which would slope upward to a height of 5,600 feet at an approximate 2 percent grade from the current dump elevation of 5,560. The construction of two lifts would facilitate slope reduction during reclamation, which would occur concurrently with operations as portions of the disposal area become inactive.

Table 2-3

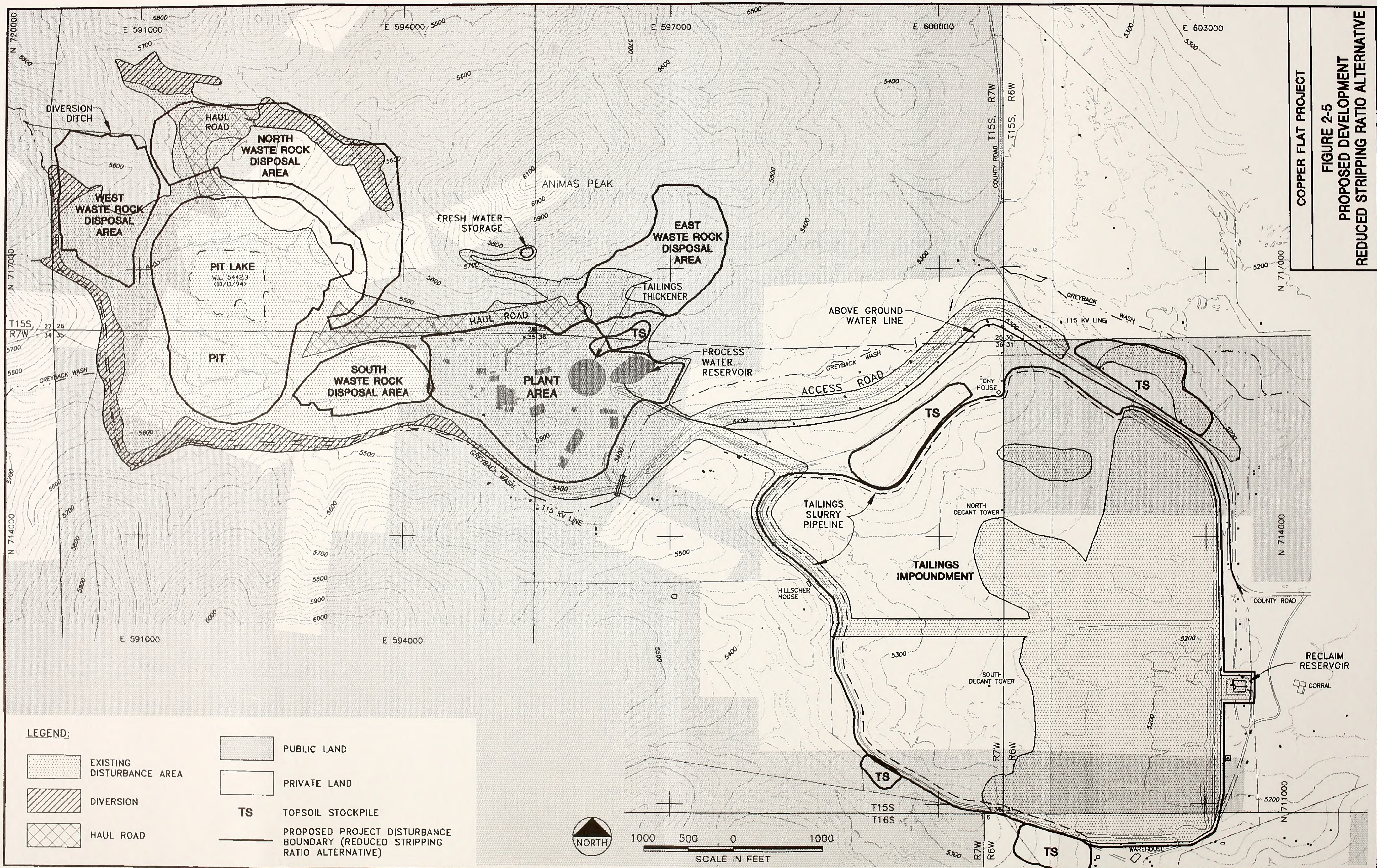
Disturbance Associated with Waste Rock Disposal and Lean Ore Stockpiling by Alternative

	Existing	Proposed Action		Alternative 2: Reduced Stripping Ratio		Alternative 3: Consolidated Waste Rock Dumps	
Disposal Area	Area (Acres)	Area (acres)	Tons ($x10^7$)	Area (acres)	Tons[1] (million)	Area (acres)	Tons[1] (million)
East	8	130	40	35	6	158	51
West	15	16	5	35	5	15	0
North	16	43	6	62	9	16	0
South*	21	21	0[2]	21	4	21	0[2]
Total	60	210	51	153	24	210	51

[1]Tons of waste rock that would be placed on a given area.

[2]No waste rock disposal would occur; lean ore would be stockpiled at this location.

*South = Lean Ore Stockpile and South Waste Rock Disposal area.



COPPER FLAT PROJECT

FIGURE 2-5
PROPOSED DEVELOPMENT
REDUCED STRIPPING RATIO ALTERNATIVE

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- The pit would be shallower than under the Proposed Action with a bottom depth of 4,800 feet, and an area of 96 acres, as compared to a depth of 4,780 feet and an area of 111 acres under the Proposed Action.

- Two of the haul trucks may not be needed due to the reduced waste rock haulage.

Disturbance comparisons by alternative are shown in Table 2-3.

2.3.3 Consolidated Waste Rock Disposal Alternative

In this alternative, all of the waste rock material would be placed in the East Waste Rock Disposal area, with the partially oxidized (transitional) material segregated within the dump (see Figure 2-6 and Table 2-3). The design of the internal segregation area could include:

- Compaction of unoxidized waste rock below the base of the segregated waste rock;
- Placement of transitional waste rock in shallow lifts (10 to 25 feet);
- Compaction of each lift after placement; and
- Compaction of the upper surface of the segregated waste rock.

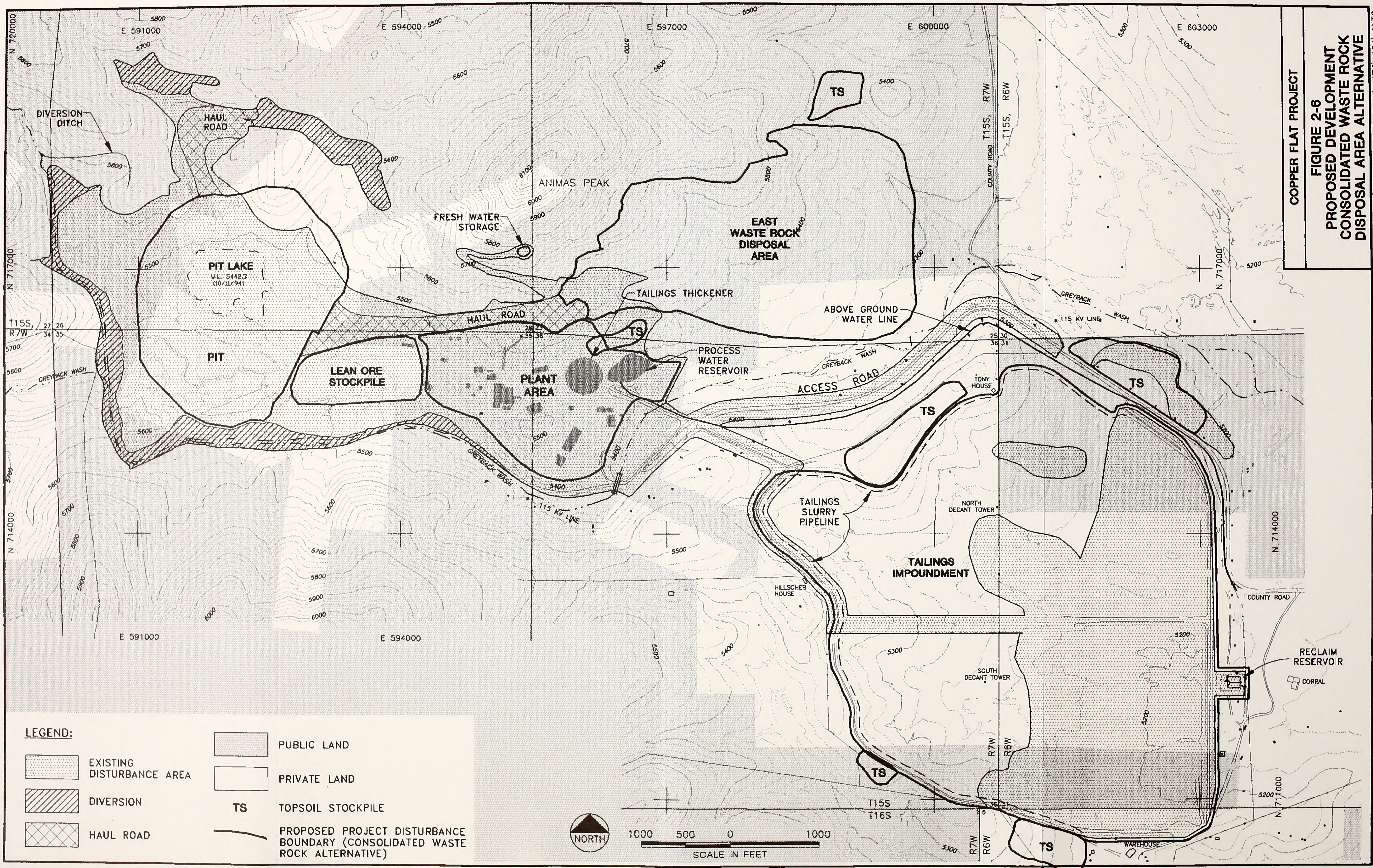
The East Waste Rock Disposal area would be constructed in three lifts at 5,450, 5,550, and 5,650 feet each with setback distances sufficient to create an overall slope of not greater than 2.5H:1V. After completion of the disposal area, the slopes would be regraded, creating final slopes of not greater than 2.5H:1V with 10-foot-wide benches at each lift. The East Waste Rock Disposal area would be 158 acres under this alternative, compared to 130 acres under the Proposed Action (see Table 2-3).

The existing disturbance at the West (15 acres) and North (16 acres) Waste Rock Disposal areas would be reclaimed during operations, as soon as equipment availabilities allow. Some unoxidized waste rock may be used to reshape these dumps to enhance runoff during recontouring prior to revegetation, but no substantial volume of material would be added to either area. The lean ore stockpile would be used to temporarily store lower grade ore until processed, similar to the Proposed Action. Most of the low grade ore would be processed during the operation, although some may be processed following cessation of mining.

2.4 OTHER ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

2.4.1 Tailings Impoundment Lining

As described in the Proposed Action, Alta has proposed a tailings embankment with a seepage interception system consisting of a series of shallow and deeper wells. This system would provide a means of intercepting seepage into the near surface geology beneath the impoundment, by virtue of the known natural



COPPER FLAT PROJECT

FIGURE 2-6
PROPOSED DEVELOPMENT
CONSOLIDATED WASTE ROCK
DISPOSAL AREA ALTERNATIVE

horizontal clay layering, and the consequent preferential horizontal direction for seepage flow. The Proposed Action excludes lining.

The permeability of the tailings to be deposited in the impoundment is the primary criterion involved in determining whether a liner would reduce impacts of the Proposed Action and what type of liner system would be most appropriate. The tailings would have a permeability of 0.000001 ($1x10^{-6}$) cm/sec which would reduce the rate of water flow and slow the rate of infiltration into the groundwater. Therefore, any liner alternative would need to have a permeability less than the tailings to be more effective in reducing water flow. Three lining scenarios were considered as alternatives. Their technical and economic feasibility are summarized below.

- Synthetic liner over the entire base area of the tailings impoundment.

  Technical Feasibility - (Permeability-$1x10^{-9}$ cm/sec). Above liner drainage would also be required to reduce the hydrostatic head on the liner and provide a means for collection and recycling of entrained water. A contingency interception and pumpback system would likely be necessary due to possible liner leakage caused by differential settlement of existing tailings.

  Economic Feasibility - The estimated cost is more than 1,200 percent greater than the proposed interception and pumpback system, and far less effective in capturing and reutilizing entrained water.

- Amended soil liner over the entire base of the tailings impoundment.

  Technical Feasibility - (Permeability from 10^{-6} to 10^{-7} cm/sec). There are insufficient near-surface, native clay soils in the vicinity of the impoundment to place a 1-foot-thick layer to provide low permeability. Therefore, about 600,000 cubic yards of native soils would be required for blending with imported bentonite. Given the need to use native soils for reclamation, the volume of soils would not be readily available in the area for use as a liner. In addition, as would have been necessary or the synthetic liner alternative, above liner drainage and a contingency interception and pumpback system would be necessary.

  Economic Feasibility - The estimated cost is about 1,200 percent more than the proposed pumpback system, and far less effective in capturing and reutilizing entrained water.

- Partial Liner

  Technical Feasibility - Partial lining, either synthetic or amended soil, would reduce the seepage rate only in selected areas. (i.e., beneath the free water pool location on the impoundment). Long-term effective permeability for the entire impoundment would not likely be lower than the consolidated tailings (10^{-6} cm/ec). A comprehensive interception and pumpback system similar to that for the Proposed Action would be required. The partial liner may in fact inhibit the rate of entrained moisture dissipation in the tailings beneath the pool, and consequent consolidation and reclamation activities. To reduce this potential, a comprehensive above liner drainage system would be required.

Economic Feasibility - The estimated cost to line 20 percent of the impoundment is more than 500 percent greater than the proposed interception and pumpback system with no substantial benefits with respect to reduction in base permeability.

The primary objective for alternatives as specified in the CEQ guidelines is to reduce the potential impacts of the Proposed Action. All lining alternatives would have technical and/or economic constraints and could potentially increase impacts with respect to make-up water requirements and additional surface disturbance required for liner soil. For these reasons, lining alternatives were judged not to be technically or economically reasonable, or effective in avoiding or minimizing adverse impacts, and were eliminated from detailed analysis.

2.4.2 Pit Backfill Alternative

Two types of backfilling were considered for this alternative; sequential and post operational. Sequential backfilling, which is sometimes used in coal mines and mines with multiple pits, would be precluded at Copper Flat because of the single configuration of the pit.

Post operational backfilling would involve returning waste rock to the open pit following the completion of mining to fill it to the approximate original surface. This alternative was considered also unreasonable for several reasons. It is estimated that the equipment fleet of loaders, trucks, dozers, and graders used for mining, and associated personnel, would have to work for approximately 5 years (875,000 manhours) following mine closure to load, haul, and dump an estimated 50 million tons of waste rock into the pit. This would replace less than 50 percent of the original material excavated from the pit and cost approximately $32 million. This effectively doubles the handling costs of the project.

During the time required to completely backfill the pit, reclamation of significant portions of the waste rock disposal areas would not proceed, and air quality, water quality, and other environmental impacts associated with loading, hauling, and dumping would continue. In addition, the final pit walls would contain mineralized material which could not be economically recovered at the time of mine closure. These zones may be mined profitably at a future date under improved economic conditions (e.g., higher precious metals prices, or with the development of new mining or mineral processing technologies.) Backfilling the pits would bury these zones, thereby making future mining of these potential reserves much more difficult and expensive. The additional costs required to re-excavate the rock waste to reach the ore could prevent future mining and preclude the significant economic benefits to society derived from that natural resource development.

Alta's current reserve estimate of 71 million tons of ore is based on expected project costs and a copper price of $1.00 per pound. An increase of $0.10 in the price of copper would add 40 million tons (56 percent) to the estimated reserves in the proposed pit. However, future mining of this material from the backfilled pit would be prevented until the copper price was high enough to cover the additional cost (>$32 million) for re-excavating the backfill material from the pit.

Therefore, since post operational backfilling the open pit would result in: 1) the loss of mineral resources that could be mined in the future, and 2) the costs of backfilling would render the project no longer economically feasible, this alternative was considered, but eliminated from further consideration.

2.5 SUMMARY COMPARISON OF IMPACTS AMONG THE PROPOSED ACTION AND ALTERNATIVES

Table 2-4 summarizes and compares the environmental impacts between the Proposed Action and the Alternatives. The quantitative information presented on this table is the net difference (plus or minus) between the Proposed Action and each alternative. Detailed descriptions of impacts are contained in Chapter 4.0. The summarized impacts include the implementation of the mitigation measures presented in Section 4.5, Potential Mitigation and Monitoring. Resource topics that are not affected by the alternatives are not shown on the comparison tables.

2.6 AGENCY-PREFERRED ALTERNATIVE

In accordance with NEPA, Federal agencies are required by the Council on Environmental Quality (40 CFR 1502.14) to identify their preferred alternative for a project in the Draft or Final EIS prepared for the project. The preferred alternative is not a final agency decision; it is rather an indication of the agency's preliminary preference. The alternative identified below is the BLM's preferred alternative at the Draft EIS stage in the environmental review process. This preference may be changed based on the agency and public comments that are received on this Draft EIS. As indicated above, an Agency-Preferred Alternative will also be presented in the Final EIS. BLM's preference at this time considers all information that has been received and reviewed relevant to the proposed project. The Agency-Preferred Alternative is a combination of potential actions that have been analyzed. It consists of the Reduced Stripping Ratio Alternative.

The reduced stripping ratio alternative was developed by Alta Gold at their own initiative following initial scoping. BLM recognized the alternative as a means to both provide for economic recovery of minerals and to ensure maximum protection of the health of the land.

The rationale for selection of this alternative is:

- The East Waste Rock Disposal area will be reduced from the Proposed Action disturbance of approximately 130 acres to 35 acres.
- There would be less drawdown of the groundwater table from pit dewatering due to the shallower depth of the pit.
- A smaller pit lake may be created after reclamation, resulting in a smaller permanent impact to the groundwater table from evaporation of water in the pit lake.

- More copper would be produced per ton of waste rock. The ratio of waste rock to copper ore under the Reduced Stripping Ratio Alternative would be approximately 1 ton of waste rock to 3 tons of ore (0.36:1), as compared to approximately 1 ton of waste rock to 1 ton of ore (0.84:1) under the Proposed Action.

- The total amount of waste rock produced would be reduced from 51 million tons to 23.5 million tons, a difference of 27.5 million tons.

- The total amount of acreage disturbed would decrease from approximately 1,103 acres to approximately 1,023 acres, a difference of 80 acres.

Table 2-4

Comparison of the Proposed Action and Alternatives

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Geology and Minerals	Approximately 71 million tons of copper and molybdenum ore would be produced; 51 million tons of waste rock would be produced.	Approximately 71 million tons of copper and molybdenum ore would not be produced and no waste rock would be produced.	Approximately 65.5 million tons of copper and molybdenum ore would be produced, 23.5 million tons of waste rock would be produced.	Same as the Proposed Action.
Water Resources				
Groundwater	Withdrawal of groundwater from the production well area at 2,000 gpm for 10 years and dewatering and evaporation at the pit lake would lower the water table in the Palomas Basin and mine area, possibly causing permanent domestic water supply interruptions and drawdown at or near Percha Box and Warm Springs Canyon; groundwater flow paths could be rearranged during production well pumping until the water table rebounds.	Groundwater would not be withdrawn. Existing effects to area groundwater from pit lake evaporation levels would continue to occur.	Water use would be the same as the Proposed Action. Potential for reduced drawdown effects from pit dewatering and evaporation.	Water use would be the same as the Proposed Action. Potential for ARD through placement of transitional material in East Waste Rock Disposal area. Drawdown effects similar to Proposed Action.

Table 2-4 (Continued)

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Wetlands and Waters of the U.S.	No wetland areas would be directly impacted. Riparian areas located at the mine in Greyback Wash may be affected following mine closure; reclamation design will attempt to mitigate. Warm Springs Canyon may be indirectly affected from pit lake drawdown.	No wetland, riparian, or drainage impacts.	Same as the Proposed Action. Effects on Warm Springs Canyon may be reduced.	Same as the Proposed Action.
Soils	Two soil associations would be impacted. 414 acres of previously undisturbed soil would be disturbed. Soils would be removed during ground-disturbing activities. Reclaimed areas on previously undisturbed soils could have long-term reductions in productivity. Reclamation on previously disturbed soils could improve productivity and reduce erosion.	No soils would be impacted. No reduction in erosion or increase in productivity would be made on previously disturbed soils through reclamation.	337 acres of previously undisturbed soils would be disturbed. Other effects are similar to the Proposed Action.	412 acres of previously undisturbed soils would be disturbed. Other effects are similar to the Proposed Action.

Table 2-4 (Continued)

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Vegetation	One range site would be impacted (see acreage above). Seed mixtures for revegetation purposes would be developed under a test plot program. 414 acres of previously undisturbed native vegetation would be disturbed. Improvements to vegetative productivity would be made to previously disturbed areas through reclamation.	No vegetation would be impacted. No improvements would be made to vegetative productivity through reclamation.	337 acres of previously undisturbed native vegetation would be disturbed. Other effects are similar to the Proposed Action.	412 acres of previously undisturbed native vegetation would be disturbed. Other effects are similar to the Proposed Action.
Wildlife and Fisheries Resources Previously undisturbed habitat removed	414 acres	0 acre	337 acres	412 acres
Habitat not reclaimed	142 acres open pit and diversion structures).	No habitat disturbed.	129 acres (open pit and diversion structures).	151 acres (open pit and diversion structures).
Terrestrial wildlife displacement/habitat fragmentation	Increased displacement and fragmentation.	No additional displacement or fragmentation.	Same as the Proposed Action.	Same as the Proposed Action.
Human presence effects	Increased harassment, poaching, and traffic.	No additional human-induced impacts.	Same as the Proposed Action.	Same as the Proposed Action.

Table 2-4 (Continued)

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Noise effects	Moderate noise impacts due to blasting, equipment, and vehicles.	No increased noise.	Same as the Proposed Action.	Same as the Proposed Action.
Effects to bats	Habitat loss and disturbance may occur. Potential direct mortality from pit development.	Habitat loss and disturbance would not occur.	Same as the Proposed Action.	Same as the Proposed Action.
Effects to foraging and nesting raptors	Habitat loss.	No habitat loss.	Same as the Proposed Action.	Same as the Proposed Action.
Threatened, Endangered, or Candidate Species				
Effects to sensitive bats	Habitat loss, potential direct mortality, and disturbance may occur.	Habitat loss and disturbance would not occur.	Same as the Proposed Action.	Same as the Proposed Action.
Effects to foraging and nesting ferruginous hawk	Habitat loss.	No habitat loss.	Same as the Proposed Action.	Same as the Proposed Action.
Effects to loggerhead shrike	Habitat loss.	No habitat loss.	Same as the Proposed Action.	Same as the Proposed Action.
Effects to Texas horned lizard	Potential direct mortality and habitat loss.	No mortalities or habitat loss.	Same as the Proposed Action.	Same as the Proposed Action.

Table 2-4 (Continued)

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Sensitive Fish Species				
Air Quality	Air quality effects from construction, operation, and reclamation activities may result in a temporary elevation of local total suspended particulate levels, as well as oxides of nitrogen, carbon monoxide, and sulfur dioxide emitted by generators, vehicles, and other equipment. Reclamation may reduce wind erosion and particulate levels on previously disturbed areas.	No air quality effects expected. Continued wind erosion and resultant particulate levels on previously disturbed area.	Same as the Proposed Action.	Same as the Proposed Action.
Noise	There would be moderate noise impacts due to blasting, equipment, and vehicles. Two residences located along Highway 152 east of the Copper Flat Mine could experience an increase in traffic-related noise.	No impacts to noise levels would occur.	Same as the Proposed Action.	Same as the Proposed Action.

Table 2-4 (Continued)

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Social and Economic Values				
Economy and Employment	Increases in employment and growth would occur in the retail and mining service community. Total income would increase.	There would be no enhancement of mining-related employment opportunities related to the Proposed Action.	Same as the Proposed Action.	Same as the Proposed Action.
Housing	Project construction would lead to an increased demand for transient-type housing. Project operations would generate demand for permanent and rental housing.	Demand for additional housing related to the Proposed Action would not occur.	Same as the Proposed Action.	Same as the Proposed Action.
Community Facilities and Services	The Proposed Action would place extra demand on, but is not expected to adversely affect community facilities and services.	Incremental demand placed on community services as a result of the Proposed Action would not occur.	Same as the Proposed Action.	Same as the Proposed Action.
Government and Public Finance	Tax revenue attributable to property taxes, mineral taxes, and sales tax would increase.	No tax revenue attributable to the Proposed Action would occur.	Same as the Proposed Action.	Same as the Proposed Action.

Table 2-4 (Continued)

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Transportation	Average daily traffic on Highway 152 would increase by approximately 58 percent or 150 round trips per day as a result of project operation. Levels of service are not expected to be adversely affected. Potential for 9 mine traffic-related accidents during life of mine. <0.1 hazardous material spills over life of project.	Traffic volumes on Highway 152 would increase slightly over time due to increases in regional population	Same as the Proposed Action.	Same as the Proposed Action.
Land Use	Public use of public lands within the affected mining area would be precluded for the life of the Proposed Action.	Public use of public lands not currently prohibited would continue without interruption.	Same as the Proposed Action.	Same as the Proposed Action.
Recreation	Use of the Proposed Project area for dispersed recreation would be temporarily precluded for the life of the Proposed Action.	Dispersed recreationists would have access to those areas currently available.	Same as the Proposed Action.	Same as the Proposed Action.

Table 2-4 (Continued)

Resource Areas	Proposed Action	No Action	Reduced Stripping Ratio	Consolidated Waste Rock
Visual Resources	Expanded project features, such as the 130-acre East Waste Rock Disposal area and the 200-foot high tailings impoundment dam would exacerbate visual contrast. Night lighting would attract attention.	The existing 8-acre East Waste Rock Disposal area and 50-foot high tailings impoundment dam would continue to contrast with the visual environment.	Expanded project features such as 35-acre East Waste Rock Disposal area and the 200-foot high tailings impoundment dam would exacerbate visual contrast. Night lighting would attract attention.	Expanded project features such as the 158-acre East Waste Rock Disposal area and the 200-foot high tailings impoundment dam would exacerbate visual contrast. Night lighting would attract attention.
Cultural Resources	Twelve NRHP-eligible and potentially eligible sites, and two potential grave sites would be directly affected. Nine NRHP-eligible sites and three grave sites may be indirectly affected. The use of site-specific treatment plans should reduce impacts.	No impact to cultural resources beyond currently occurring impacts from casual collecting and erosion would occur on public lands surrounding the project.	Eleven NRHP-eligible and potentially eligible sites and two potential graves would be directly affected. Ten NRHP-eligible and potentially eligible sites and three graves would be indirectly affected.	Eleven sites and three graves would be directly affected. Ten sites and two graves would be indirectly affected.
Paleontology	No impacts to known paleontological resources. Impacts to fossils discovered during mining would be mitigated through consultation with BLM.	No impacts to paleontological resources would occur.	Same as the Proposed Action.	Same as the Proposed Action.

3.0 AFFECTED ENVIRONMENT

This chapter describes the environment that would be affected by development of the Copper Flat Project. The environmental baseline information summarized in this chapter was obtained from studies; published sources; unpublished materials; interviews with local, State, and Federal agencies; and from field and lab studies of the project area. The affected environment for various resources was based on where direct and indirect impacts would likely occur. For some resources, such as geology, vegetation, and soils, the affected area was determined to be the physical location and immediate vicinity of the areas to be disturbed by the Copper Flat Project (i.e., mine area, tailings disposal facility). For other resources, such as water quality, air quality, social and economic values, the affected environment was larger (e.g., Sierra County). For each resource, the affected environment described was determined by the extent of the environmental impacts of the Proposed Action.

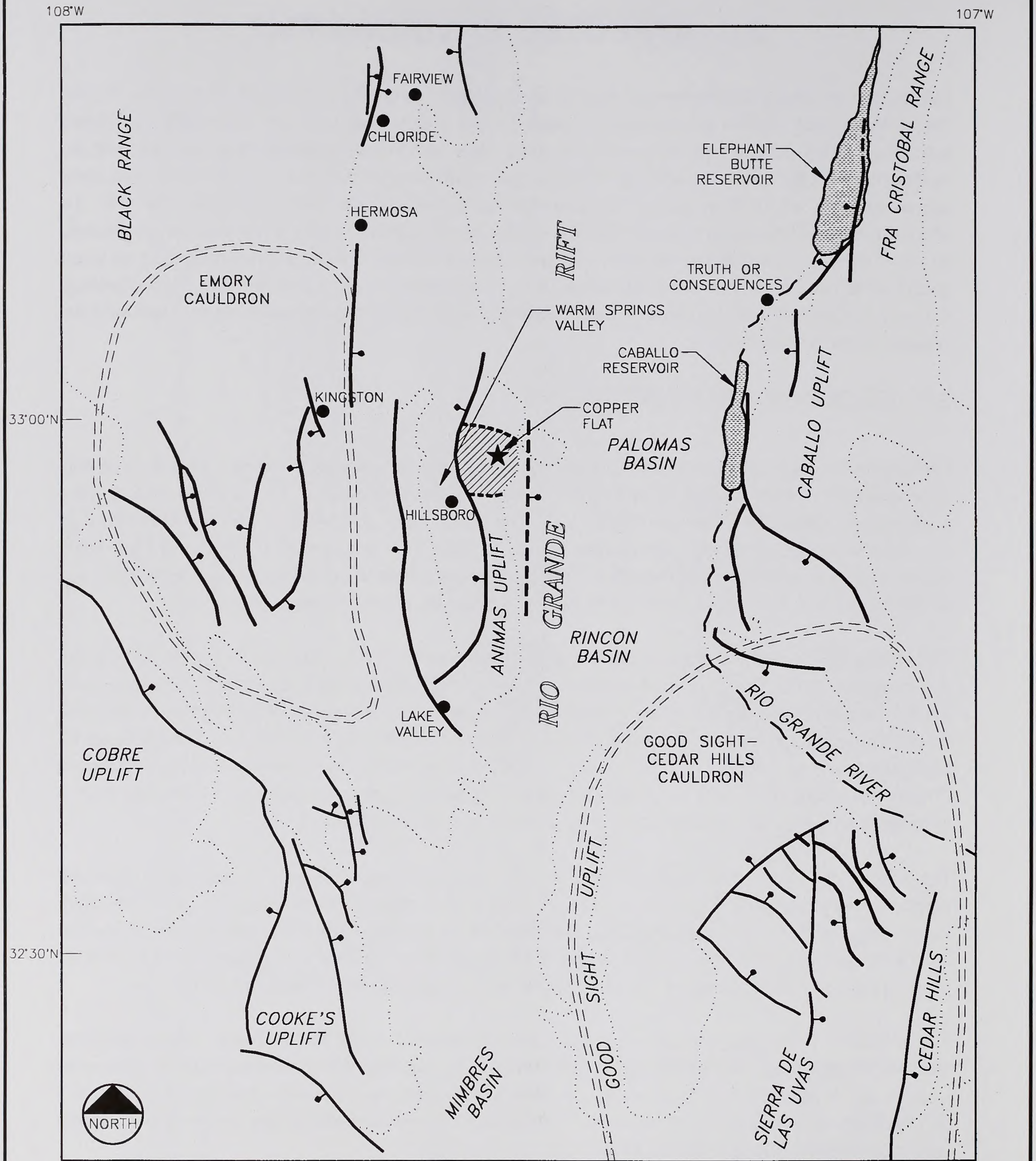
3.1 GEOLOGY AND MINERALS

The Copper Flat Mining Project is located in the Basin and Range Physiographic Province in the Animas Hills approximately 30 miles southwest of Truth or Consequences, New Mexico, and approximately 5 miles northeast of Hillsboro, New Mexico (Figure 1-1). The project is located within the historic Hillsboro (Las Animas) Mining District of Sierra County, New Mexico, in T15S, R7W, Sections 25-27, 34-36 and T15S, R6W, Sections 30-31 (New Mexico West meridian). The proposed well field for production water is located 8 miles east of the mine in T15S, R5W, Sections 30 and 32, just south of State Highway Route 152.

The Animas Hills, where the project would be located, are bounded on the east and west by Tertiary Santa Fe Group sediments. The structural development of the Animas Hills is attributed to faulting associated with the Rio Grande Rift (Figure 3-1). The central Animas Hills are underlain by a body of Cretaceous andesite, a volcanic rock, approximately 4 miles in diameter. The andesite is in fault contact with Tertiary Santa Fe sediments to the east of the site. The Copper Flat deposit is related to the emplacement of the Cretaceous Copper Flat quartz monzonite stock which intrudes the center of the andesite body. The stock itself is irregular in shape and underlies an area of approximately 0.25 square mile.

The deposit does not exhibit many of the zonal alteration and mineralization patterns typical of classic porphyry copper deposits. Economic copper mineralization is contained within the quartz monzonite stock with the highest grade ores occurring within breccia. A series of mineralized veins radiate outward from the central stock; these veins have been the target of historic mining activities in the District. Sulfide contents of up to 5 percent are reported in the quartz monzonite surrounding the minable ore body.

A relatively thin (20- to 50-foot) leached oxide cap was reported to overlie the ore body. This material was stripped during mining activities conducted by Quintana in the early 1980s, and the remaining ore is primarily unoxidized. Mineralization consists chiefly of pyrite and chalcopyrite with lesser amounts of molybdenite and trace amounts of galena and sphalerite. The deposit also contains appreciable amounts of silver and gold; non-valuable minerals present include quartz and calcite.



LEGEND:

- CAULDRON RING FRACTURE ZONE
- NORMAL FAULT
- HILLSBORO MINING DISTRICT
- UPLIFTS (MOUNTAINS)
- DRAINAGES

COPPER FLAT PROJECT

FIGURE 3-1
REGIONAL STRUCTURAL FEATURES

DATE: OCT/19/1995 ACAD FILE: 476\GENERAL

3.1.1 Mining History

The Hillsboro Mining District has been mined intermittently since 1877 when gold was discovered along the Opportunity Vein (Harley 1934). Exploration and development of both vein (lode) and placer gold from 1877 to 1893 led to the development of numerous shafts and adits along veins that radiate both southwestward and northeastward from Copper Flat, and to placer workings along most major creeks draining southwest and east from Black and Animas Peaks. Mineralization is confined to a central intrusive porphyry at Copper Flat and to the radiating dikes and veins. Two-thirds of the $7 million produced from the District through 1931 came from the underground vein deposits. The deepest mine was reported to have reached 500 feet. Exploration for copper began in the 1950s. Newmont Mining Company and Bear Creek Mining Company conducted porphyry copper exploration on the property by drilling 26 exploratory holes. Inspiration Consolidated Copper began work in 1967 and drilled 28 additional holes in the deposit. Quintana Minerals Corporation leased the property from Inspiration in 1974. After drilling an additional 127 exploration holes, Quintana defined sufficient reserves to begin development of the property in 1982. Mining ceased within 3 months due to falling copper prices. Prior to copper mining by Quintana, approximately 200 tons of oxide copper was reportedly mined from the oxide cap from 1911 to 1931 in the Sternberg Mine which was located in the central portion of the ore body in what is now the open pit (Harley 1934). In addition, a small copper leaching operation existed in the Copper Flat area in the mid-1950s (Lotspiech 1994). Sulfuric acid was added to water pumped from the Sternberg Mine shaft, located in what is how the existing pit area, to create a leach solution with a pH of less than 4. The water was then discharged on the surface and collected from underground workings as part of the leaching process. Other techniques, including the introduction of bacteria from historic waste rock dumps, were employed to increase the effectiveness of the operation. An unknown quantity of copper was produced from this operation.

3.1.2 Regional Geological Setting

The Copper Flat Project is located within the Mexican Highlands section of the Basin and Range Physiographic Province in the Las Animas Hills along the western edge of the Rio Grande Valley in southern New Mexico (Figure 1-1). The Rio Grande Valley is approximately 30 miles wide and trends north-south in this part of New Mexico. The Rio Grande flows north to south along the eastern edge of the valley, and lies about 14 miles east of the site near the Caballo Uplift. The remainder of the valley to the west of the river is filled with alluvial sands and gravels of the Santa Fe Group. The project area is located within the western bounding uplift of the lower Rio Grande Valley in the Animas Uplift (Figure 3-1). To the west of the Animas Uplift lies a parallel subbasin of the Rio Grande Valley; the Warm Springs Valley. The Animas Uplift and the project area are separated from the Rio Grande and its reservoirs by nearly 20 miles of Santa Fe Group alluvial sediments, referred to as the Palomas Basin of the Rio Grande Valley (Seager et al. 1982).

The Black Mountains rise to elevations above 9,000 feet about 25 miles west of the project area and form the Continental Divide. The project area itself lies near the eastern foothills at an elevation of about 6,000 feet.

3.1.2.1 Stratigraphy

The stratigraphy of the lower Rio Grande Valley is displayed in the uplifts that bound the valley and in the streams and rivers that transect the valley-filling alluvial gravels and sands. Basement rocks consist of Precambrian granite and Paleozoic-Mesozoic sedimentary rocks. These sedimentary rocks range from major basal sandstone units, such as the Bliss Sandstone, to shales, limestone, and evaporites. Important sedimentary rock units that are exposed near the project area in the Animas Uplift are the Ordovician Montoya Limestone, the Silurian Fusselman Dolomite, and the Devonian Percha Shale. The regional stratigraphy of the lower Rio Grande Valley is summarized in Table 3-1 adapted from Harley (1934) and Seager et al. (1982).

Late Cretaceous andesites of Copper Flat, Tertiary volcanics erupted from the Emory and Good Sight-Cedar Hills cauldrons, and the Tertiary to Quaternary alluvial sediments of the Santa Fe Group and the overlying more recent valley-fill sediments overlie the Paleozoic-Mesozoic sedimentary rocks. The Cretaceous andesites are found as a subcircular outcrop in the Animas Uplift and contain a central intrusive quartz monzonite stock. The Tertiary volcanics consist of basaltic, andesitic, and rhyolitic flows and tuffs erupted primarily from the Emory Cauldron. The Santa Fe Group alluvial sedimentary rocks consist of alluvial fan, braided stream, and basin-fill sands, gravels, and clays. The lower Rio Grande Valley is currently undergoing erosion and infilling with clastic sediments.

3.1.2.2 Structure

The structure of the lower Rio Grande Valley consists of block faulting related to emplacement and doming of the Emory and Good Sight-Cedar Hills cauldrons and rift faulting related to the formation of the Rio Grande Rift (Figure 3-1). The Tertiary cauldrons preceded the formation of the Rio Grande Rift and were active during the early to middle Tertiary (35 to 45 million years ago). These cauldrons formed both peripheral ring faults and interior closely-spaced normal faults that formed during doming of the cauldron interior as volcanic activity related to the cauldron began to wane. The Good Sight-Cedar Hills cauldron ring fault extended into the southern Caballo Uplift, while the ring faults associated with the Emory Cauldron formed the valleys that border the Black Range Uplift.

Rifting and basin formation due to block faulting began in the Rio Grande Rift during the middle Tertiary, approximately 25 to 30 million years ago. This north-south block faulting was associated with continental extension, downfaulting of crustal blocks to form a rift basin, and eruption of basaltic lava flows. This Tertiary rifting overprinted the early volcanism and cauldron formation and resulted in alluvial sediments and basaltic volcanics covering both the earlier volcanic tuffs and the Paleozoic-Mesozoic sedimentary rocks. Rifting continues to the present in the Rio Grande Valley. The Palomas Basin section of the Rio Grande Valley to the east of the Animas Uplift and the Warm Springs Valley to the west are both the result of this rifting. The Animas Uplift and the Caballo Uplift form the western and eastern margins, respectively, of the lower Rio Grande Valley.

	FIGURE SYMB.①	THICKNESS	STRATIGRAPHIC UNIT(S)	
TERTIARY - QUATERNARY	Qvy	10–70'	Pleistocene and Holocene valley alluvium	
	Qvo	50–100'	Pleistocene river, arroyo and fan deposits	
	TQb	50–200'	Pliocene basalt flows, dikes and plugs	
	Tsfp	300–1000'	Upper Santa Fe Group Fanglomerates (Palomas Formation)	
	Tsf	1000–2000'	Santa Fe Group, Rincon Formation	
	Tv	1000'	Tertiary volcanic rocks	
CRETACEOUS	Kql		Quartz latite dikes	**COPPER FLAT VOLCANICS AND INTRUSIVES**
	Kii		Intermediate composition intrusives	
	Kd		Late Cretaceous andesite dikes	
	Ka	3000' +	Andesite rocks near Copper Flat	
	Kis		Late Cretaceous – silicic intrusives	
	Kacfs		Sandstone	
	KM	300–400'	Mancos Shale. Not exposed in project area.	
	KDS	100–200'	Dakota Sandstone. Not exposed in project area.	
PALEOZOIC	PM	1000–2000'	Manazano Group sedimentary rocks. Abo Sandstone, Yeso Formation shales, sandstones, and gypsum deposits, and San Andres Limestone. Not exposed west of Rio Grande River in project area.	
	IP	400–1000'	Pennsylvanian carbonate rocks including Syrena, Oswaldo and Magdalena Groups, minor conglomeratic sandstone and cherty massive limestone	
	DM	200–500'	Devonian and Mississippian carbonate rocks (Kelly Limestone, Lake Valley Limestone, Caballero Formation) and Percha Shale	
	OS	250–600'	Ordovician Montoya Group and Fusselman Dolomite	
	€O	500–700'	Cambrian – Ordovician Bliss Sandstone and El Paso Group Limestones	
PRECAMBRIAN	p€		Precambrian massive granite	

① SEE FIGURE 3–2 FOR EXPOSED STRATIGRAPHIC UNITS.

SOURCES:
(1) HARLEY (1934)
(2) SEAGER ET AL. (1982)
(3) HEDLUND (1977)
(4) ALMINAS ET AL. (1975)

COPPER FLAT PROJECT

TABLE 3-1
STRATIGRAPHIC COLUMN FOR THE PROJECT AREA

DATE: OCT/19/1995 ACAD FILE: 476\GEO-LEG

3.1.2.3 Mineralization

Mineralization is common along the graben-bounding faults of Warm Springs Valley at Hillsboro and Kingston, Lake Valley on the south, Hermosa, and Fairview-Chloride on the north (Figure 3-1). Most of this mineralization is Tertiary in age and consists of precious metal (gold and silver) mineralization related to volcanism along the eastern margin of the Emory Cauldron. Copper mineralization at Copper Flat is Cretaceous in age, and thus older than the Tertiary precious metal mineralization, and limited to the subcircular exposure of the Cretaceous andesitic stratovolcano and its central intrusive stock and breccia.

3.1.2.4 Geological History

The geological history of the lower Rio Grande Valley reflects the geological evolution of New Mexico. Precambrian basement granites and gneisses were overlain during the Paleozoic by clastic and carbonate sediments deposited in bank, platform, and deltaic environments by marine and near-shore seas. During the late Paleozoic (Permian Period), near-shore evaporites were deposited throughout southern New Mexico and adjacent Texas. The Cretaceous Period saw deposition of sandstones and shales followed by extensive andesitic volcanism and copper mineralization. This late Cretaceous copper mineralization extends from Arizona to central New Mexico. The Tertiary Period was dominated by development of large cauldron complexes, the eruption of extensive fields of volcanic lavas and tuffs, faulting along the margins and within the cauldron complexes, and precious metal mineralization along the major cauldron-related fault systems. Rio Grande rifting began in the middle-late Tertiary and continues to the present. The extensive alluvial deposits of the Rio Grande Valley and the current configuration of this valley are the result of this on-going block faulting. The geological history of the project area is summarized in Table 3-2.

3.1.3 Geological Setting of the Project Area

The Copper Flat Project occupies the historic Hillsboro (Las Animas) Mining District and represents a reactivation of that late 19th century mining district for copper instead of gold. The project area encompasses the area around the central intrusive stock that was emplaced into the core of a subcircular, late Cretaceous andesitic stratovolcano approximately 3 to 4 miles in diameter. The historic Hillsboro District encompassed the entire andesitic stratovolcano and focused on the veins and placers. Although the workings are numerous, they are generally small and aligned along northeast-southwest trending veins, or along streams (placers). The mining project proposed by Alta would focus on the central stock and its breccia zone, and would occupy approximately 1,103 acres along Greyback Wash. The general geology of the project area thus consists of a quartz monzonite stock with associated veins and breccias surrounded by an eroded andesite stratovolcano with at least 3,000 feet of volcanic flows and tuffs overlying Paleozoic sedimentary rocks (Dunn 1982).

Table 3-2

Geologic History of the Copper Flats District

Geologic Time[1]	Geologic Settings	Mineralization
Precambrian Era (570 - 1,500)	Metamorphism and intrusion of granites.	Not mineralized in project area.
Paleozoic Era (225 - 570)	Deposition of marine and near-shore clastic and carbonate sediments in bank, platform, and deltaic environments. Limestone and dolomites dominate with lesser shales and evaporites.	Not mineralized during this time period -- mineralized during the Cretaceous.
Mesozoic Era (65 - 225)	Early deposition of shales and sandstones followed by extensive andestic volcanism, plutonism, and formation of porphyry copper deposits from Arizona to south-central New Mexico.	Extensive mineralization of the andesites and especially the porphyritic intrusives associated with the andesites. Copper and gold/silver mineralization at Copper Flat. Minor lead and zinc replacement mineralization of Paleozoic carbonate rocks near Hillsboro and upper Percha Creek (The Box).
Cenozoic Era (0 - 65)		
Early-Middle Tertiary (25 - 40)	Development of large volcanic cauldrons and eruption of extensive volcanic fields of lava and ash. Formation of Emory and Good Sight-Cedar Hills Cauldrons.	Mineralization in gold and silver along ring faults of large cauldrons. Formation of Kingston, Fairview, and Chloride districts.
Late Tertiary (10 - 25)	Inception of rifting in the Rio Grande Valley. Formation of the present rift valley structure and the Palomas Basin. Deposition of the Rincon Valley Formation of the Santa Fe Group.	No mineralization.
Late Tertiary-Quaternary (1 - 10)	Entrenchment of the Rio Grande due to renewed rifting. Deposition of the Palomas Formation alluvial fan gravels and sands. Formation of a paleo-graben within Palomas Basin between Copper Flat and the Rio Grande.	Formation of the Las Animas placer gold deposits in Greyback Arroyo and Dutch and Hunkidori Gulches.
Quaternary (0 - 1)	Continued downcutting of streams that flow to the Rio Grande. Formation of paleo-stream terraces and recent stream deposits.	No mineralization.

[1]Geologic time in millions of years before present.

Source: Harley 1934.

3.1.3.1 Copper Flat Area

The geology of the Copper Flat area is presented in Figure 3-2 and illustrated in cross section in Figure 3-3. This geology was compiled and simplified from Dunn (1982); Seager et al. (1982); Harley (1934); Hedlund (1977); and Segerstrom and Antweiler (1975).

Stratigraphy

Late Cretaceous andesites dominate the Copper Flat area and consist of flows, breccias, and tuffs. The andesites are generally massive, but can be porphyritic and usually have a dark gray to gray-green color. They often weather to a brownish gray color. The andesites are intruded by a radiating swarm of quartz latite dikes and a central quartz monzonite stock in the upper part of Greyback Wash (see Table 3-1 and Figures 3-2 and 3-3). Pliocene basalts capped the andesites, but erosion has removed all but a few isolated remnants of these dark, massive rocks. Quartz veins parallel the quartz latite dikes and numerous shafts and adits attest to the intense mining of gold and silver during the last century. The thickness of the andesites is not known, but drilling for copper has penetrated 3,000 feet of andesite without encountering the underlying Paleozoic sedimentary rocks (Dunn 1982).

Paleozoic quartzite and carbonate rocks surround the exposed remnant of the Cretaceous andesite stratovolcano. These units undoubtedly underlie the andesites, but are exposed only along the margins of the Cretaceous andesites and are generally found only in fault contact with the andesites. To the south of Copper Flat in the vicinity of Warm Springs Canyon and Ready Pay Gulch are the Cambrian-Ordovician Bliss Sandstone and the El Paso Group limestones along with the Ordovician Montoya Group carbonates and the Fusselman Dolomite. Isolated exposures of Precambrain granite along with Devonian-Mississippian carbonates and the Pennsylvanian Magdelena Group limestones are found here also. These same Paleozoic units are exposed north of the andesites in the Wanda and Tank canyon areas and are also in fault contact with the volcanics. Here the Cambrian-Ordovician Bliss Sandstone and El Paso Group limestones dominate.

The intrusive quartz monzonite porphyry that hosts the copper mineralization consists of potassium feldspar phenocrysts set in a finer-grained, equigranular matrix of feldspars, quartz, and ferro-magnesian minerals such as biotite and hornblende. The quartz monzonite stock is elongate to the northeast, parallel to the Hunter fault (Figure 3-4). Within the intrusive stock is a breccia pipe consisting of brecciated and mineralized fragments of the quartz monzonite. This pipe is oriented northwest, parallel to Greyback Wash and the Patten fault (Figures 3-4 and 3-5). This breccia pipe occupies one-third of the stock and hosts approximately half of the copper ore. The remainder of the ore is disseminated in the stock.

Structure

The Copper Flat area is dominated by three principal structural patterns: 1) the northeast-southwest trending Hunter fault system that controls the emplacement of the quartz latite dikes and associated veins, as well as the elongation of the intrusive stock, 2) the northwest-southeast trending Patten-Lewellyn fault system that is subparallel to Greyback Wash and controls the orientation of the breccia pipe (Figure 3-4), and 3) ring faults such as the Greer and the Olympia that dip inward toward the intrusive stock (Figure 3-4).

STRATIGRAPHY

TERTIARY - QUATERNARY
- Quaternary Alluvium (Qvy+Qvo)
- Tertiary Volcanics (TQb+Tv)
- Tertiary Santa Fe Group (Tsfp+Tsf)

CRETACEOUS
- Late Cretaceous – Silicic Intrusives (Kii)
- Cretaceous Latite – Andesite Intrusives (Kql+Kd+Kis)
- Andesite rocks near Copper Flat (Ka)

PALEOZOIC AND PRECAMBRIAN
- Paleozoic Siliclastic and Carbonate Sedimentary Rocks (pC through PM)

LEGEND
- NORMAL FAULT, BALL ON DOWNTHROWN SIDE; DASHED WHERE INFERRED, DOTTED WHERE BURIED.
- CONTACT
- B B' CROSS SECTION LOCATION

SOURCES:
(1) HARLEY (1934)
(2) SEAGER ET AL. (1982)
(3) HEDLUND (1977)
(4) ALMINAS ET AL. (1975)

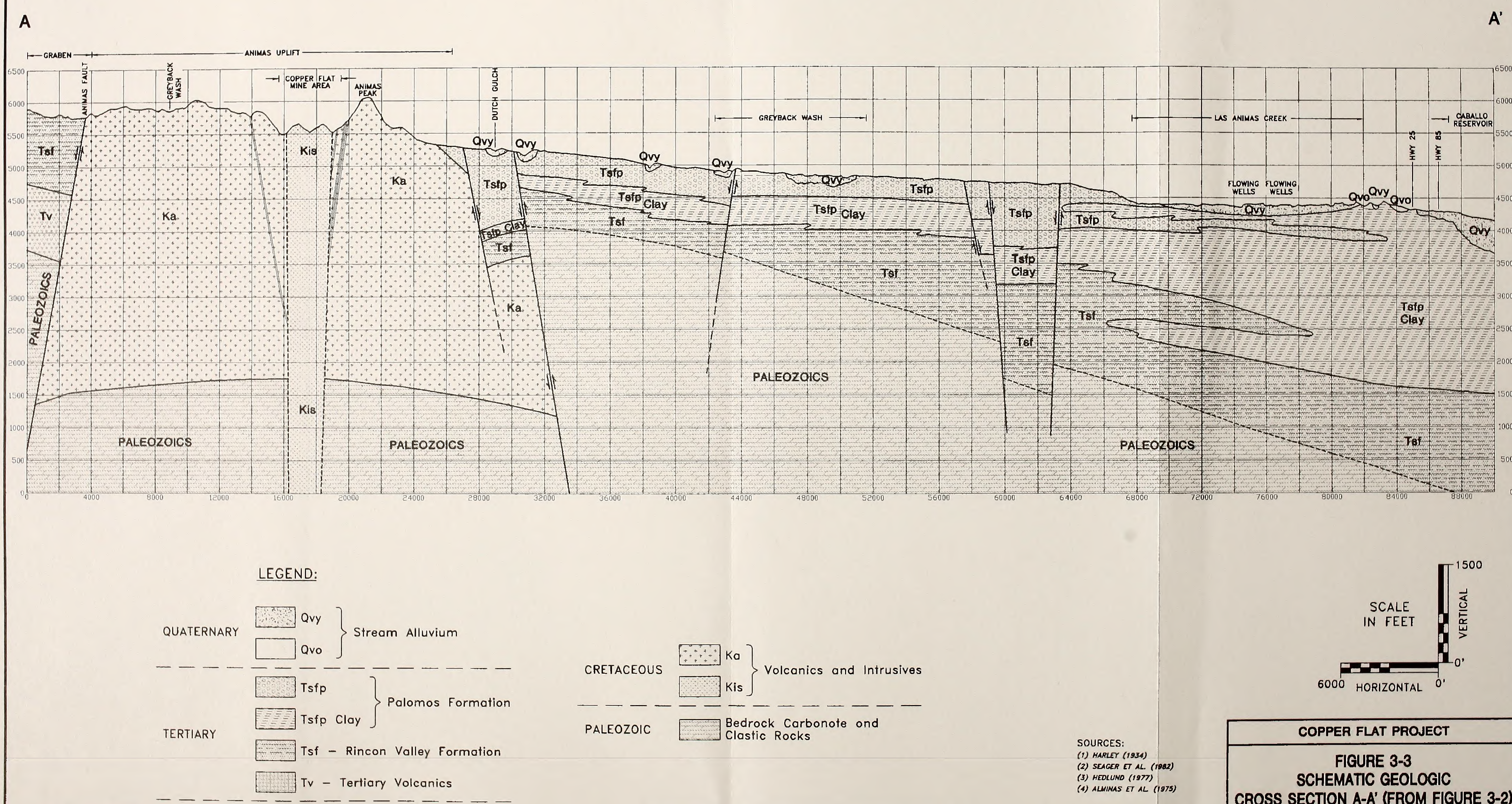
0 5,825 11,650
FEET

NORTH

COPPER FLAT PROJECT

FIGURE 3-2
GENERALIZED REGIONAL SURFACE GEOLOGY

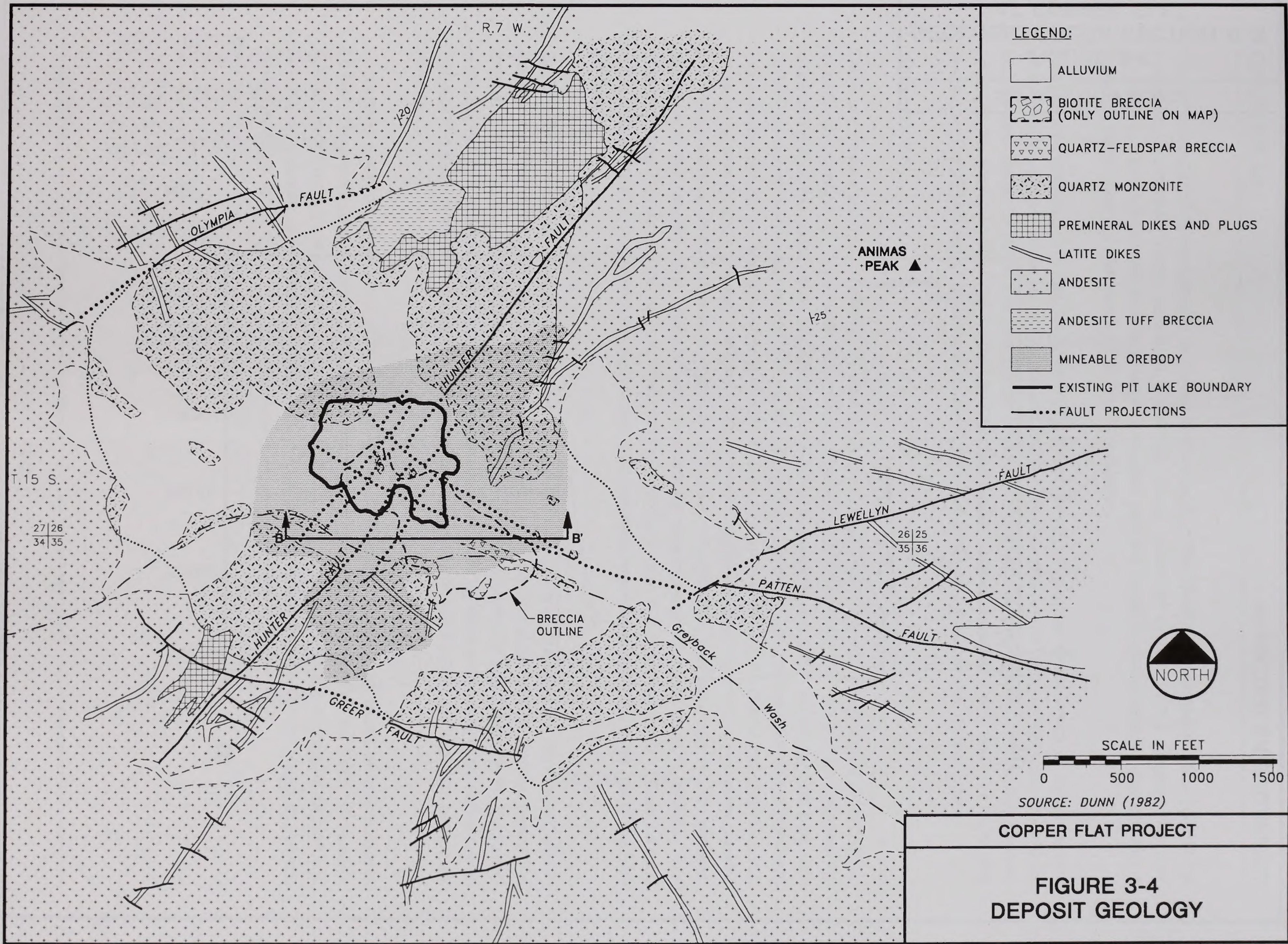
DATE: NOV/17/1995 ACAD FILE: 476\GEO-2



COPPER FLAT PROJECT

FIGURE 3-3
SCHEMATIC GEOLOGIC CROSS SECTION A-A' (FROM FIGURE 3-2)

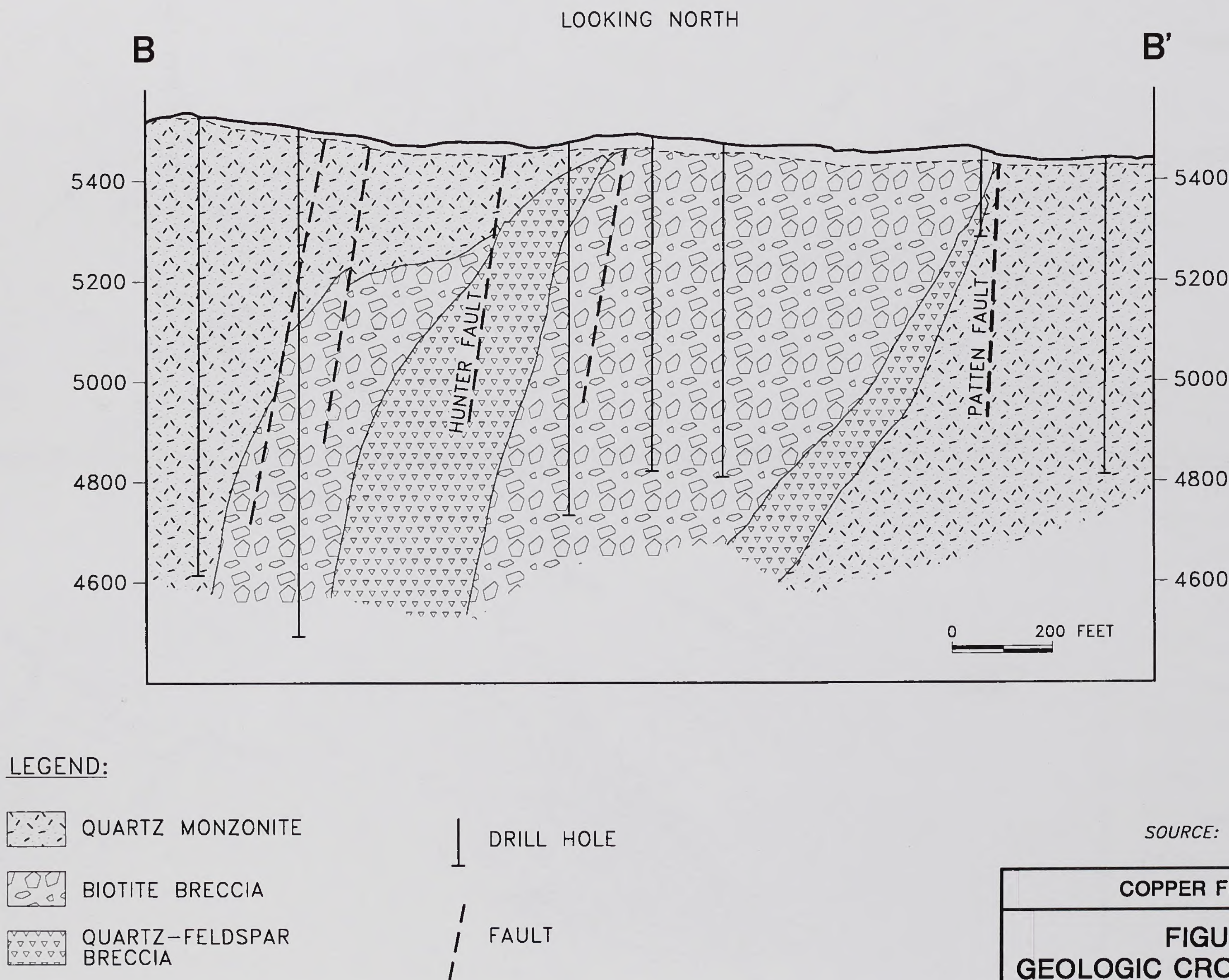
DATE: NOV/17/1995 ACAD FILE: 476\XSEC-AA



COPPER FLAT PROJECT

FIGURE 3-4
DEPOSIT GEOLOGY

DATE: OCT/19/1995 12-476\401\GEO-DEP2



SOURCE: DUNN (1982)

COPPER FLAT PROJECT

FIGURE 3-5
GEOLOGIC CROSS SECTION B-B'
AT COPPER FLAT

DATE: JUN/5/1995 ACAD FILE: 476\XSEC-BB

The north-trending Animas fault and east-west faults that drop the Cretaceous andesites down against the Paleozoic sedimentary rocks constitute a possible fourth structural system in the Copper Flat area (Figure 3-2). Block faults which juxtapose the andesites with the Santa Fe Group gravels east of Animas Peak will be discussed in Section 3.1.3.2, Palomas Basin.

The Hunter (northeast) and Patten-Lewellyn (northwest) structural systems existed prior to emplacement of the intrusive stock. These two structural sets control mineralization in the Copper Flat area. The Hunter fault system shows considerable wet gouge with the consistency of wet concrete where encountered underground (Dunn 1982). The Patten-Lewellyn fault system contains broken rock and can have fault breccias up to 25 feet wide. Most faults in the Copper Flat area show post-mineral displacement.

Mineralization

There are three stages of mineralization evident in the Copper Flat stock and breccia pipe (Dunn 1982): 1) early introduction of pyrite with subordinate chalcopyrite throughout the stock that followed the emplacement of the radial dikes but preceded the breccia pipes; 2) formation of the breccia pipe with stockwork veinlets and disseminated mineralization consisting of pyrite and chalcopyrite with subordinate molybdenite, sphalerite, and galena; and 3) a final stage of narrow quartz-pyrite-chalcopyrite veinlets that transect the breccia and the stage 2 veinlets. Stage 1 mineralization was accompanied by pervasive chloritic and locally intense sericitic alteration. The stage 2 main mineralization was accompanied by potassic alteration in the breccia pipe. Sericite and chlorite form envelopes around the stage 3 veinlets. The radiating veins that parallel the dikes formed during the stage 2 main mineralization period. Gold is found in the oxidized portions of these veins and attracted the original prospectors during the latter half of the 19th century.

Sulfides range from 1 to 5 percent by volume in the breccia pipe and the adjacent mineralized stock. Pockets of high-grade ore in the breccia pipe can carry up to 20 percent sulfides. The western part of the breccia pipe contains more sulfide and thus higher grade ore than the eastern part (Dunn 1982). Pyrite and chalcopyrite are the main sulfide minerals. Molybdenite, galena, and sphalerite are minor in abundance, with molybdenite being common enough to recover during milling. Fluorite and calcite are common accessory minerals.

Supergene oxidation is not common at Copper Flat and extends to a maximum depth of approximately 50 feet. The main oxidized copper minerals are malachite, azurite, and chrysocolla (Dunn 1982). Chalcocite is found in the supergene zone and forms films on chalcopyrite. It does not form a supergene blanket and is not a recoverable ore mineral at Copper Flat. Fresh pyrite and chalcopyrite can be found in outcrop along Greyback Wash.

3.1.3.2 Palomas Basin

The Palomas Basin lies to the east of Copper Flat and the Animas Uplift. The existing water and transmission lines and the production wells, which would be used to serve the proposed mine, are located in this basin. The Palomas basin is one of many sub-basins within the Rio Grande Valley and occupies the area west of the Rio Grande from Truth or Consequences south to just north of Hatch, New Mexico, where the Rio Grande turns eastward. These boundaries are not definite, and the Palomas Basin grades into the Rincon Basin southward (Wilson et al. 1981). This basin is filled with Santa Fe Group alluvial sands, gravels, and lacustrine clays.

Stratigraphy

There are four main sedimentary units that have been recognized either in field mapping or drill cuttings (Davie and Spiegel 1967; Segerstrom and Antweiler 1975): 1) the basal Rincon Valley Formation of the Santa Fe Group, which consists of reddish-brown clays, silty clays, and clayey sands, 2) the upper alluvial member of the Santa Fe Group, called the Palomas Formation in this part of New Mexico, that consists of alluvial fan gravels and distal braided-stream sands and silts that interfinger with clays near the Rio Grande, 3) paleo-river channel terrace deposits consisting of sands and silts, and 4) recent river channel deposits.

The basal or Rincon Valley Formation of the Santa Fe Group is exposed near Hillsboro, New Mexico, where the reddish-brown clays and clayey silts characteristic of this basal unit are interbedded with basalts dated at 28 million years before present (Seager et al. 1984). These clays are found again in drill holes in the Gold Dust Camp area (Section 6, T16S, R6W) at a depth of 300 feet. The clays are over 1,000 feet thick at this locality (Segerstrom and Antweiler 1975). In the proposed production well field (Section 31, T15S, R5W), the clays lie beneath approximately 1,000 feet of alluvial sands and gravels.

The Palomas Formation in the project area represents the upper alluvial member of the Santa Fe Group in this part of New Mexico (Lozinsky and Hawley 1986). This unit grades eastward from the Animas Uplift from coarse alluvial fan material to braided-stream and deltaic sands and silts to clays near the Rio Grande. The interfingering with clays begins approximately 3 to 5 miles west of the current position of the Rio Grande and is responsible for the flowing wells common in this part of the Palomas Basin (Murray 1959). A basalt flow dated at 4.2 million years before present caps the Palomas gravels near Copper Flat (Seager et al. 1984).

The paleo-channel terrace deposits follow many of the current drainages (Figure 3-1) due to the entrenchment of the Rio Grande that began approximately 0.50 to 1 million years ago (Seager et al. 1984). These terrace deposits often sit on a base of caliche, or calcite-cemented Palomas gravels and sands. These terrace deposits host placer gold deposits just east of Copper Flat in the area of Greyback, Hunkidori, and Dutch Washes (Figure 3-1; Segerstrom and Antweiler 1975).

Present stream channel deposits consist of channel and floodplain gravels, sands, and silts. These units are generally 30 to 50 feet thick near the mouths of Seco, Las Animas, and Percha Creeks (Davie and Spiegel 1967).

Structure

The structural setting of the Palomas Basin in the project area is shown in Figure 3-2 and in cross section in Figure 3-3. There are two important structural components to the basin: 1) the faults that separate the alluvial sediments from the Cretaceous andesites at Copper Flat, and 2) the faults within the basin that may be due to step faulting down toward the Rio Grande Valley, or to a buried paleo-river channel or failed graben within the Palomas Basin (Wilson et al. 1981).

The faults adjacent to the andesites at Copper Flat drop the alluvial sediments down against the andesites. The vertical offset on these faults is poorly known. Also, the number of faults in this area and the width of the fault zone separating the andesites and the Palomas gravels in the area where Greyback Wash emerges from the gap between Animas and Black Peaks (Section 31, T15S, R6W and Section 6, T16S, R6W) are not known. This is the area of historical placer workings and the area of the proposed tailings impoundment.

The extent at depth of the faults within the Palomas Basin, and the amount and direction of offset on the faults are not well known and have been inferred from aerial photographs (Seager et al. 1984; Wilson et al. 1981). The faults in Sections 30-31, T15S, R5W, Sections 5-6, T16S, R5W, and Section 1, T16S, R6W may represent a failed paleo-graben that has been buried by the Palomas gravels. The proposed well field lies in Sections 30-31, T15S, R5W. This area has the best potential for water resource development in this part of the Palomas Basin (Wilson et al. 1981).

Las Animas Placers

Placer gold has been mined intermittently from the drainages southwest of Black Peak and from Greyback Wash, Dutch Gulch, Hunkidori Gulch, and Gold Run since the initial discovery of gold in 1877. Most of the placer production has come from the drainages adjacent to Greyback Wash where it emerges from the gap south of Animas Peak. The gold is found at the base of the paleo-stream terraces and gravels just above the calcite-cemented Palomas gravels. These placers are found at depths up to 15 to 20 feet below the surface (Segerstrom and Antweiler 1975).

3.1.4 Mineral Resources

3.1.4.1 Copper Flat Porphyry

The Copper Flat porphyry has an estimated resource of 100 million tons at a grade of 0.25 percent copper and 0.01 percent molybdenum. Of this estimated resource, the Proposed Action would mine and mill approximately 60 million tons at an estimated average grade of 0.40 percent copper and 0.01 percent molybdenum and would stockpile an estimated 11 million tons of low-grade ore with an average grade of less than 0.18 percent copper. Approximately 51 million tons of waste rock would remain in the proposed overburden piles.

3.1.4.2 Placer Deposits

The past production in the placer deposits was estimated by Segerstrom and Antweiler (1975) to be 125,000 ounces of gold at an estimated average grade of 0.015 ounce/cubic yard (yd^3). These authors estimate that the following resources remain in the placer district, primarily in the Greyback-Hunkidori gulch area: 1) Greyback Wash with 1.2 million yards at 0.006 ounces/yd^3, 2) Hunkidori Gulch with 350,000 yd^3 at 0.003 ounce/yd^3, and 3) historic placer tailings containing 6.8 million yd^3 at 0.003 ounce/yd^3.

3.1.4.3 Vein Deposits

Past production in the vein deposits was estimated by Harley (1934) to be approximately $4.7 million for the period 1877-1931, using historic prices for gold, silver, and copper for that time period. It is unlikely that any resources remain in the historic veins.

3.1.5 Seismic Potential

The Rio Grande Rift is a zone of moderate seismicity (SHB 1980). The majority of seismic events have occurred near Socorro, New Mexico, approximately 85 miles northeast of the project area. Two earthquakes in 1906 near Socorro were about magnitude 6.0 on the Richter Scale (SHB 1980) and represent the largest historical events in the Rio Grande Valley. Studies of microearthquake activity indicate that the portion of the Rio Grande Rift near the project site has been a zone of low seismic activity over the past 10 years (SHB 1980). Figure 3-6, taken from SHB (1980) shows the pattern of earthquakes in southern New Mexico. Table 3-3 gives the location of major earthquakes over the past 100 years that may have affected the project area and the estimated effective peak horizontal ground acceleration (EPA) at the project site (SHB 1980). No active faults have been identified at the project site. The Army Corps of Engineers' seismic zone rating of the project site is 2, based on a historical record of at least one minor earthquake. The potential for earthquake activity in this part of New Mexico is low.

3.2 WATER QUANTITY AND QUALITY

The Water Resources section discusses existing surface and groundwater quantity and quality, water quality in the existing mine pit at Copper Flat, and the quantity and quality of water that has seeped from the existing waste rock and tailings impoundment areas at the mine site.

The description of the affected environment for water resources was produced from: 1) a review of U.S. Geological Survey and New Mexico State Engineers Office publications on water resources in the project area, 2) the hydrologic assessment of the Copper Flat area provided by Newcomer et al. (1993) for the Copper Flat Environmental Assessment, and 3) the Copper Flat Hydrogeological Studies report prepared by SRK (1995) for Alta Gold Company. Details concerning the hydrology of the project area are discussed in the Copper Flat Hydrogeological Studies report on file at the BLM office in Las Cruces, New Mexico.

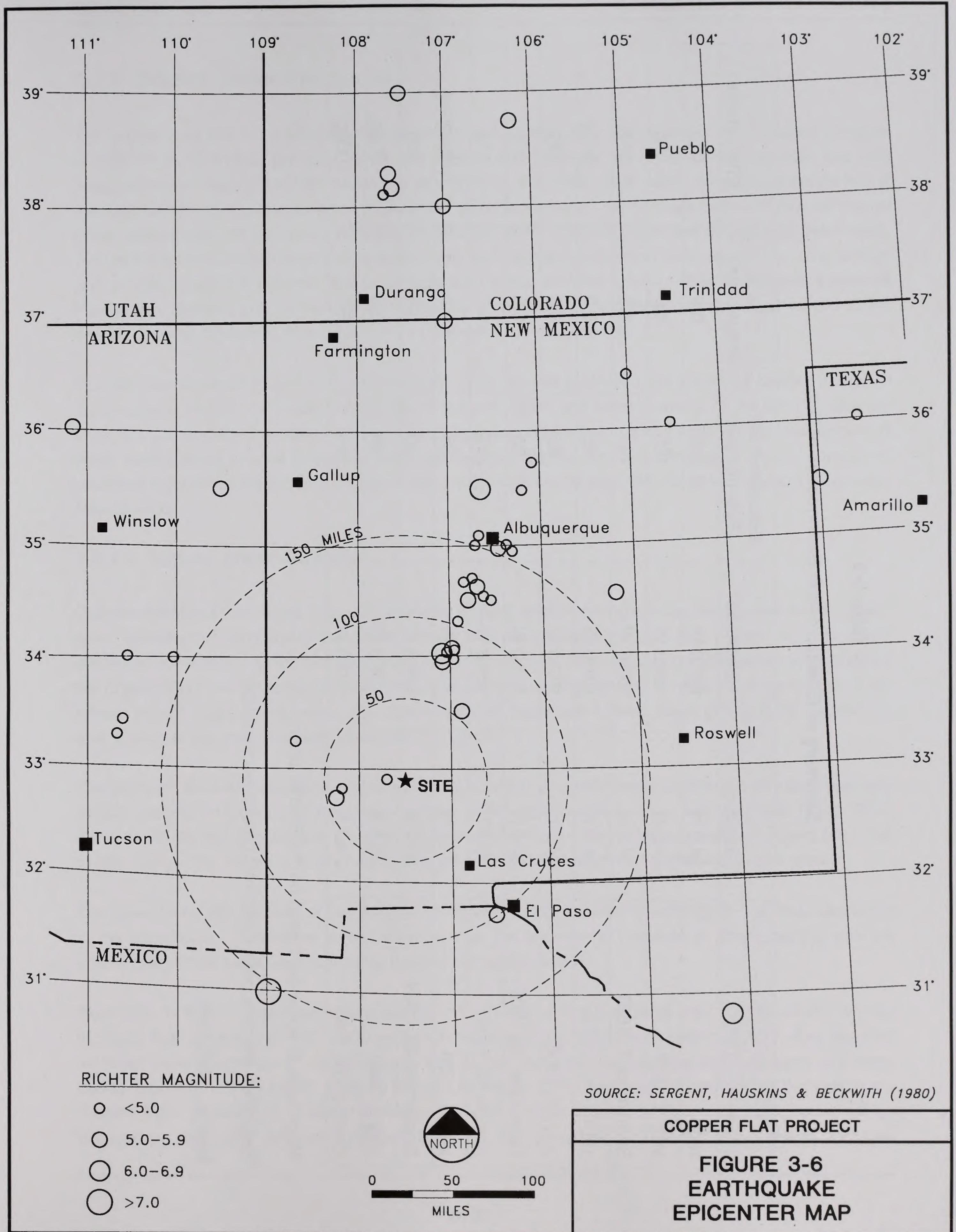


FIGURE 3-6
EARTHQUAKE
EPICENTER MAP

Table 3-3

Summary of Effects of Past Earthquakes at Site

Date	Latitude	Longitude	Distance from Site (miles)	Magnitude[1]	EPA[2] at site
1869	34.0 N	107.0 W	85	5.6	.01g
May 3, 1887	31.0 N	109.0 W	155	8.0	.03g
September 7, 1893	34.7 N	106.6 W	145	5.6	.01g
1897	34.0 N	107.0 W	85	5.0	.005g
July 12, 1906	34.0 N	107.0 W	85	6.0	.02g
November 15, 1906	34.0 N	107.0 W	85	6.0	.02g
August 16, 1931	30.9 N	104.2 W	260	6.3	.01g
May 6, 1934	32.7 N	108.2 W	38	4.3	negligible
September 29, 1934	33.2 N	108.6 W	60	5.5	.02g
July 3, 1961	33.6 N	106.9 W	65	5.0	.005g
October 31, 1985	34.0 N	107.0 W	85	5.0	.005g

[1]Magnitude at epicenter based on the Richter scale.

[2]Estimated effective peak horizontal ground acceleration.

Source: SHB 1980.

3.2.1 Surface Water Resources

The project area lies in the arid semi-desert country of south-central New Mexico. Precipitation averages around 10 to 13 inches per year, while pan evaporation averages 80 to 90 inches per year and lake evaporation averages around 65 inches per year (Wilson et al. 1981; SRK 1995). Most precipitation falls in the form of rain during late summer to early fall (July-September). Winters are cold and dry, with snow falling occasionally on the higher peaks of the Animas Uplift. Surface water flow is generally intermittent. Two streams in the project area, Las Animas Creek and Percha Creek, show fairly regular flow over at least part of their respective courses due to springs and/or late summer rainfall. Flow in the area known as Percha Box appears to be enhanced by spring flow from faults in carbonate bedrock (Figure 3-2). Other creeks, such as Greyback Wash, flow only in response to heavy rainfall.

The Caballo Reservoir (Figure 1-2), which lies along the course of the Rio Grande at the eastern margin of the proposed project area, was constructed in the late 1930s and water quantity, in the form of reservoir level, is controlled by interstate water compacts between New Mexico and Texas. Water quality reflects water quality along the Rio Grande in south-central New Mexico and is controlled in part by agricultural practices adjacent to the Rio Grande and in part by the high evaporation rate for standing water in southern New Mexico.

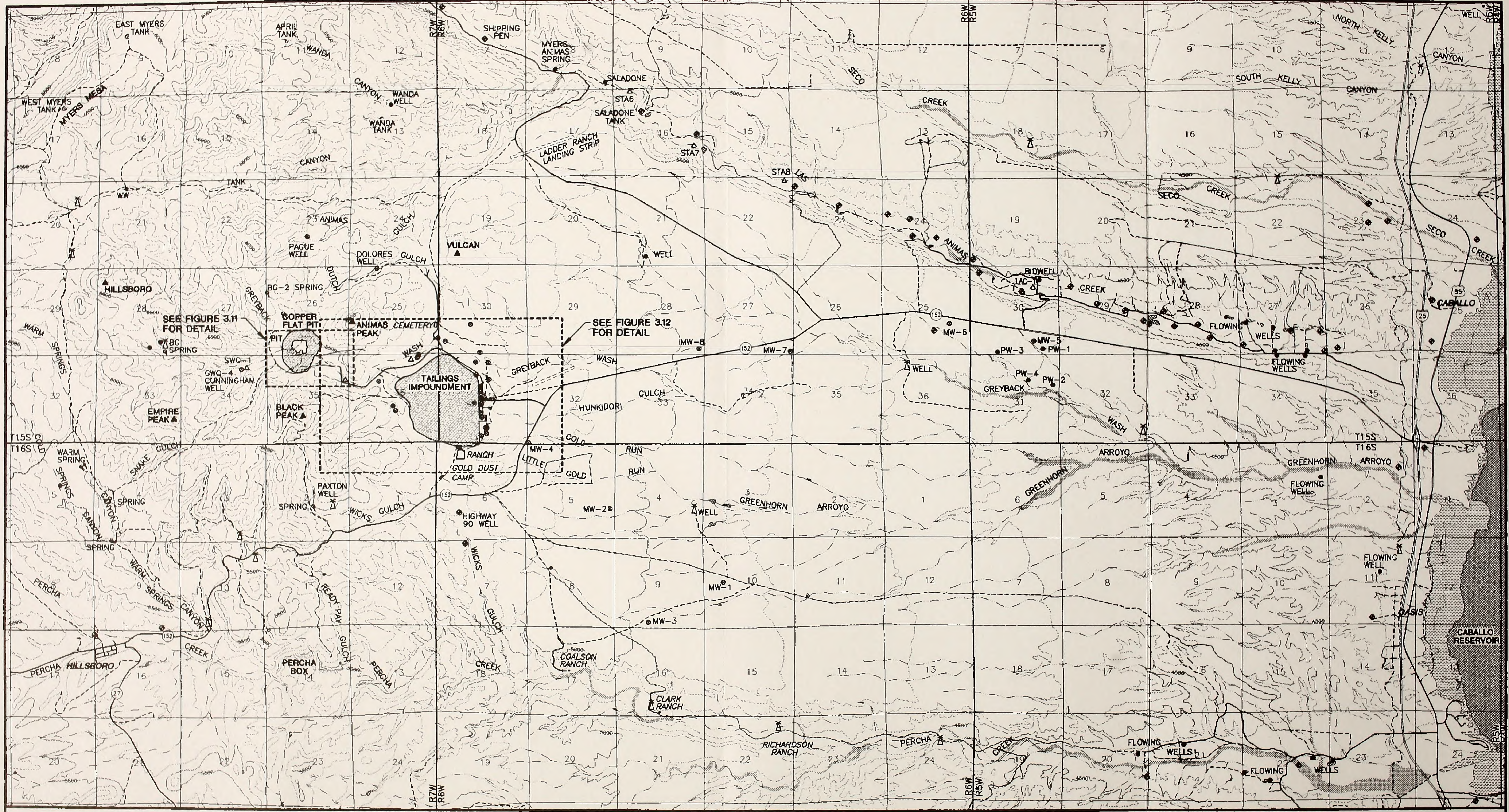
3.2.1.1 Surface Water Quantity

Due to intermittant flow, limited data are available for flow rates in springs, seeps, and creeks in the project area. Locations of springs and wells in the project area are provided in Figure 3-7. Newcomer et al. (1993) attempted to measure spring and seep flow rates in the Copper Flat area as part of their baseline study for the Copper Flat Environmental Assessment and found most springs flowing at rates less than 1.0 gallon per minute (gpm). Many springs were dry. Warm Spring in upper Las Animas Creek (T14S, R7W, Section 35) was flowing at the maximum rate observed, 3.3 gpm.

The study of Las Animas Creek by Davie and Spiegel (1967) provides historical flow rates for the upper and middle reaches or sections of this surface stream. The upper reaches of Las Animas Creek (T14S, R7W, Sections 34-36) had flow rates at gauging stations ranging from 1.0 to 2.0 cubic feet per second (cfs) (448 to 898 gpm). The middle reaches had slightly lower flow rates of 1.0 to 1.5 cfs (448 to 673 gpm).

The upper to middle reaches of Las Animas Creek are "losing reaches" (declining) in that they lose water to the subsurface. Agricultural diversions to ditches are common in Las Animas Creek starting with the middle reach; flow rates are not reliable beyond the middle reach.

Flow rates in Percha Creek were measured by SRK (1995) during the fall of 1994. Their results showed localized flow ranging from 177 to 456 gpm, with many reaches of the creek having no flow. Reaches that exhibited measurable flow averaged roughly 200 to 250 gpm. Most of the flow measurements and water quality reported by SRK (1995) were for the middle reach of Percha Creek around and to the east of the "Percha Box" (Figure 3-7). Farther to the east, Percha Creek leaves the Paleozoic carbonate bedrock exposed by faults and enters the Tertiary Santa Fe Group gravels and sands. Here flow in the creek



LEGEND:

- ● MONITORING WELL
- • WELL
- ⊕ IRRIGATION WELL
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

NORTH

0 5,825 11,650
FEET

COPPER FLAT PROJECT

FIGURE 3-7
SPRING AND WELL LOCATIONS

DATE: NOV/17/1995 ACAD FILE: 476\GND-WAT

disappears during most of the year, and Percha Creek becomes a stream that loses water to the alluvial sands and gravels. Flow reappears near the eastern terminus of Percha Creek due to artestian groundwater conditions that create local springs and flowing wells along the creek.

Newcomer et al. (1993) measured flow rates in Greyback Wash of 12.5 gpm during March of 1993 at a point along this wash that is east and downgradient from the current mine pit and former plant site. Greyback Wash is an intermittent stream that generally flows only during periods of snow melt or heavy precipitation events. Three seep areas were located by the BLM along Greyback Wash; one seep with associated riparian vegetation is located near the buried process reservoir; a second seep is located downstream from this seep and supports a small cottonwood/willow stand; the third seep is located south of the plant area.

Surface water in the area use is mainly for agriculture and stock watering adjacent to the flowing creeks. Surface diversions are generally ditches that lead to irrigated fields or stock tanks. Domestic use of surface water is very limited and confined to permanent dwellings along Las Animas Creek.

3.2.1.2 Surface Water Quality

Water quality is regulated by the State of New Mexico. Water quality standards are set for various types of use for each of the major drainage basins in the State and vary from basin to basin. Table 3-4 summarizes the water quality standards for the project area. Visual comparisons and trends of basic water quality parameters in surface water in the proposed project area are displayed with Stiff diagrams in Appendix A-3. Water quality sampling data for both surface and groundwater are also presented in Appendix A-3. General water quality is summarized below.

Water flowing in the Rio Grande is mildly saline with the total dissolved solids (TDS) ranging from 600 to 3,000 milligrams per liter (mg/l). In the summer months TDS values are lower, while values are consistently above 1,000 mg/l (Wilson et al. 1981) during winter months. Sodium has the highest concentration with a range of 100 to 800 mg/l versus 80 to 150 mg/l for calcium. Sulfate ranges from 200 to 1,000 mg/l, while bicarbonate is in the range of 80 to 150 mg/l. Chloride is typically around 100 to 300 mg/l, but can range up to 800 mg/l. Thus, water in the Rio Grande system is sodium sulfate-dominated with a high chloride content and shows variations in chemistry from summer to winter months (Wilson et al. 1981). State domestic use surface water standards for sulfate and chloride are currently exceeded in the Rio Grande Basin.

Sampling of the Caballo Reservoir during November of 1994 by SRK (1995) showed the water to be sodium bicarbonate-dominated with bicarbonate values of 180 mg/l and sulfate values of 110 mg/l. Chloride values were less than 100 mg/l and TDS was 440 mg/l. The water was within New Mexico human health and domestic use surface water standards for metals, sulfate, chlorine, pH, and TDS.

Surface water flowing in Las Animas Creek has a chemistry dominated by calcium bicarbonate, a pH between 7.0 and 8.0, TDS around 300 mg/l, and falls within New Mexico human health and domestic use surface water standards for these constituents in the lower Rio Grande Basin area (SRK 1995; Appendix A-3).

Table 3-4

New Mexico Water Quality Standards[1]

Parameter	Discharge Onto Surface or to Groundwater (mg/l)			General Standards (mg/l)		
	Human Health	Domestic Use	Irrigation Use	Domestic Use	Irrigation Use	Livestock/Wildlife
Arsenic	0.10			0.05	0.10	0.02
Barium	1.00			1.00		
Cadmium	0.01			0.01	0.01	0.05
Chromium	0.05			0.05	0.10	1.00
Cyanide	0.20			0.20		
Fluoride	1.60					
Lead	0.05			0.05	5.00	0.10
Mercury	0.002			0.002		0.01
Total Nitrogen	10.00			10.00		
Selenium	0.05			0.05	0.13(0.25)	0.05
Silver	0.05			0.05		
Uranium	5.00			5.00		
Total Radium	30 Pci/L[2]			30 Pci/L[2]		30 Pci/L[2]
Copper		1.00			0.20	0.50
Iron		1.00				
Manganese		0.20				
Zinc		1.00			2.00	25.00
Aluminum			5.00		5.00	5.00
Boron			0.75		0.75	5.00
Cobalt			0.05		0.05	1.00
Molybdenum			1.00			
Nickel			0.20			
Vanadium					0.10	0.10
pH		6-9				
Total Dissolved Solids		1000.00				
Sulfate		600.00				
Chloride		250.00				
Phenols		0.005				
Benzene	0.01					
Toluene	0.75					
Carbon Tetrachloride	0.01					
Total Xylenes	0.62					

[1]All units are in mg/L (milligrams/liter) unless otherwise stated.
[2]Pci/L = Picocuries/Liter
Source: New Mexico Water Quality Commission Regulations as amended through October 12, 1993. Water quality standards for interstate streams in New Mexico, November 12, 1991.

Surface water flowing in Percha Creek also has a chemistry dominated by calcium bicarbonate, a pH in the 7.0 to 8.0 range, a TDS that ranges from 300 to 400 mg/l, and water quality that falls within the New Mexico human health and domestic use surface water standards for the lower Rio Grande Basin area, except for fluoride which ranged from 2.0 to 3.7 mg/l and exceeded the standard of 1.6 mg/l (SRK 1995).

Surface water flowing in Greyback Wash was sampled by Newcomer et al. (1993). One sample point was upgradient from the existing pit (SWQ-1), one sample point was just downgradient from the pit but still within the area of mining disturbance (SWQ-2), and the third sample point was approximately 1 mile from the pit near the Guest House (SWQ-3), as shown on Figure 3-7. Water quality in Greyback Wash upstream from the current mine pit and pit lake (SWQ-1) showed a pH in the 7.4 to 8.3 range, bicarbonate values around 400 to 500 mg/l, sulfate in the 275 to 300 mg/l range, and TDS in the 780 to 965 mg/l range. Based on this sampling, water in Greyback Wash upgradient of the existing mining disturbance was just within New Mexico human health and domestic use surface water standards and was dominated by calcium bicarbonate, but carried appreciable sulfate.

As water in Greyback Wash passed the mining area and the pit, sodium levels increased from 107 mg/l to about 270 mg/l, TDS increased to the 2,300 to 3,300 mg/l range, and sulfate levels increased to 1,150 to 1,650 mg/l. The pH did not change and metals did not change appreciably. Water exiting the area of existing mining disturbance in Greyback Wash was dominated by calcium/sodium sulfate and exceeded New Mexico domestic use surface water standards for sulfate and TDS, but was within standards for pH and metals; and met livestock/wildlife standards for measured parameters.

Water in the mine pit sampled by Newcomer et al. (1993) had a pH of 7.2 in 1991; this pH decreased to 4.4 to 4.9 in 1992, and then increased to 5.6 in 1993. Measurements of pH variation with depth in 1993 showed an increase in pH to 6.7 at 40 feet, compared to the pH of 5.6 near the shore. Variations in pH from 1991 to 1993 may be attributable to variations in sampling techniques and precipitation events during the sampling period. Pit water sampled by Newcomer et al. (1993) had a TDS of 2,700 mg/l in 1991; this value increased to a range of 3,800 to 4,200 mg/l by 1993. Pit water was dominated by calcium and sulfate, with sulfate in the 2,300 to 2,800 mg/l range and calcium ranging from 580 to 610 mg/l. Fluoride was elevated and in the 4.0 to 6.0 mg/l range. Manganese ranged from 1.8 to 4.3 mg/l, copper ranged from 1.4 to 3.2 mg/l, zinc from 1.4 to 1.8 mg/l, and cadmium from .01 to .035 mg/l. All of these metal levels exceeded the New Mexico human health and domestic use surface water standards. Other metals were either below detection limits or within New Mexico human health and domestic use standards. In general, pit water sampled by Newcomer was calcium sulfate-dominated with a pH in the 4.0 to 6.0 range, TDS in the 2,000 to 4,000 mg/l range, and sulfate in the 2,000 to 3,000 mg/l range. This water exceeded New Mexico human health and domestic use surface water quality discharge standards for pH, sulfate, TDS, fluoride, manganese, zinc, copper, and cadmium. Pit water exceeded livestock/wildlife standards for copper, but met zinc, chromium, and cadmium standards.

Sampling of the pit water by SRK (1995) during November 1994 showed a pH of 7.5 to 7.7, TDS in the range of 4,300 to 4,600 mg/l, sulfate values around 2,900 mg/l, and water that could be characterized as calcium-sodium-magnesium sulfate dominated. Differences in pH values obtained by Newcomer et al. (1993) and SRK (1995) may have been due to seasonal variations, precipitation events occurring during sampling, and different sampling techniques. Except for pH, the values obtained by SRK (1995) were comparable to those of Newcomer et al. (1993), although sulfate and TDS measured by SRK (1995) were slightly higher than values for these constituents measured by Newcomer et al. (1993). Pit water sampled by SRK also exceeded New Mexico human health and domestic use surface water quality discharge standards for sulfate, TDS, manganese, fluoride, and cadmium.

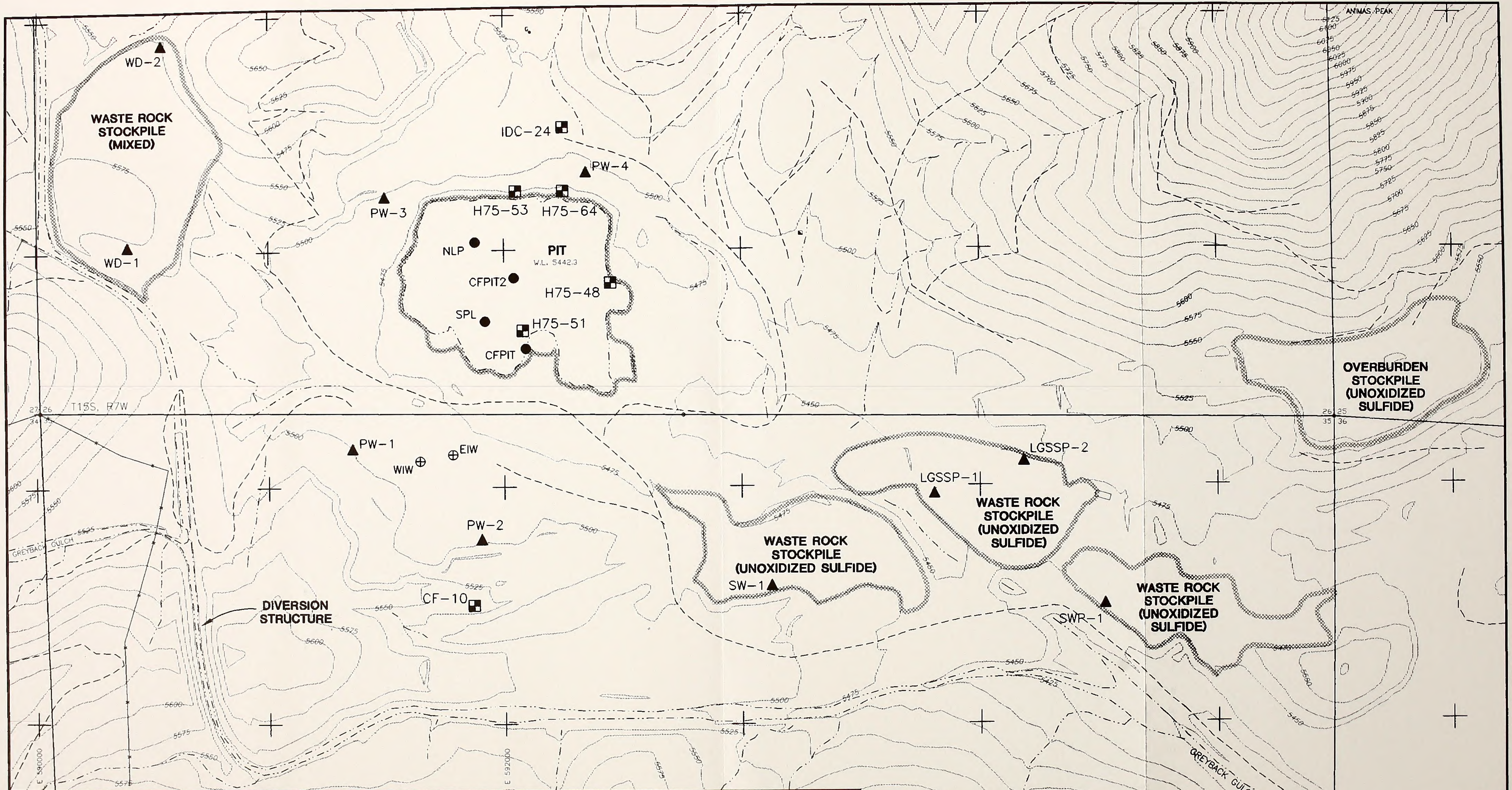
3.2.1.3 Waste Rock Piles

Currently, there are several million tons of waste rock piled on the surface along the southeast slope of Animas Peak (Sections 25-26, T7W, R15S) and in various piles around the pit and in the area of the old plant site (Figure 3-8). This waste rock was generated by Quintana Minerals during their operation of the open-pit mine during 1982 (SRK 1995). Newcomer et al. (1993) reported a small (less than 1 gpm) seep issuing from a sulfide waste rock pile into a sedimentation pond in the old plant site area. The water had a pH of 1.9, sulfate values in the 10,000 mg/l range, and fluoride values of 11.1 mg/l. The water was calcium-magnesium-sulfate-dominated and may have been in equilibrium with gypsum.

During a recent site visit, SRK identified a small area of sulfate precipitation near the base of the East Waste Rock Disposal area; this area is believed to be the site that Newcomer identified as a waste rock seep. No water or evidence of significant flow from the area was identified (Parshley 1995b). Construction of the East Waste Rock Disposal area as described in the Proposed Action should mitigate this area and limit the likelihood of similar seeps occurring in the future.

SRK (1995) classified rock in the mining district as: 1) oxidized, 2) transitional or partially oxidized, and 3) unoxidized. Unoxidized rock consists mainly of pyritic quartz monzonite or pyritic andesite with pyrite contents up to 4 percent, but generally in the 0.50 percent to 2.0 percent range, and can be acid-generating given sufficient time, water, and oxygen. In oxidized rock the pyrite has generally oxidized to iron oxides; transitional rock is partially oxidized and contains both iron oxides and pyrite and can also be acid-generating under specific combinations of water, air, and waste rock. The existing waste rock piles shown on Figure 3-8, are divided into: 1) the mixed waste rock piles west and north of the pit; 2) unoxidized sulfide waste rock piles southeast of the pit in the area of the old plant site; and 3) the unoxidized sulfide waste rock pile along the southeast slope of Animas Peak.

Table 3-5 (SRK 1995) shows that waste rock currently on site or exposed in pit walls has the chemical capability to be acid generating as indicated by its low net neutralizing potential (NNP). In Table 3-5, samples from the mixed waste rock pile have the prefix WD-#, samples from the sulfide waste rock piles have the prefix SW-# or LGSSP-#, and samples from the pit walls that are mostly oxidized or transitional rocks have the prefix PW-#. Drill holes within and around the pit that contained unoxidized pyritic rocks have the prefix H75-#, CF10-#, or IDC-#. Unoxidized pyrite-bearing rock present in the sulfide waste rock piles or sampled in the drill holes within and around the pit has total sulfide NNP values generally less than 1 (negative) and neutralizing potential/acid-generating potential (NP/AP) ratios less than 3.0 and usually less than 1.0. NNP values less than 0 and NP/AP values less than 3.0 generally suggest acid-generating capability. Oxidized rock in the pit walls and in the mixed waste rock pile also has the chemical capability for acid generation. A Modified EPA 1312 Procedure leach test conducted during SRK's studies (1995) on



SOURCE: SRK 1995

LEGEND:

H75-51 — SAMPLED DRILL HOLE COLLAR LOCATION (APPROXIMATE)

PW-1 — SURFACE GRAB SAMPLE LOCATION

CFPIT — PIT LAKE SAMPLES

WIW — EXISTING WELL

MIXED = MIXED UNOXIDIZED AND OXIDIZED SULFIDE-BEARING WASTE ROCK

EXISTING WASTE ROCK BOUNDARIES

UNOXIDIZED SULFIDE = UNOXIDIZED SULFIDE-BEARING WASTE ROCK

SCALE IN FEET

410 0 820

NORTH

COPPER FLAT PROJECT

FIGURE 3-8
PIT LAKE AND WASTE ROCK SAMPLING LOCATIONS

DATE: OCT/19/1995 476\401\SAMPLINE

Table 3-5

Summary of Static Test Results

Sample ID	Sample Description (see Figures 3-8 & 3-9 for locations)	Type	Paste pH	Total Sulfur (%)	Pyritic Sulfur (%)	Sulfate Sulfur (%)	NP (t/kt)	Sulfide Sulfur (%)	Undefined Sulfur (%)	Pyrite			Sulfide			Acid-Generating Capabilities
										AP (t/kt)	NNP (t/kt)	NP/AP	AP (t/kt)	NNP (t/kt)	NP/AP	
Tailings																
T-10-12	Tailings from Borehole SRKBH-1-94	--	7.8	1.26	0.68	0.03	24	1.23	0.55	21.25	2.75	1.13	38.44	-14.44	0.62	Yes
T-5-7	Tailings from borehole SRKBH-1-94	--	7.5	1.10	0.53	0.18	31	0.92	0.39	16.56	14.44	1.87	28.75	2.25	1.08	Yes
	Average	--	--	1.18	0.61	0.11	28	1.08	0.47	18.91	8.59	1.50	33.59	-6.10	0.85	Yes
Waste Rock																
WD-1	West Dump Area, QM Waste Rock	M	2.7	4.34	2.12	0.005	0.1	4.34	2.22	66.25	-66.15	0.00	135.47	-135.37	0.00	Yes
PW-3	Pit Wall, Northwest of Pit Lake	O/T	2.6	2.20	0.84	0.005	0.1	2.20	1.36	26.25	-26.15	0.00	68.59	-68.49	0.00	Yes
SW-1*	Sulfide Waste Pile, QM Waste Rock	U	--	1.36	0.47	0.005	36	1.36	0.89	24.69	21.31	2.45	42.34	-6.34	0.85	Yes
PW-2*	Pit Wall, Oxidized Cap Rock	O/T	--	0.37	0.04	0.005	11	0.37	0.33	1.25	9.75	8.80	11.41	-0.41	0.96	No
PW-4	Pit Wall, Northeast of Pit Lake	O/T	3.9	1.89	0.78	0.005	16	1.89	1.11	24.38	-8.38	0.66	58.91	-42.91	0.27	Yes
SWP-1	Sulfide Waste Pile, QM Rock	U	6.8	3.08	1.46	0.005	40	3.08	1.62	45.63	-5.62	0.88	96.09	-56.09	0.42	Yes
LGSSP-1	Sulfide Waste Pile, QM Rock	U	6.6	1.52	0.61	0.005	47	1.52	0.91	19.06	27.94	2.47	47.34	-0.34	0.99	Yes
LGSSP-2*	Sulfide Waste Pile, QM Rock	U	6.9	0.61	0.20	0.005	39	0.61	0.41	6.25	32.75	6.24	18.91	20.09	2.06	No
WD-2	West Dump Area, QM Waste Rock	M	--	1.98	0.87	0.005	60	1.98	1.11	27.19	32.81	2.21	61.72	-1.72	0.97	Yes
IDC-24-222-241*	QM From IDC Drillhole 24, 222-241 Feet	U	--	1.74	0.75	0.005	31	1.74	0.99	23.44	7.56	1.32	54.22	-23.22	0.57	Yes
CF10-177.8-190	Andesite From Drillhole CF10, 177.8-190	U	--	2.86	1.77	0.06	52	2.80	1.03	55.31	-3.31	0.94	87.50	-35.50	0.59	Yes

Table 3-5 (Continued)

Sample ID	Sample Description (see Figures 3-8 & 3-9 for locations)	Type	Paste pH	Total Sulfur (%)	Pyritic Sulfur (%)	Sulfate Sulfur (%)	NP (t/kt)	Sulfide Sulfur (%)	Undefined Sulfur (%)	Pyrite			Sulfide			Acid-Generating Capabilities
										AP (t/kt)	NNP (t/kt)	NP/AP	AP (t/kt)	NNP (t/kt)	NP/AP	
CF10-190-199*	QM From Drillhole CF-10, 190-199	U	--	3.59	1.09	0.07	44	3.52	2.43	34.06	9.94	1.29	110.00	-66.00	0.40	Yes
CF10-214-220	QM From Drillhole CF10, 214-220	U	--	3.92	2.05	0.005	65	3.92	1.87	64.06	0.94	1.01	122.34	-57.34	0.53	Yes
H75-53-42	QM, Reverse Circulation Cuttings	U	8.2	1.77	0.88	0.005	36	1.77	0.89	27.50	8.50	1.31	55.16	-19.16	0.65	Yes
H75-64-44	QM-Reverse Circulation Cuttings	U	7.2	1.69	0.69	0.005	39.	1.69	1.00	21.56	17.44	1.81	52.66	-13.66	0.74	Yes
H75-51-34	QM, Reverse Circulation Cuttings	U	8.6	2.02	0.72	0.005	49	2.02	1.30	22.50	26.50	2.18	62.97	-13.97	0.78	Yes
H75-48-58	QM, Reverse Circulation Cuttings	U	7.2	1.18	0.38	0.005	16	1.18	0.80	11.88	4.13	1.35	36.72	-20.72	0.44	Yes
H75-48-44	QM, Reverse Circulation Cuttings	U	7.4	1.06	0.15	0.005	9	1.06	0.91	4.69	4.31	1.92	32.97	-23.97	0.27	Yes
PW-1	Pit Wall, SW of Pit, Transition Zone, QM	O/T	6.1	3.61	2.00	0.14	32	3.47	1.47	62.50	-30.50	0.51	108.44	-76.44	0.30	Yes
	Average	--	--	2.15	0.94	0.02	33	2.13	1.19	29.39	3.36	1.97	66.51	-33.77	0.62	Yes

Source: SRK 1995.
*Samples selected for kinetic testing.
[1]M = Mixed waste rock.
O/T = Oxidized and/or transitional waste rock.
U = Unoxidized sulfide waste rock.

[2]Sulfide sulfur = Total sulfur-sulfate sulfur

[3]AP = Acid-Generating Potential.
AP (Pyrite) = Pyrite sulfur x 31.25
AP (Sulfide) = (Total Sulfur - sulfate sulfer) x 31.25
NP = Neutralizing Potential.
NNP = Net Neutralizing Potential (NP-AP).
NP/AP = The ratio of the neutralizing potential to the acid-generating potential of the waste rock. If the ratio is less than 3:1, the rock has acid-generating chemical potential.
t/kt = Tons per kiloton.

Notes: Sulfate sulfer non-detect reported as ½ of the detection limit. Neutralization potential non-detect reported as 1/10 of the detection limit.

mixed waste sample WD-1 (Figure 3-8), showed that rain water flowing through the mixed waste rock pile could yield an effluent (seep) carrying 102 mg/l iron, 3.35 mg/l manganese, 13.6 mg/l copper, and 3,050 mg/l sulfate. This seep, if it were to occur, would exceed New Mexico human health and domestic use surface water standards for metals, sulfate, and TDS. The unoxidized sulfide waste rock pile on the southeast slope of Animas Peak has been in place for 10 to 12 years and has not produced visible evidence of acid generation, with the exception of a small sulfate precipitation area located by SRK near the base of the existing East Waste Rock Disposal area immediately north of the tailings thickener below a portion of the disposal area that contained a local zone of transitional waste rock material. No water or evidence of major or recent flow was observed in the area (Parshley 1995b). The unoxidized sulfide waste rock piles southeast of the pit in the old plant site area have paste pH values in the 6.0 to 7.0 range, suggesting that the pyrite in these waste rock piles (up to 2.0 percent) has not appreciably oxidized in the past 10 to 12 years.

3.2.1.4 Existing Tailings Facility and Surface Water Effects

During 1982, Quintana Minerals deposited 1.2 million tons of tailings (SRK 1995) in the existing tailings impoundment facility (Figure 1-3). This tailings facility consists of a tailings dam approximately 50 feet high and a two-compartment tailings impoundment area behind a 6,600-foot-long dam with installed decant towers. Tailings consist of approximately 50 percent water and 50 percent sand-sized crushed rock and minerals that are discarded because they have no economic value. The existing tailings facility is unlined and has completely drained over the past 10 to 12 years, releasing an estimated 100 to 150 million gallons of water to the subsurface. Monitor wells installed in front of the tailings dam by Quintana detected this seepage of water from the tailings as an increase in water levels and an increase in sulfate with time. Figure 2-4 illustrates the geology below the tailings impoundment and the proposed placement of seepage capture wells in front of the current tailings dam (SRK 1995).

The chemistry of the tailings water that seeped into the subsurface and ultimately into shallow groundwater in the alluvium beneath and in front of the tailings facility was probably similar to the water chemistry of the tailings decant liquid reported by Newcomer et al. (1993). This decant liquid, taken from the tailings impoundment lake present during previous operations, had a pH of 7.8, a TDS of 2,230 mg/l, a sulfate concentration of 1,440 mg/l, and a fluoride level of 1.46 mg/l. The fluid was a sodium-calcium sulfate-dominated water with bicarbonate less than 100 mg/l. A Modified EPA 1312 Procedure leach of the tailings reported by SRK (1995) showed sulfate levels to 940 mg/l and calcium to be more abundant than sodium. Drain water sampled by Quintana during the 3 months of operation of the tailings impoundment in 1982 reported sulfate in the 395 to 460 mg/l range and TDS in the 710 to 1,130 mg/l range. Although the tailings have the chemical potential for acid generation, a paste pH test result reported by SRK (1995) gave values of 7.5 to 7.8, suggesting that acid generation is not occurring. The water quality values reported by Newcomer et al. (1993) and SRK (1995) suggest that the tailings fluid released by the existing tailings was a calcium to calcium-sodium-sulfate-dominated water with elevated TDS and sulfate that exceeded New Mexico human health and domestic use surface water standards. The tailings currently have been reclaimed, and borings drilled into the thickest section of the tailings in 1994 indicated that the tailings are no longer in a super-saturated condition (Parshley 1995b). However, the groundwater mounding formed beneath the tailings impoundment during previous operations still continues to dissipate as evidenced by continued high sulfate values identified during SRK's tailings water (1995) sampling.

The tailings impoundment facility is located above an area of north-northwesterly and northwest-southeasterly (NW-SE) trending fault intersections, as shown in Figure 3-9. The north-northwesterly (N-NW) faults (referred to as NS-# faults) are basin margin faults for the Palomas Basin and probably form the western boundary of the basin. The NW-SE trending faults (referred to as NW-# faults), trend approximately N65W and are probably the eastward extension of the Patten-Lewellyn fault system found in the mining district (Figure 3-4). The NW-SE faults control the paleo-drainages in the alluvial gravels that overlie the Palomas Formation. These gravels were and are mined for placer gold. Fault NW-1 may have localized seepage from past use the tailings facility that led to the artesian flow and increased sulfate and TDS found in wells NP-3 and IW-1 (Figure 3-9). The north-northwesterly fault NS-1 could act as a barrier to flow because it is a basin-margin fault, however, groundwater studies by SRK (1995) that included drilling and geophysical evaluations suggest that this and the other basin-margin faults may not act as barriers to eastward flow of groundwater from the mining district and the tailings impoundment.

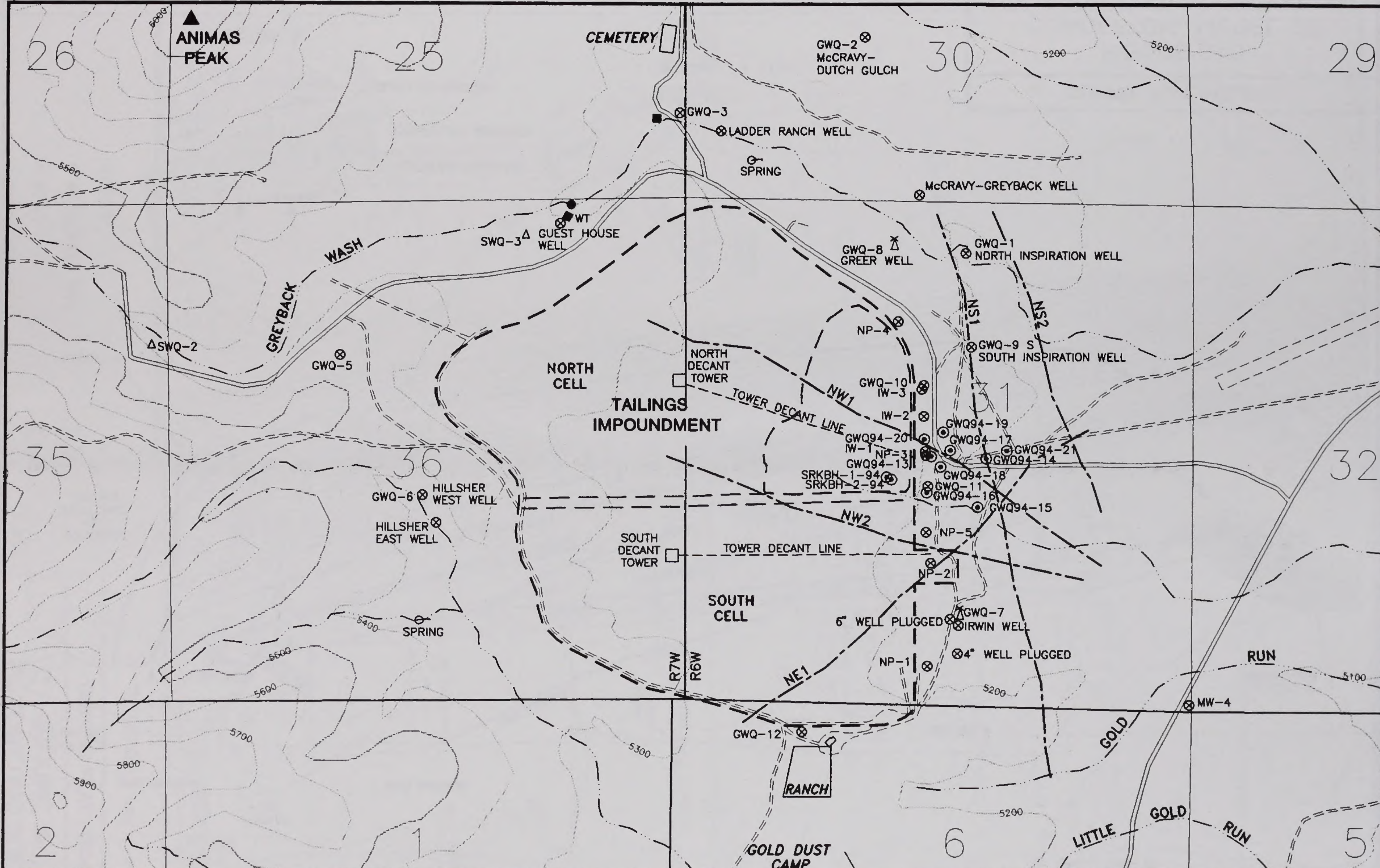
3.2.2 Groundwater Resources

Groundwater provides a major source of water for domestic and agricultural consumption in southern New Mexico. The high evaporation rate during the long, hot summers and the low precipitation rate result in surface waters being an unreliable source of water on a year-round basis. The Rio Grande provides water for both New Mexico and Texas. Intermittent streams that feed the Rio Grande, such as Las Animas Creek and Percha Creek in the project area, are local sources of water for at least part of the year. Additional water comes from shallow domestic and agricultural wells. Water in the Lower Rio Grande Basin is fully appropriated.

3.2.2.1 Regional Groundwater System

Groundwater in the lower Rio Grande basin flows from the highlands on either side of the basin through bedrock and valley alluvium to the center of the basin and to the Rio Grande itself. See Figure 3-10 for a conceptual model of groundwater flow in the project region. Bedrock aquifers in the Paleozoic sedimentary rocks are recharged by snowmelt and heavy rains in the highlands by flow along faults and bedding planes. This water flows along a hydraulic gradient toward the approximate center of the Rio Grande Valley. Occasionally, this deep regional flow surfaces as springs along faults where the Paleozoic bedrock outcrops within the valley. This occurs in Percha Creek at a locality called "Percha Box", where springs follow faults and provide surface flow to this middle reach of Percha Creek. Figure 3-11, taken from SRK (1995), shows the current configuration of groundwater table elevations in the project area. Groundwater near the existing pit lies at approximately 5,400 feet; groundwater near Caballo Reservoir lies at about 4,200; a difference of 1,200 feet.

Valley alluvium is recharged by precipitation along mountain fronts where the alluvial fans are exposed and by streams that flow out of the highlands and loose water to the alluvium as they flow toward the Rio Grande. Many intermittent streams, such as Las Animas Creek and Percha Creek, are "losing streams" over



LEGEND:

⊗ PRE-1994 GROUNDWATER MONITORING WELL

⊙ 1994 GROUNDWATER MONITORING WELL

—·— FAULT

WINDMILL

SPRING

△ SURFACE WATER SAMPLE SITE

SOURCE: SRK (1995)

NORTH

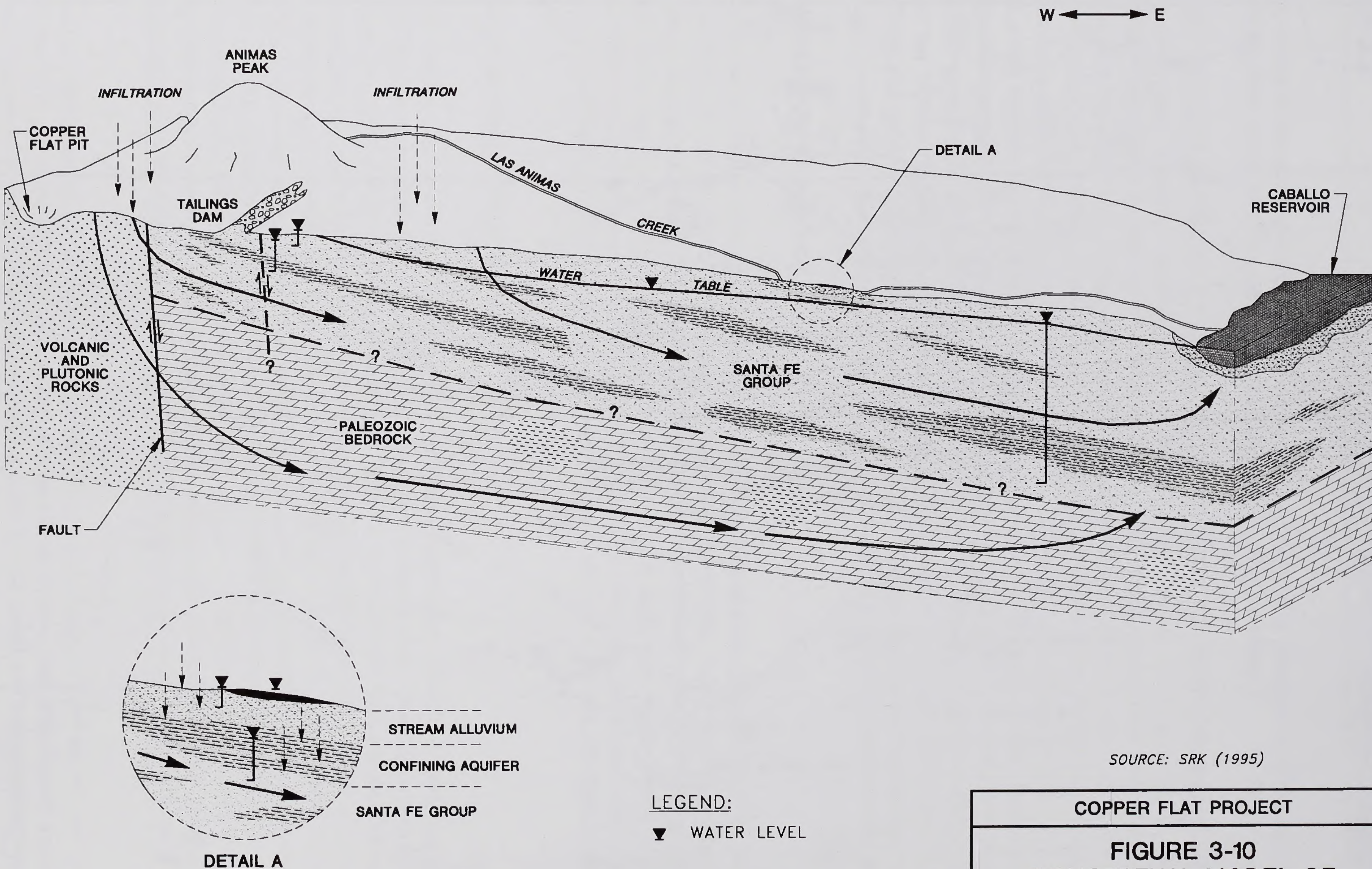
0 1456 2912

FEET

COPPER FLAT PROJECT

FIGURE 3-9
TAILINGS IMPOUNDMENT FAULT AND WELL LOCATIONS

DATE: NOV/17/1995 ACAD FILE: 476\TAIL-WEL



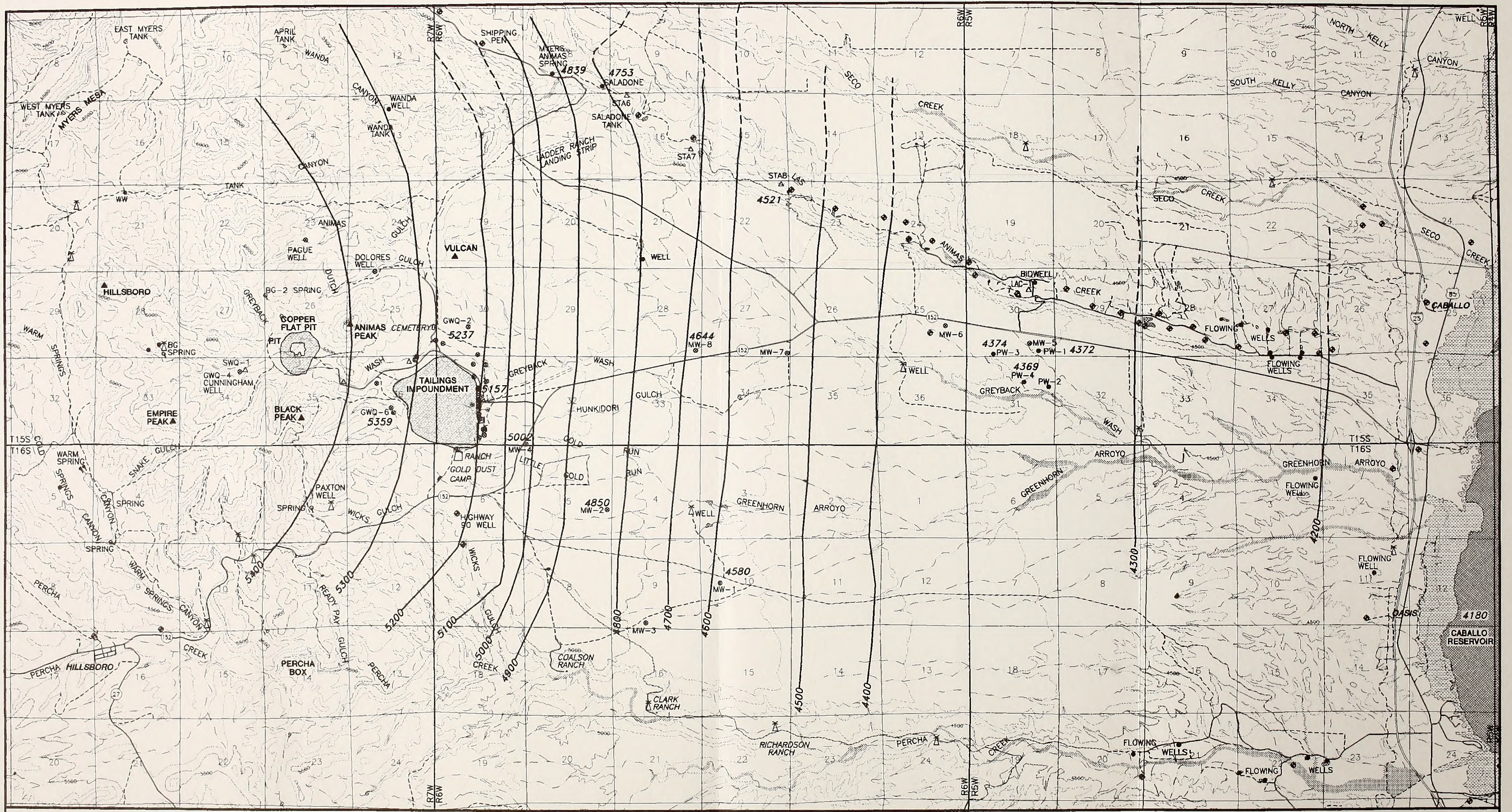
NOT TO SCALE

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE 3-10
CONCEPTUAL MODEL OF
GROUNDWATER FLOW SYSTEM

NOV/17/1995 ACAD FILE: 12-476\WFL-CON



LEGEND:

- MONITORING WELL
- WELL
- IRRIGATION WELL
- WINDMILL
- SPRING
- STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE
- 5400 —— PIEZOMETRIC ELEVATIONS IN FEET

NORTH

0 5,825 11,650
FEET

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE 3-11
PIEZOMETRIC SURFACE MAP

DATE: NOV/17/1995 ACAD FILE: 476\PIEZ-EL

at least part of their reach. This alluvial groundwater then flows downgradient to the Rio Grande. Most areas within the lower Rio Grande Valley that have not been significantly disturbed by human activity are in hydraulic equilibrium. That is, water coming into the system by precipitation recharge is balanced by outflow to major streams, evapotranspiration, and interbasin flow.

3.2.2.2 Local Groundwater System

The local groundwater system within and near the Proposed Action consists of two main components: 1) groundwater in the volcanic rocks and the intrusive porphyry that dominate the mine area, and 2) groundwater within the alluvial sediments of the Palomas Basin adjacent to the mine and in the area of the proposed well field for production water. Groundwater in the alluvial sediments beneath and just downgradient from the existing tailings impoundment has been impacted by seepage from the existing tailings over the past 10 years.

3.2.2.2.1 Groundwater within the Mining District

Groundwater within the mining district and the area of the present open pit is hosted in andesitic volcanic rocks. The current groundwater level of the pit water reported by SRK (1995) is 5,443 feet mean sea level (msl). Newcomer et al. (1993) measured a water level of 5,370 feet (msl) in well GWQ-5, which is approximately 4,000 feet east-southeast from the pit and within the old plant site area (Figure 3-9). These authors also reported a water level of 5,360 feet (msl) in the Hillscher West well (GWQ-6), which lies approximately 2,500 feet southeast from well GWQ-5. These limited groundwater elevation data suggest that if hydraulic communication exists between the wells and the current pit at Copper Flat, the groundwater gradient in the andesitic volcanic rocks may be to the east or southeast from the current pit lake. Springs to the west of the pit are located at elevations of 5,700 to 5,900 feet (msl), but may reflect local perched aquifers that do not have hydraulic communication with groundwater near the pit. A basin-margin fault approximately 10,000 to 12,000 feet east of the current pit probably restricts eastward flow of water within the andesites of the mining district. Regional groundwater flow in the Rio Grande Basin is generally towards the Rio Grande (Parshley 1995b).

Water sampling by Newcomer et al. (1993) showed that two springs west of the current pit (wells BG and BG-2 on Figure 3-7) have a pH in the range of 8.0 to 8.2, bicarbonate values ranging from 411 to 535 mg/l, sulfate values of 184 to 228 mg/l, and TDS of approximately 600 to 700 mg/l based on a conductivity of around 1,000 µmhos/cm with a correction factor of 0.65. The springs have sodium-magnesium-calcium bicarbonate-dominated groundwater. Well GWQ-4, which is west and upgradient from the current pit lake, has groundwater with a pH equal to 7.2 to 7.6, TDS in the 600 mg/l range, bicarbonate in the 400 mg/l range, and sulfate in the 250 mg/l range. This water is calcium-sodium-magnesium bicarbonate-dominated groundwater and is sufficiently different from the spring water to suggest that groundwater along Greyback Wash in the mine area is separate hydrologically from the perched water that feeds the springs.

Only two groundwater wells are downgradient from the current pit lake in the mining district; well GWQ-5 in the old plant site area and well GWQ-6 at the Hillscher West site. Sampling of these two wells by Newcomer et al. (1993) showed that this groundwater had pH values of 7.3 to 7.7, and TDS ranging from

360 mg/l (well GWQ-6) to 900 mg/l (well GWQ-5). In well GWQ-5, which is approximately 4,000 feet due east-southeast from the current pit lake, sulfate levels exceeded bicarbonate levels with values in the range of 575 mg/l, versus 398 mg/l for bicarbonate. In well GWQ-6, the sulfate was less than 50 mg/l and bicarbonate was in the range of 300 mg/l. Thus, water in well GWQ-5 was calcium-sodium-magnesium sulfate-dominated with high bicarbonate, while water in GWQ-6, which is approximately 2,000 feet farther from the pit lake, was calcium-sodium-magnesium bicarbonate-dominated. This suggests that water may be currently flowing from the pit lake into groundwater within the mining district and moving slowly to the east-southeast. An alternate explanation is that water in well GWQ-5 was contaminated during mining and milling because it lies within the old plant site at the mine. Water quality in the mining district is illustrated on Piper and Stiff diagrams in Appendix A-3.

3.2.2.2.2 Groundwater within the Palomas Basin

Groundwater in the Palomas Basin reflects the geology and particularly the stratigraphy of the sediments within the basin. As discussed earlier (Section 3.1.2, Regional Geological Setting), the stratigraphy of the sediments within the Palomas Basin consists principally of three units: 1) upper stream and floodplain alluvial sands and gravels along the major drainages, including the Rio Grande; 2) alluvial fan sands, gravels, and clays of the Palomas Formation which underlie the stream and floodplain sediments, thicken eastward from the foothills of the Animals Uplift, and are interbedded with alluvial clays of the ancient Rio Grande drainage starting about 5 miles west of the current position of the Rio Grande; and 3) the Rincon Valley Formation lacustrine red clays that underlie the Palomas Formation and thicken southward toward Hatch, New Mexico, and the Rincon Basin (Wilson et al. 1981). The Palomas Formation is the upper member of the Tertiary Santa Fe Group and the Rincon Valley Formation is the lower member of the Santa Fe Group in the Palomas Basin (Table 3-1). Each of these three stratigraphic units can also act as a hydrostratigraphic unit and contain groundwater that can be separate from groundwater in the other units, or can interact with groundwater in the other units.

Groundwater in the western part of the Palomas Basin, in the vicinity of Gold Dust Camp (Figure 3-7), begins about 30 feet above the contact between the Palomas Formation gravels and the reddish-brown clays of the Rincon Valley Formation (Wilson et al. 1981). This contact is approximately 300 to 500 feet down from the surface. The groundwater gradient is approximately 100 feet/mile to the east and the water table can be within the Palomas Formation or the Rincon Valley Formation, as the contact between these two units is a highly irregular erosional contact. Near the center of the Palomas Basin, in the vicinity of the proposed well field (Sections 30 and 31, T15S, R5W), the Palomas Formation is approximately 1,000 feet thick and groundwater is about 300 feet below the surface (Newcomer et al. 1993). Farther to the east toward Caballo Reservoir, the Palomas Formation gravels are interbedded with clays of the ancient Rio Grande and water is found confined within gravel beds that lie between clay beds (Davie and Spiegel 1967). The groundwater gradient decreases to approximately 25 feet per mile from here to the Rio Grande. This confined water often has a pressure surface (potentiometric surface) that lies above ground elevation, producing artesian flow in wells drilled along lower Las Animas Creek. This artesian flow ranges from 10 to 40 gpm.

Groundwater within the Palomas and Rincon Valley formations is generally semi-confined, and can range from unconfined in areas of the Palomas Formation with low clay content to confined in areas with high clay content. The stream alluvium along Las Animas Creek is deposited along an erosional surface cut into the Palomas Formation by the channel of Las Animas Creek. This stream alluvium is 50 to 60 feet thick near the junction between Las Animas Creek and the Rio Grande (Davie and Spiegel 1967) and can contain thick clay zones that allow water in the stream alluvium to be perched above groundwater in the underlying Palomas and Rincon Valley formations. A study completed by SRK (1995) along a middle reach of Las Animas Creek in Section 29, T15S, R5W showed that the stream alluvium is 60 to 80 feet thick and contains a thick clay base that separates water in the stream alluvium from groundwater in the Palomas Formation. This suggests that there should be no interaction between groundwater in the Palomas Formation and water in the stream alluvium.

Davie and Spiegel (1967) suggested, however, that the upper reaches of Las Animas Creek lose water to the Palomas Formation and that the lower reaches of Las Animas in the vicinity of the flowing wells gain water from the Palomas Formation. Similarly, Percha Creek loses water to the Palomas Formation gravels in its lower reaches, but gains water from springs in the Paleozoic limestones along its middle reach east of Hillsboro in the area called "Percha Box." Thus, interaction between groundwater in the Palomas Basin and water in stream alluvium that may be occasionally used for agricultural and domestic purposes varies along the course of a stream. For the stretch of Las Animas Creek across from the proposed well field, SRK (1995) has shown that there is no connection between groundwater in the Palomas Formation and water in the stream alluvium of Las Animas Creek.

Groundwater within the eastern part of the Palomas Basin undoubtedly interacts with water in the stream and floodplain alluvium of the Rio Grande and with water in the Caballo Reservoir. The exact nature of this interaction is not certain because detailed hydrologic studies of this part of the Rio Grande system and the interaction between the Rio Grande and groundwater have not been completed. Wilson et al. (1981) suggested that the stretch of the Rio Grande south of the Caballo Reservoir gains water from groundwater in the Palomas Basin. Studies of the Rio Grande system in the Mesilla Basin (Las Cruces area), south of the Palomas Basin show that: 1) the stream and floodplain alluvium of the Rio Grande is approximately 100 feet thick; 2) there is vertical downward flow of water from the Rio Grande system to the underlying basin groundwater; and 3) changes in water levels in the Rio Grande are rapidly reflected in wells drilled into the Mesilla Basin alluvial sediments (Nickerson and Myers 1993). Although this stretch of the Rio Grande loses water to the alluvium, in contrast to the portion of the Rio Grande along the eastern edge of the Palomas Basin which gains water from the alluvial sediments, the stratigraphy and alluvials composition in both areas are similar. It can be assumed that the Rio Grande and its floodplain alluvium along the eastern edge of the Palomas Basin are similar to that found to the south in the Mesilla Basin, and that the interaction between the Rio Grande and the Caballo Reservoir and the underlying groundwater in the alluvial sediments is similar to that reported in studies of the Mesilla Basin.

Groundwater beneath the existing tailings impoundment (Figure 2-4) is influenced by a thick clay layer approximately 20 to 30 feet down from the surface along the front of the tailings dam. A detailed study of the existing tailings impoundment and the area to be occupied by expansion of this impoundment under the Proposed Action by SRK (1995) has shown that a gravel layer roughly 20 to 30 feet thick is underlain by this clay bed, which can be 60 to 100 feet thick under the tailings dam and probably thickens to the east, and that this clay layer is followed by another gravel zone of undetermined thickness.

The present tailings facility overlies the old placer workings of Greyback Wash and Hunkidori Gulch (Figure 3-7). The proposed expanded tailings facility would completely cover these old placer workings. A study of these placer workings by Segerstrom and Antweiler (1975) showed that the placers are found in paleo-stream terrace alluvium approximately 25 to 30 feet thick that is underlain by caliche and red clay. The work of SRK (1995) has confirmed and expanded the areal extent of this clay layer. Beneath the clay layer lies the top of the Palomas Formation gravels. The clay layer and the 25 to 30 feet of paleo-stream terrace gravels that lie above the clay have acted to prevent downward migration of water draining from the old tailings and resulted in a mound of water beneath the tailings impoundment that has extended eastward beyond the tailings dam. This mounding of water, due to drainage of the tailings, became evident in some tailings dam monitor wells that either showed a rise in water level with time, showed an increase in sulfate content with time, or experienced artesian flow (Newcomer et al. 1993).

Groundwater within the Palomas Basin occurs in a variety of hydrogeologic environments dictated primarily by stratigraphy. Along the western edge of the basin near the foothills of the Animas Uplift, groundwater can be found perched in alluvial terraces due to a clay or caliche base that separates the paleo-stream terrace alluvium from the underlying Palomas Formation gravels. This groundwater is probably temporary in nature, except when supplied by a constant source of water. Beneath the stream terrace alluvium, the Palomas Formation is stratigraphically heterogeneous with gravel, sand, and clay beds. Groundwater can thus be unconfined, semiconfined by a clay bed, or fully confined and show artesian flow due to thick clay beds (Newcomer et al. 1993). Moving eastward toward the center of the basin and the area near the proposed well field, the Palomas Formation becomes thicker, probably contains less clay, and groundwater can be unconfined to semi-confined within the gravels. Farther eastward toward the Rio Grande and the Caballo Reservoir, thick clay interbeds become common in the Palomas Formation (Figure 3-3; Davie and Spiegel 1967) and the groundwater becomes semi-confined to confined and may show artesian flow as evidenced by the flowing wells along the lower reaches of Las Animas and Percha Creeks. Groundwater in the Palomas Formation may interact with stream water in Las Animas and Percha Creeks, but this depends on whether thick clay zones are present at the base of the stream alluvium as shown by SRK (1995) for Las Animas Creek.

3.2.2.2.3 Groundwater Quality within the Palomas Basin

Groundwater quality within the Palomas Basin is displayed with Stiff and Piper diagrams in Appendix A-3 contains a table with available analyses of surface and groundwater chemistry taken from SRK (1995), Newcomer et al. (1993), and Wilson et al. (1981). Factors which control groundwater chemistry and quality are: 1) depth within the basin, 2) lithology of the screened interval sampled by a well, 3) possible interactions with surface water, and 4) proximity to the mining district and especially the existing tailings facility. Water within the basin that is confined and has not been recharged by infiltration for a long period of time will have a chemistry that reflects equilibration with the rock in which it is contained, while groundwater that moves readily along a gradient or has been recharged by infiltration will have a chemistry that reflects mixing of waters and not the rock in which the water was contained during sampling.

Groundwater in the vicinity of the proposed production well field is represented in Appendix A-3 in samples PW-# and monitor well samples MW-5 and MW-6 (Figure 3-7). This water is sodium-calcium bicarbonate-dominated with sodium values in the range of 35 to 90 mg/l and calcium values in the range of 15 to 30 mg/l. The pH falls in the 7.6 to 8.2 range with TDS values between 200 to 500 mg/l and sulfate values generally less than 100 mg/l. These values fall within the New Mexico human health and domestic use surface water standards. Chloride values are somewhat high and range from 15 to 70 mg/l. Metals are within New Mexico human health and domestic use surface water standards, with only two samples showing a minor exceedance for fluoride.

Moving westward toward the tailings impoundment but still within the basin, groundwater in monitor wells MW-1, MW-2, MW-4, and MW-8 is still within New Mexico human health and domestic use standards and is sodium-calcium bicarbonate-dominated (Figure 3-7, Appendix A-3). The pH and TDS values are similar to those from the production well field, but chloride has dropped noticeably to values in the range of 10 to 15 mg/l. Bicarbonate has increased to values that range from 200 to 230 mg/l, while sulfate is still low and generally below 100 mg/l. The Piper diagram (Appendix A-3) illustrates the dominance of sodium over calcium and the sodium-calcium bicarbonate nature of the groundwater in the central and west-central parts of the Palomas Basin. This figure also shows that this groundwater has a chemistry distinct from groundwater sampled along the front of the existing tailings impoundment.

Groundwater sampled in monitor wells installed along the front of the tailings impoundment (Figure 3-9) shows a distinct chemistry with a possible trend on the Piper diagram towards increasing sulfate, especially in the NP-# wells. Wells installed north of the tailings impoundment include GWQ-1 (North Inspiration Well), GWQ-2 (McCravey Well), GWQ-3, GWQ-8, GWQ-9, and the McCravey-Greyback Well. These wells have water with pH values in the range of 7.2 to 7.8 and TDS in the range of 400 to 700 mg/l. Well GWQ-3 was anomalously high in TDS and sulfate with values of 890 to 1,060 mg/l and 360 to 380 mg/l, respectively. The range for sulfate in the other wells north of the tailings impoundment was 130 to 207 mg/l. Chloride averages around 20 mg/l, except for GWQ-3 where the range is 30 to 80 mg/l. Bicarbonate is generally greater than sulfate and calcium and sodium values fall in the same range, making these waters calcium-sodium bicarbonate-dominated. These groundwaters are similar to those in the west-central part of the Palomas Basin except for the higher sulfate levels. Well GWQ-3 is anomalous for the area north of the tailings facility since it has elevated sulfate, chloride, and TDS. Except for sulfate and TDS, groundwaters north of the tailings impoundment are generally within New Mexico human health or domestic use surface water standards.

Groundwater sampled in front of the tailings dam in the NP-# wells and GWQ-7,10, and 11 is similar to that sampled in the wells north of the tailings facility, except that pH values range from 7.6 up to 8.5, chloride is generally somewhat higher with values in the range of 20 to 100 mg/l, and well NP-3 shows definite evidence of contamination with tailings seepage since it has TDS values in the 1,100 to 1,600 mg/l range and sulfate in the 500 to 1,000 mg/l range (see Section 3.2.1.4, Existing Tailings Facility and Surface Water Effects, for a discussion on tailings water quality). Calcium values in this well are in the 250 to 300 mg/l range versus 30 to 120 mg/l for the other NP wells. Thus, groundwater along the front and north of the tailings dam is similar to groundwater found in the west-central part of the Palomas Basin except for increased sulfate and chloride values. Some wells, such as GWQ-3 north of the tailings facility and monitor well NP-3 in front of the tailings dam, show elevated sulfate values. NP-3 has probably been contaminated with tailings seepage; the reason for elevated TDS and sulfate in GWQ-3 is less clear.

Groundwater in the Tertiary Santa Fe Group sediments in the eastern part of the basin was sampled by Wilson et al. (1981) from wells drilled into the Palomas Formation along Las Animas and Percha Creeks. Wells drilled to depths of 160 to 340 feet along Las Animas Creek had pH values generally around 8.0 with TDS values in the 200 to 900 mg/l range. Most TDS values were between 200 to 400 mg/l. Sulfate values were in the 10 to 70 mg/l range and chloride was either around 20 mg/l or in the 100 to 400 mg/l range. Bicarbonate values were in the 100 to 300 mg/l range and sodium values were comparable to calcium values and both ranged from 30 to 120 mg/l with sodium showing a maximum value of 200 mg/l. Thus, these groundwaters were sodium-calcium bicarbonate-dominated with somewhat alkaline pH values and low sulfate. These values do not exceed New Mexico human health or domestic use surface water standards.

Groundwater in the Palomas Formation sampled from wells drilled along Percha Creek to depths of 100 to 265 feet showed alkaline pH values around 8.1, TDS in the 200 to 400 mg/l range, low sulfate in the 30 to 40 mg/l range, chloride less than 10 mg/l, and roughly equal sodium and calcium in the 30 to 80 mg/l range. Bicarbonate ranged from 170 to 200 mg/l. These waters are also sodium-calcium bicarbonate-dominated with low sulfate, low chloride, and slightly alkaline pH values. These waters are similar enough to those sampled from Las Animas Creek along the eastern one-third of the Palomas Basin to conclude that groundwater in the Palomas Formation in this part of the basin is slightly alkaline, dominated by sodium-calcium bicarbonate, and generally low in sulfate and chloride. These values do not exceed New Mexico human health or domestic use surface water standards.

3.2.3 Summary of Existing Water Quantity and Quality

Surface and groundwater within the Palomas Basin and the area of the Proposed Action is generally within New Mexico human health and domestic use surface water standards, except for water found in the area of past mining, groundwater in front of the existing tailings impoundment facility, and areas where agricultural practices may have impacted surface water. Water flow in Las Animas and Percha Creeks is intermittent, with flow rates in the range of 0.50 to 2.0 cfs, and both streams have gaining and loosing reaches. Generally, the upper reaches are losing and the lower reaches are gaining. Las Animas Creek has a thick clay base to its valley alluvium and this prevents interaction between surface water and groundwater in the Palomas Formation across from the production well field. Water in both Las Animas and Percha Creeks is dominated by calcium bicarbonate with pH values in the 7.0 to 8.0 range, low sulfate values, and other constituents usually within New Mexico human health and domestic use surface water standards. Water in the Rio Grande is mildly saline and dominated by sodium sulfate with high chloride values. Water quality varies seasonally in the Rio Grande. Water in the Caballo Reservoir is sodium bicarbonate-dominated with sulfate values in the 110 mg/l range and a pH of around 8.0. Surface water in the area of past mining has been impacted by mining. Water quality in Greyback Arroyo shows the influence of past mining and the presence of the pit lake since sulfate and TDS increase sharply as water flows past the existing mine pit and the old plant site area. Water in the existing mine pit is dominated by calcium sulfate and exceeds New Mexico human health and domestic use surface water standards for TDS, sulfate, fluoride, and cadmium. The current pH values measured by SRK (1995) appear to be within domestic use standards. Pit lake water appears to exceed State livestock and wildlife standards for copper, but is within other measured parameters (see Section 4.1.5.1. Mine Development/Operation).

Groundwater in the Palomas Basin flows from west to east, from the foothills of the Animas Uplift to the Rio Grande and the Caballo Reservoir. The gradient decreases sharply from west to east across the basin. The Rio Grande and the Caballo Reservoir gain water by recharge from groundwater in the Palomas Formation of the Tertiary Santa Fe Group. Groundwater within the basin is sodium-calcium bicarbonate-dominated with variable sulfate and chloride values. The water is within New Mexico human health and domestic use surface water standards. Groundwater beneath and especially in front of the existing tailings facility has been impacted by seepage from this unlined facility and shows elevated TDS, sulfate, and calcium. This water often does not meet New Mexico human health or domestic use standards, however, it does meet State livestock/wildlife standards for measured parameters. Groundwater within the andesites of the mining district appears to have been affected by mining and possibly by eastward subsurface movement of water from the existing mine pit. Elevated TDS and sulfate are found downgradient in one well within the area of existing mining.

Surface and groundwater within the Palomas Basin is good and generally useable for domestic and agricultural purposes. Past mining in the Hillsboro District and drainage of an unlined tailings facility have impacted surface and groundwater within and immediately adjacent to the area of past mining and resulted in elevated TDS and sulfate that exceeds domestic use standards. This impact has not spread into the main part of the basin, nor has it affected the water quality of important streams such as Las Animas and Percha Creeks. Water in these two creeks has a chemical signature distinct from that of groundwater that may be due in part to equilibration with the atmosphere. The sodium-calcium bicarbonate nature of groundwater in the Palomas Basin may be due to the presence of ancient lake beds within the Palomas and Rincon Valley formations.

3.3 SOILS

Two soil associations occur in the immediate vicinity of the proposed mine area: the Luzena-Rock Outcrop association, very steep, and the Scholle-Ildefonso association, moderately rolling (SCS 1984). All but the easternmost portion of the proposed mine area lies within the Luzena-Rock Outcrop association. This soil association encompasses a large area within the mine area and vicinity, including Animas Peak to the north and Black Peak to the south and occurs on hills and low mountains with slopes ranging from 5 to 55 percent. Luzena soils are generally shallow (approximately 14 inches), very gravelly and cobbly loams and clay loams, with 30 percent of the surface consisting of stones, cobbles, and gravel. Native vegetation typically established on these soils predominantly consists of a variety of grasses with scattered shrubs and juniper. The easternmost portion of the mine area lies within the Scholle-Ildefonso association. This soil occurs on gentle slopes, piedmonts, and mountain toe slopes, with slopes ranging from 1 to 15 percent. This soil consists of mixed alluvium with various textures including gravelly to very gravelly loams and clay loams; these soils are greater than 60 inches deep and are well drained. Native vegetation commonly established on Scholle-Ildefonso association soils primarily consists of grass species. The Luzena-Rock Outcrop association is a characteristic soil of the Hills Range Site, or ecological area. The Scholle-Ildefonso association is a characteristic soil of the Gravelly Range Site. Both range sites are part of the Western Plateau III Major Land Resource Area (MLRA). Soils in the proposed mine area vary little in depth, quality, and quantity. Some soils in the proposed mine area have been previously disturbed by historic mining activities. All the soils present are classified as gravelly to very gravelly loams.

Descriptive and interpretive data for the two soil associations present in the proposed mine area were obtained from the *Soil Survey of Sierra County, New Mexico* (SCS 1984) and from three earlier environmental reports (Glover 1977a; BLM 1978; BLM 1993) prepared for the mine area. Table 3-6 provides a summary of the physical properties of the two soil associations used to assess suitability of the soils as growth medium for future reclamation activities. Approximate acreage totals for each soil association within the immediate boundaries of the proposed mine site are 600 acres for Luzena-Rock Outcrop and 500 acres for Scholle-Ildefonso.

Soils in the proposed mine area were evaluated to determine if they could provide sufficient material for use in future reclamation activities. Salvageable depths for reclamation purposes were determined from physical and chemical characteristics of the soils that would be disturbed by mining activities (see Table 3-6). These depths were assumed to be restricted to material lying above duripan/caliche layers and bedrock layers, and material not characterized as strongly alkaline, or extremely gravelly, stony, or cobbly. All soils within the proposed mine area have slight to moderate hazards for water and wind erosion. The majority of the undisturbed soils in the Proposed Project area have a salvageable soil depth of 14 inches. However, the majority of the soils present in the tailings impoundment area (i.e., Scholle-Ildefonso association) are salvageable to a depth of 60 inches or greater.

Four additional soil units occur along the existing water pipeline and transmission line south of State Highway 152. They include the Tres Hermanos-Hap association, gently sloping (approximately 2 miles); the Tres Hermanos, gravelly fine sandy loam, gently sloping (approximately 2 miles); the Nickel-Chamberino association, gently sloping (approximately 7 miles); and the Nickel, very gravelly fine sandy loam, very steep (approximately 1 mile). These deep and well drained soils are generally located on gentle slopes and typically support native plant species including creosote bush, tarbush, and variety of perennial grasses. Textures range from gravelly loam to extremely gravelly sand.

3.4 VEGETATION

The proposed mine area is located within the Mexican Highlands section of the Basin and Range Physiographic Province. The distribution of plant communities within the proposed mine area have been influenced by elevation, precipitation, soil type, aspect, and gradient with the primary limiting factor being low annual precipitation. The dominant plant communities consist of desert grassland, creosote bush, juniper woodland, riparian/wetland areas, and previously disturbed lands. Much of the proposed mine area has been disturbed by past mining activities, some of which has been reclaimed (Figure 3-12).

Desert grassland is the predominant plant community that occurs in the proposed mine area. This community is established on Scholle-Ildefonso and Luzena-Rock outcrop soils located on nearly level to moderately sloping alluvial fans and upland slopes. This community is characterized by scattered shrubs and a dominant herbaceous layer primarily consisting of grasses and a variety of forbs. Shrub species

Table 3-6

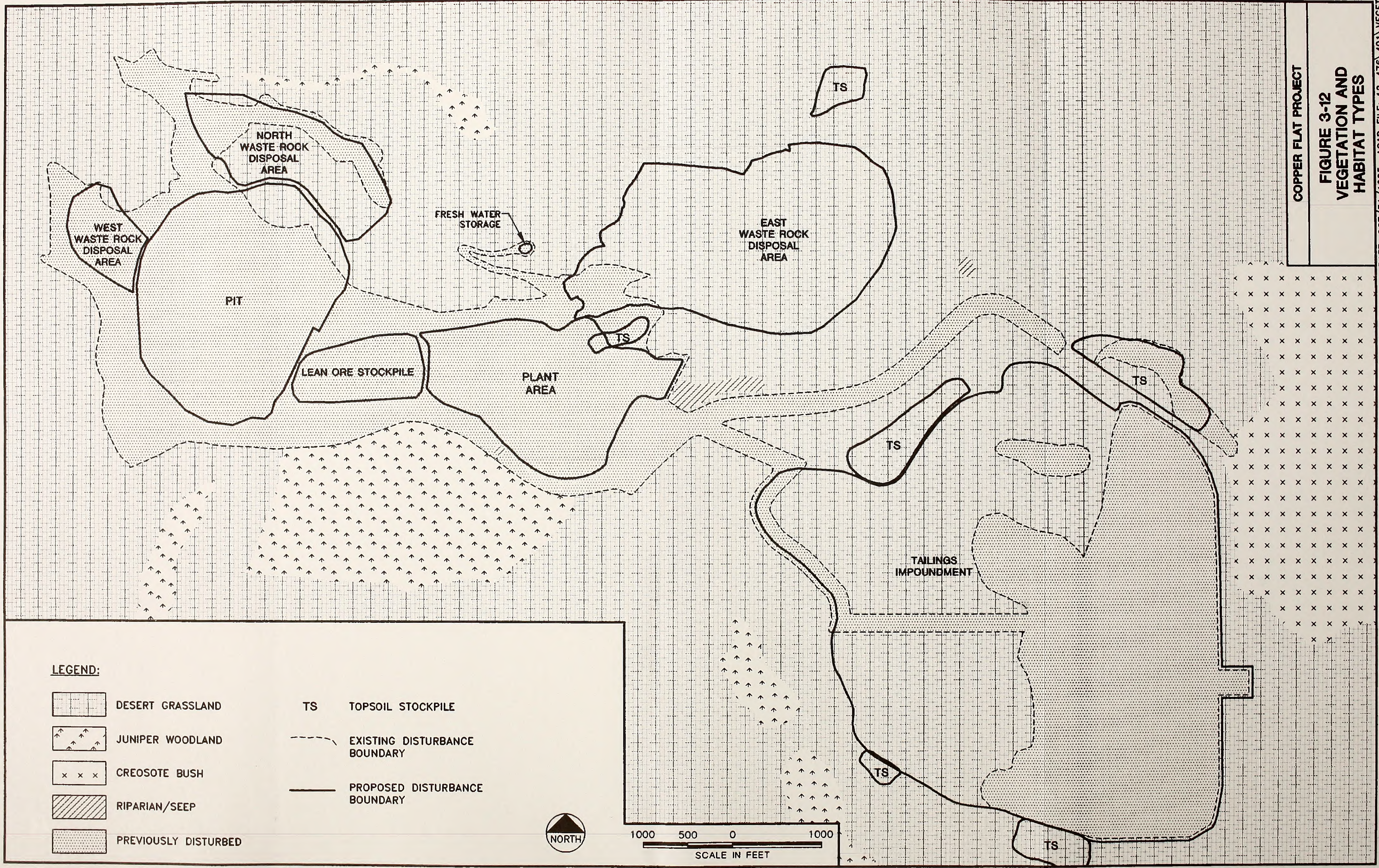
Summary of Soil Characteristics and Suitability Evaluations in the Proposed Mine Area

Map Unit Number	Soil Association	Average Soil Depth (inches)	Average Salvageable Growth Medium Depth (inches)[1]	Texture	Dominant Vegetation[2]	Limiting Factors
53 Luzena-Rock Outcrop:						
	Luzena	14	14	0-2" Gravelly loam 2-14" Gravelly clay loam 14" Unweathered bedrock	Side-oats grama, dropseed, black grama, sideoats grama, galleta, yucca, muhly, juniper; seep willow, tamarisk, and brickellia were observed in the disturbed areas; rabbitbrush, seep willow, snakeweed, bluestem, three-leaf sumac, cottonwood, coyote willow, and brickellia along Greyback Wash and other drainages.	Shallow depth to bedrock.
	Rock Outcrop	N/A	N/A	N/A	N/A	N/A
76 Scholle-Ildefonso:						
	Scholle	60	60	0-5" Very gravelly loam 5-60" Gravelly clay loam	Creosote bush, sideoats grama, galleta, black grama, blue grama, mesquite, yucca, muhly.	Gravelly texture of soils.
	Ildefonso	60	60	0-14" Gravelly loam 14-60" Very gravelly loam, very gravelly fine sandy loam	Creosote bush, side-oats grama, galleta, grama, mesquite, yucca, muhly.	Gravelly texture of soils.

[1]Growth medium to be salvaged for use in reclamation was assumed to be restricted to material lying above caliche/duripan layers, material lying above decomposed bedrock layers, and material that was not extremely gravelly, stony, or cobbly. Growth medium depth ranges correspond to each specific soil series within an association. Salvageable growth medium depths are average maximum obtainable depths based upon limiting factors in each soil unit.

[2]Dominant plant species observed during field reconnaissance of the site.

Source: USDA-NRCS. 1984.


COPPER FLAT PROJECT
FIGURE 3-12
VEGETATION AND HABITAT TYPES
DATE: OCT/31/1995 ACAD FILE: 12-476\401\VEGET
NORTH WASTE ROCK DISPOSAL AREA
WEST WASTE ROCK DISPOSAL AREA
PIT
FRESH WATER STORAGE
EAST WASTE ROCK DISPOSAL AREA
TS
LEAN ORE STOCKPILE
PLANT AREA
TAILINGS IMPOUNDMENT
LEGEND:
DESERT GRASSLAND
JUNIPER WOODLAND
CREOSOTE BUSH
RIPARIAN/SEEP
PREVIOUSLY DISTURBED
TS TOPSOIL STOCKPILE
EXISTING DISTURBANCE BOUNDARY
PROPOSED DISTURBANCE BOUNDARY
NORTH
1000 500 0 1000
SCALE IN FEET

commonly present include soaptree yucca, skunkbush, little leaf sumac, mesquite, creosote bush, prickly pear cactus, sagebrush, and rabbitbrush. Dominant grasses and forbs include black grama, sideoats grama, tobosa, three-awn, and locoweed. Greyback Wash, which runs through the mine site south of the pit and plant site and to the east, contains rabbitbrush, seep willow, snakeweed, three-leaf sumac, cane and little bluestem, cottonwood, and coyote willow in the vicinity of three seep areas located along the drainage.

The creosote bush community occurs east of the proposed tailings impoundment area and along the existing water pipeline and transmission line corridor located along State Highway 152. This community is established on the Scholle-Ildefonso, Tres Hermanos-Hap, Tres Hermanos, Nickel-Chamberino, and Nickel associations located on gentle to steep alluvial fan slopes. This community consists of an dominant overstory characterized by creosote bush and tarbush and a subdominant understory with a variety of forb and grass species. Other shrub species occasionally present in this community include mesquite and rabbitbrush. The understory includes wild buckwheat, threadleaf groundsel, lemon verbena, black grama, sideoats grama, mesa dropseed, three-awn, bush muhly, and fluffgrass (BLM 1978).

The juniper woodland community in the vicinity of the mine is generally concentrated along the intermittent drainages and adjacent toe slopes. This community is established on Luzena-Rock outcrop soils located on nearly level to moderately sloping alluvial fans. The dominant overstory consists of one-seeded juniper and the subdominant understory contains various forbs and grasses. Shrubs commonly associated with one-seeded juniper include skunkbush, little leaf sumac, feather peabush, and rubber rabbitbrush. Common forb and grass species include wild buckwheat, threadleaf groundsel, wheatgrass, blue grama, sideoats grama, New Mexico feathergrass, and spike muhly. Utah junipers are also scattered in areas of desert grassland vegetation.

No wetlands areas are present in the immediate area of the proposed mine. Riparian areas, however, are located in the project vicinity near the Paxton well south of Black Peak, and along Greyback Wash, Las Animas Creek, and Percha Creek. Three seep areas with associated riparian vegetation occur in the Greyback Wash area. One seep area is located north of the access road and east of the proposed East Waste Rock Disposal area. This seep supports a small group of cottonwoods and willows. The second seep area is located south of the Plant Area and does not support cottonwoods or willows. Water present in this seep is supplied either by groundwater or by runoff diverted from the road present between the plant site and the pit area. This seep provides water intermittently to wildlife throughout the year. The third riparian area located on Greyback Wash is located immediately below the proposed process reservoir area. The area supports cottonwoods, willows, and various herbaceous species. This riparian area is not apparent in aerial photos taken prior to the 1982 mining operation and appears to have its water supplied by seepage from the existing buried process reservoir and surface run-off. One wetland of relatively moderate functional value is located in Warm Spring Canyon to the west of the proposed mine. Riparian habitat associated with Las Animas Creek, a perennial stream located approximately 4.0 miles northeast of the proposed mine area, supports a variety of trees and shrubs including plains cottonwood, Arizona sycamore, walnut, mesquite, Apache plume, hackberry, Mormon tea, and prickly pear. Percha Creek is a perennial stream located approximately 2.2 miles south of the proposed mine area which supports a prevalence of riparian vegetation. Dominant plant species present along this creek include willow, seep willow, ash, plains cottonwood, locust, and walnut. Warm Spring, located approximately 2.8 miles southwest of the proposed mine area, supports several wetland species, including willow and tamarisk. This small wetland covers less than a 0.10 acre area that includes the spring and the drainage bottom extending approximately 50 feet downstream.

Vegetation established on previously disturbed lands primarily include species associated with the desert grassland community. Species commonly present include soaptree yucca, sand dropseed, black grama, sideoats grama, tobosa, and bush muhly. The majority of disturbed lands found at the proposed mine site are sparsely covered by vegetation.

Two range sites, as identified by the Natural Resources Conservation Service (NRCS, formerly the SCS), occur within the proposed mine area. They include the Hills and Gravelly Range Sites (SCS 1980) that are located within the MLRA (see Section 3.3, Soils). Identification of the ecological condition of these range sites within the mine area was based on observations made during field reconnaissance activities in 1994; ecological conditions at that time were fair for both range sites. Vegetation types in the proposed mine area that are associated with the Hills Range Site include desert grassland and juniper woodland. Vegetation types in the proposed mine area that are associated with the Gravelly range site include desert grassland and creosote bush.

The composition of the potential natural plant community for the Hills Range Site includes 65 to 75 percent grasses and grass-like plants, 15 to 25 percent woody vegetation, and 5 to 10 percent forbs (SCS 1980). Dominant plant species in this community include sideoats grama, blue grama, hairy grama, black grama, little and cane bluestem, shrub live oak, sacahuista, skunkbush, little leaf sumac, mountain mahogany, Wright silktassel, wild buckwheat, wooly Indianwheat, and threadleaf groundsel. The composition of the potential natural plant community for the Gravelly Range Site includes 80 to 90 percent grasses and grass-like plants, 5 to 10 percent woody vegetation, and 5 to 10 percent forbs (SCS 1980). Dominant plant species in this community include black grama, New Mexico feathergrass, sideoats grama, blue and hairy grama, soaptree yucca, sacahuista, feather peabush, winterfat, wild buckwheat, threadleaf groundsel, lemon verbena, and goldenweed.

Foliar cover and forage productivity estimates for desert grassland and previously disturbed land present within the project area were based on visual observations made during field reconnaissance activities and data provided in the soil survey for the Sierra County area (NRCS 1984). Average foliar cover for undisturbed desert grassland within the general vicinity of the project area is estimated at approximately 30 to 40 percent. Undisturbed desert grassland forage productivity ranges from 400 to 1,300 pounds of forage per year during unfavorable and favorable years, respectively. Undisturbed desert grassland primarily occurs in the tailings impoundment area, the East Waste Rock Disposal area, the North Waste Rock Disposal area, and the topsoil stockpiles.

Approximately 63 percent of the project area has been disturbed by previous mining operations. Average foliar cover for previously disturbed land is approximately 5 to 10 percent, with the highest foliar cover of approximately 15 percent occurring in the tailings impoundment area and the lowest foliar cover of less than 5 percent generally occurring at the pit, the West and North Waste Rock Disposal areas, and the Lean Ore Stockpile. The majority of previously disturbed land occurs in the tailings impoundment area, the pit, the lean ore stockpile area, and the West Waste Rock Disposal area.

3.5 WILDLIFE AND FISHERIES RESOURCES

As stated in the vegetation description, the habitat surrounding the existing mine is dominated by creosote bush and desert grassland communities, with sparse, scattered junipers on the higher knolls and northern aspects. Stinnett (1991) refers to three standard habitat sites (SHS) in the area; the creosote rolling upland SHS, the grass mountain SHS, and the pinyon-juniper/grass mountain SHS. These SHS are reasonably analagous to the creosote bush, desert grassland, and pinyon-juniper communities, respectively, discussed in Section 3.4, Vegetation. Wildlife species known or expected to occur within these SHS are provided in Appendix B. The transportation and related linear facilities corridor (along State Highway 152) primarily crosses creosote bush and tarbush habitats. Rocky outcrops are scattered throughout the area, and perennial and intermittent drainages with small, natural springs provide limited surface water in the region.

The arid upland areas are typically characterized by a diversity of wildlife species rather than high population densities. Available water for wildlife consumption and support of riparian vegetation are the primary limiting factors in the Proposed Action area. Therefore, riparian habitats, particularly those containing a multi-story canopy and free water, support a greater diversity and population density of wildlife species than any other habitat type occurring within the vicinity of the Proposed Action.

Las Animas Creek and Percha Creek are the nearest perennial streams to the mine site. These drainages flow eastward toward the Rio Grande (Caballo Reservoir) and are approximately 4 miles north and 3 miles south of the mine site, respectively. Surface water resources within the immediate mine area are limited to the existing pit lake; small, intermittent drainages; and three small, seep areas along Greyback Wash that contain riparian vegetation. Greyback Wash once flowed through what is now the mine pit, but was diverted around the south side of the pit during previous mining activities. Other intermittent drainages and localized perennial springs occur in the region, as described in Section 3.2, Water Quantity and Quality.

The conditions of the limited riparian habitats located near the mine site and production well field range between fair to excellent, depending on the amount of available water for vegetative cover. Both Percha Creek and Las Animas Creek appeared to support excellent habitat for wildlife use. Warm Springs Canyon maintains fair habitat that has been heavily impacted by livestock grazing.

Of the three riparian areas located in the Greyback Wash area, the one that presently occurs below the process water reservoir provides the greatest value for wildlife species. This riparian area contains deciduous trees, including cottonwood and willow, and extends approximately 0.25 mile down the drainage. The riparian vegetation associated with this area has been artificially created by surface runoff and ongoing water seepage from the buried process reservoir. A second seep exists downstream of this area and supports a small cottonwood/willow stand. The third seep in Greyback Wash is located southwest of the plant area and is apparently supplemented by surface water runoff that is diverted from a mine road that connects the plant site to the pit area. Although the deciduous trees and riparian vegetation associated with the larger riparian zone and downstream seep are of primary importance to wildlife resources, this third seep also provides intermittently available open water for wildlife consumption.

The following species' information focuses on both resident and migratory wildlife that may occupy the Proposed Action area. Because of the nature of wildlife and their mobility, some of these characterizations include more regional information.

Mule deer are the principal big game species in the region. A small number of mule deer frequent the mine site to feed on the grasses reseeded during the 1986 reclamation effort, but move into the remote hills during the fall and into the lowlands during severe winters (BLM 1993). No designated seasonal ranges or important migration corridors for mule deer are present in the vicinity of the mine (Cassidy 1994). Other mammals typically found in the Proposed Action area include the coyote, bobcat, badger, raccoon, blacktailed jackrabbit, and a number of small rodent species (Glover 1977a). A list of wildlife species known or suspected to occur in the region is provided in Appendix B.

Upland game bird species occurring near the mine include Gambel's quail, scaled quail, and mourning dove. Mearn's quail could use the area, although none have been documented at the mine site. Based on New Mexico Department of Game and Fish (NMDGF) data, the combined population density of Gambel's and scaled quail in high years in excellent habitat could be 80 to 100 birds per square mile and 10 per square mile in low years (BLM 1978). Habitat in the proposed mine area is not considered optimal for these upland game birds, and, conversely, population densities are expected to be lower.

Waterfowl and shorebird species typically use large bodies of water (e.g., Caballo Reservoir), as well as small wetlands, area stock ponds, and natural springs. Depending on the season and the species, area water sources may provide important breeding, resting, and foraging habitat for both resident and migratory birds. No prominent nesting or foraging areas for waterfowl occur within the Proposed Action area. Waterfowl sporadically use the existing pit lake, particularly during migration; however, shorebird use is limited, due to the lack of shallow foraging areas and appropriate habitat.

The diverse habitats found in the valley systems, mountain ranges, and drainages surrounding the Proposed Action area also support a variety of nongame species. Although species' diversity is typically greater than population density, certain habitats (e.g., riparian) support a greater number of these species. Many of the nongame wildlife species, particularly small mammals and birds, are widely distributed, occupying a variety of habitat types. Bat species that may reside year-long or seasonally in the region include the pallid bat, pale Townsend's big-eared bat, Allen's big-eared bat, southwestern myotis, California myotis, and the western pipistrelle, among others. A shaft is located within the vicinity of the proposed pit area and may provide roosting habitat for area bats; adjacent areas could also contain numerous abandoned mine adits and shafts that may support bats (e.g., hibernacula, bachelor roosts, or nursery colonies). The Tony House, located adjacent to the existing tailings facility, is used for roosting by bats; the Townsend's big-eared bat and other myotis have been observed in this abandoned building.

Resident and wintering nongame birds found in the area include such raptors as the red-tailed hawk, American kestrel, northern harrier, golden eagle, prairie falcon, turkey vulture, great-horned owl, barn owl, and short-eared owl. No active raptor nests have been documented in the Proposed Action area. The potential presence of sensitive raptor species is discussed in Section 3.6. Three inactive stick nests located on cliffs in Greyback Wash to the west of the pit, on the south side of the pit, and on an east-facing cliff to the southeast of the pit, were observed during the July 1994 site visit. Representative passerines or perching birds found in the area are numerous. Numbers and species of birds vary widely with the seasons. To characterize the birds occurring in the Copper Flat area, the BLM conducted bird surveys in 1991 and 1992. A list of bird species observed during these surveys is presented in Appendix B. Although a number of species observed during these surveys exhibited breeding behavior (e.g., courtship flights, territorial defense), documented nesting was limited. However, the BLM assumed that many of these species typically breed in the various habitats found within the Proposed Action area.

Although only six species of reptiles have been observed in the Proposed Action area, approximately 36 species of reptiles and amphibians are expected to occur in the region; the most numerous of which are lizards. No amphibians have been documented at the mine site, but several species of toads including the great plains, Texas, and Woodhouses toad, and the Couch's and western spadefoot toads inhabit riparian areas within the SHS represented at the mine site (BLM 1994c).

Due to the temporary, intermittent nature of Greyback Wash, the only perennial aquatic environments at the mine site is the pit lake and the seep located below the process water reservoir. No fish are currently found within the pit lake, due to the sterile nature of the aquatic habitat, nor or any fish associated with the seeps located within Greyback Wash. High quality native fish populations and riparian communities are found in and along Las Animas and Seco Creeks, north of the Copper Flat area and in and along Percha Creek, south of the mine area. Studies conducted during the summer of 1995 documented the long-fin dace and Rio Grande sucker within Percha Creek. The water sources that occur in and near the Proposed Action are discussed in detail in Section 3.2, Water Quantity and Quality.

3.6 THREATENED, ENDANGERED, AND OTHER SENSITIVE SPECIES

3.6.1 Wildlife and Fisheries

The project region contains a variety of habitat types that may support sensitive wildlife resources. However, relatively few sightings of Federally threatened or endangered, Federal candidate, or State-sensitive species have been recorded near the mine site. Table 3-7 lists the sensitive species that were considered for this project and their current status.

A Biological Assessment has been prepared for the Copper Flat Project, in accordance with Section 7(c) of the Endangered Species Act, to determine if any sensitive plant or animal species may be impacted by the Proposed Action. The BLM, as the Federal lead agency, initially requested a species list under informal Section 7 consultation from the U.S. Fish and Wildlife Service (USFWS). Additional species were addressed in the Biological Assessment, based on the BLM's directives for sensitive species protection.

A total of 4 Federally listed and 15 Federal candidate species were addressed in detail in the Biological Assessment. Data sources included information from Federal, State, and Tribal agencies; the Biota Information System of New Mexico (BISON-M); Federal recovery plans; published literature; and direct correspondence with Federal, State, and Tribal agency personnel.

Table 3-7

Threatened, Endangered, and Other Sensitive Species Addressed for the Copper Flat Project

Common Name	Scientific Name	Status[1]	Habitat Description
MAMMALS			
Jaguar	*Panthera onca*	PE	Dense vegetation along streams and rivers
Arizona black-tailed prairie dog	*Cynomys ludovicianus arizonensis*	C2	Shortgrass, high plains
Greater western mastiff bat	*Eumops perotis californicus*	C2	Rugged rocky canyons; roosts in cliffs, vertical crevices and fissures, shallow caves on rock walls, man-made structures; roosts require vertical relief for flight
Occult little brown bat	*Myotis lucifugus occultus*	C2	Riparian habitats associated with permanent water sources such as streams, drainage ditches, and lakes; roosts in man-made structures, caves, tunnels, hollow trees
Spotted bat	*Euderma maculatum*	C2,SE-2	Cliffs near riparian, pinyon-juniper woodlands, and ponderosa pine forest; roosts in crevices or cracks in cliffs or rock outcrops
Fringed myotis	*Myotis thysanodes*	C2	Wide variety of vegetation types including mixed shrub, sagebrush, pinyon-juniper woodland, riparian areas, and cropland; roosts in caves, mines, and buildings
Long-legged myotis	*Myotis volans*	C2	High-elevation ponderosa pine and mixed conifer; roosts in caves, man-made structures, and rock crevices
Yuma myotis	*Myotis yumanensis*	C2	Desert, grassland, woodland, and riparian communities from 4,000 to 7,000 feet; roosts in buildings, caves and crevices
Pale Townsend's big-eared bat	*Plecotus townsendii pallescens*	C2	Desert shrublands, pinyon-juniper woodlands, and mixed grass prairies; roosts in caves, rocks, or man-made structures
BIRDS			
American peregrine falcon	*Falco peregrinus anatum*	FE[2],SE-1,	Cliffs in close proximity to water; breeds in New Mexico
Arctic peregrine falcon	*Falco peregrinus tundrius*	SE-1	Migratory through New Mexico
Bald eagle	*Haliaeetus leucocephalus*	FT,SE-2	Riparian areas, wetlands, and open water for nesting, wintering, and migrating

Table 3-7 (Continued)

Common Name	Scientific Name	Status[1]	Habitat Description
Southwestern willow flycatcher	*Empidonax traillii extimus*	FE,SE-1	Nesting habitat includes shrubs and trees in willow thickets, shrubby mountain meadows, and deciduous woodlands along streams, lakes, and bogs
Loggerhead shrike	*Lanius ludovicianus*	C2[3]	Nests in shrubs and small trees in sagebrush, desert scrub, pinyon-juniper woodlands, and woodland edges
Common black hawk	*Buteogallus anthracinus anthracinus*	C2,SE-2	Riparian forest in relatively arid regions supported by perennial water
Ferruginous hawk	*Buteo regalis*	C2	Nesting sites include trees, ledges, rock outcrops, and low cliffs in desert shrub and grassland communities
Northern goshawk	*Accipiter gentilis*	C2	Nesting sites are located in large, older trees in dense portions of old growth forests
Baird's sparrow	*Ammodramus bairdii*	C2,SE-2	Shortgrass prairie; migrant in New Mexico
REPTILES			
Texas horned lizard	*Phrynosoma cornutum*	C2	Arid, open, flat grasslands with sparse vegetation in shortgrass prairie, mesquite grasslands, shrublands, desert scrub, and desert grasslands
PLANTS			
Grama grass cactus	*Toumeya papyracantha*	C2,L1B	Sandy or gypsum soil in semidesert grasslands, Great Basin conifer woodland, and plains and Great Basin grassland

[1] Status:

FE = Federally listed as endangered.
PE = Proposed to be Federally listed.
C2 = Federal candidate-category 2.
SE-1 = State-listed as endangered, Group 1, in New Mexico.
SE-2 = State-listed as endangered, Group 2, in New Mexico.
L1 = Plant species endangered in New Mexico.
L1B = The taxon is so rare across its entire range and of such limited distribution and population size that unregulated collection could jeopardize its survival in New Mexico.

[2] Proposed to be delisted; final rule is pending.

[3] The USFWS indicates that the status of the loggerhead shrike in the western United States is under review; final decision is pending.

The following baseline descriptions have been limited to information summaries for those species identified for the Copper Flat Project. Detailed species' descriptions pertaining to status, distribution, life history, habitat associations, endangerment, and presence in the project area are presented in the Biological Assessment.

3.6.1.1 Mammals

The jaguar historically occurred in New Mexico. A number of sightings within the State were recorded from 1900 to 1904, but no subsequent observations have been documented (Findley et al. 1975). Jaguars typically prefer areas of dense vegetation along riparian drainages, although one individual was recorded in a high elevation pine and spruce forest (Bailey 1971; Caras 1967). Potential habitat for this species is present in the project region; however, no jaguars have been recorded in southwestern New Mexico, and specifically Sierra County, in recent times. Currently, the species is thought to be extirpated from the State.

The Arizona black-tailed prairie dog is one of two subspecies of prairie dogs found in New Mexico. This species typically inhabits shortgrass prairies, often preferring slopes of open valleys, but may also be found on mesas among scattered pinyon and juniper woodland. This subspecies has adapted to a more arid environment than other prairie dog subspecies (Bailey 1971). Population declines throughout its range have been predominantly attributed to habitat changes and widespread poisoning campaigns (BISON-M 1995; AGFD 1988), in addition to sylvatic plague. No prairie dog colonies have been identified for the Proposed Action area, and no records indicate that the Arizona black-tailed prairie dog once occupied the project region.

A number of sensitive bat species occur in New Mexico and could occupy roosting sites or foraging habitats in and near Proposed Action area. Seven sensitive bat species have been identified for this analysis, as shown on Table 3-7. Although no maternity colonies, hibernacula, or bachelor roosts are known to occur in the vicinity of the mine site, specific features could either provide roosting habitat or foraging areas for a number of bat species. An abandoned mine shaft is presently located on the northeast edge of the existing mine pit, which could support roosting bats. Bat use has been documented by the BLM in the Tony House, which is located adjacent to and north of the existing tailings impoundment. Other man-made structures (e.g., Golddust Ranch and the existing decant towers) could also provide roosting areas, in addition to naturally occurring roosts in trees, along cliffs, and in rock outcrops. Potential foraging areas associated with water encompass the open pit lake, Greyback Wash, Percha Creek, Las Animas Creek, and Warm Springs Canyon. A number of bat species are foliage gleaners in both riparian and upland habitats. Of the seven bat species analyzed for this project, potential roosting or foraging habitat may occur within the Proposed Action area for six species, including the greater western mastiff bat, occult little brown bat, spotted bat, fringed myotis, Yuma myotis, and pale Townsend's big-eared bat; however, some of these habitats would be considered marginal to support these species. The Townsend's big-eared bat has been documented roosting in the Tony House, located near the tailings facility. The remaining long-legged myotis would not likely occur in the project region, due to the lack of appropriate habitat. The detailed background information and the potential for occurrence pertaining to these seven sensitive bat species is presented in the Biological Assessment prepared for this project.

3.6.1.2 Birds

A number of sensitive birds could occur in the vicinity of the Copper Flat Project. The American peregrine falcon both nests in and migrates through New Mexico. The arctic peregrine falcon migrates through the region. No known falcon eyries for the American subspecies occur in or near the Proposed Action area; suitable nesting habitat in proximity to the mine site is located at Caballo Mountain, approximately 10 miles east of the Proposed Action area. Peregrines may forage in the riparian habitat found along Percha Creek, Las Animas Creek, and Warm Springs Canyon.

The only documented nest site for the bald eagle in New Mexico is located approximately 5 miles north of the mine site. Bald eagles have been observed flying through the Proposed Action area (Williams 1995), and eagles occasionally occupy the Las Animas Creek area during the winter and early spring. A breeding pair associated with a nest located north of the Proposed Action area primarily forages along Caballo Reservoir. Wintering birds also frequent both Caballo and Elephant Butte Reservoirs. Although the majority of bald eagles documented in the project region use these reservoirs for roosting and foraging activities, the riparian drainages located in and near the Proposed Action area could provide potential foraging habitat for eagles. Prominent drainages would encompass Percha Creek and Las Animas Creek. However, these areas would not be considered optimal foraging habitat for eagles, and no records indicated that bald eagles use them for foraging or roosting.

The southwestern willow flycatcher typically occupies riparian habitat with specific nesting parameters. Appropriate habitat for this subspecies in the vicinity of the Proposed Action would be limited to Percha and Las Animas Creeks. Percha Creek and portions of Las Animas Creek (northwest of Hillsboro) were surveyed in 1994 for the presence of the southwestern willow flycatcher. No sign of this subspecies was recorded, and no other documented sitings along the lower portions of Las Animas Creek are known to exist (McBride 1995).

The loggerhead shrike is widespread throughout New Mexico and would occupy the appropriate habitat types within the Proposed Action area. Suitable nesting habitat is widespread throughout the mine site and production well field. No shrike nesting in the Proposed Action area has been documented; however, breeding birds may be present.

The common black hawk typically occupies riparian habitat that contains mature, relatively undisturbed deciduous woodlands with perennial water. These riparian systems provide both nesting and foraging habitat for this species, which predominantly preys on aquatic organisms. The black hawk has been recorded along Percha Creek; however, no nest sites have been documented. Based on associated habitat, this species could also occur along Las Animas Creek.

The ferruginous hawk historically occupied the project region and has been recorded within the creosote upland and grass mountain habitats near the Proposed Action (USDOI 1984). The mine area was surveyed in 1991 for the presence of nesting ferruginous hawks; no sign of nesting hawks was observed in or near the Copper Flat Project area at that time (Stinnett 1991). However, this species could occupy the project region for both nesting and foraging activities.

The northern goshawk is associated with a variety of forest types, including ponderosa pine, Englemann spruce, subalpine fir, and Douglas-fir/white-fir often mixed with blue spruce and aspen. This species typically nests in dense woodland areas, including old growth forests (Reynolds 1983; Reynolds et al. 1992; Kennedy 1988). Habitat associated with the Proposed Action is not appropriate for the northern goshawk, and no sightings of this species have been reported in the vicinity of the Copper Flat Project.

In New Mexico, the Baird's sparrow is migratory and most commonly observed during the fall period (Hubbard 1978). This species has been observed in Sierra County (NMDGF 1988), but foraging grassland habitat is limited in the Proposed Action area, and no sightings of the Baird's sparrow have been reported in the vicinity of the Proposed Action.

3.6.1.3 Reptiles

The Texas horned lizard is found in arid, open, flat grasslands with sparse vegetation (Finch 1992). This species typically prefers sandy and coarse gravel that is often associated with alluvial fans and playas, but is also found on bajadas and mesa tops (BISON-M 1995). The Texas horned lizard has been documented in Sierra County and is known to occur in and near the Proposed Action area.

3.6.1.4 Fish

Studies conducted during the summer of 1995 documented the long-fin dace within Percha Creek. This fish is a Federal candidate-category 2 species. The current belief is that this fish was introduced to Percha Creek, since it does not occur naturally in the region east of the Continental Divide (BISON-M 1995). The long-fin dace is limited to the watershed of the Gila River.

3.6.2 Plants

Of the sensitive plant species identified for the Proposed Action area, only the grama grass cactus was considered to potentially occur in or near the mine site and production well field. This assessment was based on relative habitat associations. The grama grass cactus is known to occur in open flats in grasslands and woodlands at elevations of 5,000 to 7,300 feet (Benson 1969). This species is typically found in sandy or gypsum soil (NMNPPAC 1984). Plant surveys were conducted in the mine area in 1976 and 1991 (Glover 1977a; Stinnett 1991). In 1991, potentially suitable habitat for the grama grass cactus was documented along the southern slope of Animas Peak, located above the proposed East Waste Rock Disposal area. However, the surveys did not record grama grass cactus within the Proposed Action area.

3.7 NOISE

The nearest residents to the proposed mine area are located at two ranches (the Coalson and Clark ranches) within the Percha Creek drainage, approximately 3 to 4 miles southeast of the Copper Flat Project. These ranches are located along the north bank of Percha Creek near the base of the steep creek embankment. The nearest community is the town of Hillsboro, located approximately 5 miles to the southwest. Hillsboro is also located within the Percha Creek drainage. The town is separated topographically from the Copper Flat Mine by two high ridges. Current noise levels in the vicinity of the ranches and Hillsboro are unknown, however, estimated background noise levels for these sites were based on published information on typical average day and night sound levels (L_{dn}) for various population densities (NAS 1977). These data, presented in Table 3-8, are for areas where there are no well-defined noise sources other than traffic. Sound levels are expressed in decibels, A-weighted (dBA). The A-weighing system simulates human hearing, which is more sensitive to high-frequency (high-pitch) sounds. The A-weighing system de-emphasizes lower frequency sounds to simulate the response of the human ear. Contribution to hearing impairment begins at 70 dBA, a noise level that is equivalent to freeway traffic at 50 feet, while sustained noise levels of 90 dBA can cause hearing damage (BLM 1983).

Background noise levels at Hillsboro are expected to be dominated by transportation noise. According to Table 3-8, the town of Hillsboro can be compared to a quiet suburban to rural setting (40 to 45 dBA), while noise levels at the Coalson and Clark ranches are more typical of undeveloped rural areas (35 dBA). The mine exists in an undeveloped rural setting (35 dBA).

3.8 AIR QUALITY

3.8.1 Climatology

The regional climate is high desert and is generally hot and dry in the summer and mild in the winter, with limited precipitation and cloudiness. Climatic variation exists primarily due to elevation differences throughout the region; higher elevations are wetter and cooler then the valley floors.

This region of New Mexico lies within the belt of mid-latitude westerlies, and the prevailing wind direction is from the west. In the surrounding area, winds blow from the northwest during the winter and from the southwest and southeast during the remainder of the year. Winds at the Truth or Consequences, New Mexico airport, located about 30 miles northeast of the project area, are generally from the northwest; however, the Black Range and foothills cause local variations in the winds. At Copper Flat, the wind direction is predominantly west to east, and secondarily north to south. Local wind speeds average about 10 to 15 miles per hour. Winds in excess of 50 miles per hour may occur as major storms pass through the area. Temperature inversions are rare at Copper Flat but are more common farther east along the Rio Grande Valley, especially during the winter months. Vertical air dilution is generally good because of the area's high surface temperatures, creating strong daytime thermal mixing. Thermal mixing and moderate winds generally tend to suppress occasional nighttime inversions. The presence of higher winds and the lack of inversions contribute to a relatively clean atmosphere at the mine site since any pollutants are readily mixed and dispersed (National Climatic Data Center, n.d.).

Climatic data collected between 1948 and 1993 at the Hillsboro, New Mexico, National Weather Service Station, are considered representative of the project area (National Climatic Data Center, n.d.). Temperature data available for the project area indicate the relatively wide diurnal and seasonal variability typical of dry climates. The warmest temperatures occur in June and July and the coldest temperatures usually occur

Table 3-8

Typical Average Day-Night Sound Levels for Various Population Densities[1]

Description	Population Density (people/sq. mi)	Noise Level- dBA
Rural (undeveloped)	20	35
Rural (partially developed)	60	40
Quiet Suburban	200	45
Normal Suburban	600	50
Urban	2,000	55
Noisy Urban	6,000	60
Very Noisy Urban	20,000	65

[1]For areas where there are no well-defined noise sources other than transportation noise.

Source: National Academy of Sciences 1977.

in December and January. In spring and fall, daily maximum temperatures are moderate, typically averaging 65 to 85 degrees Fahrenheit (°F). Nights are cooler, with low temperatures averaging 32 to 50°F. Winter temperatures are frequently below freezing at night, but can be above 50°F during the day. During summer, temperatures can approach 100°F during the day. Daily temperature fluctuations of 30°F are common throughout the year. Mean daily maximum and minimum temperatures for this area are presented in Table 3-9.

Precipitation at the mine site averages about 13 inches per year (extremes range from nearly 3 inches in 1956 to over 20 inches in 1986). Some precipitation occurs during all months of the year but 40 to 50 percent of the precipitation occurs as infrequent but intense thunderstorms during the months of July (with an average of 2.50 inches), August (2.61 inches), and September (2.06 inches). The higher amounts coincide with the monsoon season when moist air enters the region from the Gulf of Mexico. Summer thunderstorms may result in heavy rainfall and threats of flash floods. The months of January through June usually have low precipitation with a monthly average of 0.50 inch or less. There is a wide variation in precipitation from year-to-year and month-to-month.

Snowfall is possible from October through April, but most likely (greater than 1 inch) between December through February. Mean monthly precipitation and snowfall for this area are presented in Table 3-10.

Evaporation records for southwestern New Mexico indicate that evaporation exceeds precipitation. Pan evaporation data are the most common form of record and are collected from calibrated measurement devices. Pan evaporation data are correlated with lake evaporation (i.e., free water surface evaporation) to predict evaporation from reservoirs and lakes. Pan evaporation rates tend to be higher than lake evaporation rates due to the increased efficiency of evaporation from the small-scale pan evaporation measuring device. The conversion coefficient for pan evaporation to lake evaporation at the site is approximately 0.72 (SRK 1995). Pan evaporation rates are applicable to estimate evaporation from wetted surfaces and shallow pools.

Lake evaporation at the project site is estimated to be approximately 58 to 65 inches per year, and pan evaporation is estimated to be approximately 80 to 90 inches per year (SRK 1995).

3.8.2 Air Quality

The project area is designated as attainment for all criteria pollutants. The principal air quality protection mechanism under the PSD program involves a system of area classifications that define significant deterioration for individual pollutants. Areas of special national concern where the need to prevent significant deterioration is the greatest are designated Class I areas. Class I areas include all national parks and national wilderness areas. Less restrictive rules apply in areas are designated as Class II areas. The project area is designated as a PSD Class II area. The nearest Class I area is the Gila Wilderness which lies approximately 35 kilometers (21 miles) west of the mine. No Class I areas are expected to be impacted by the proposed mine operations.

Table 3-9

Average Maximum and Minimum Temperature (°F)
Hillsboro, New Mexico (1953-1993)

Monthly	Maximum	Minimum
January	54	24
February	60	28
March	66	33
April	74	40
May	82	47
June	91	55
July	91	61
August	88	59
September	83	52
October	74	42
November	63	31
December	55	25
Annual Average	73	41
Annual Maximum	75 (1956)	44 (1957)
Annual Minimum	71 (1991)	39 (1987)

Source: National Climatic Data Center, n.d.

Table 3-10

Average Precipitation and Snowfall (Inches)
Hillsboro, New Mexico (1848-1993)

Monthly	Precipitation	Snowfall
January	0.61	2.4
February	0.47	1.7
March	0.34	0.5
April	0.29	0.1
May	0.52	0.0
June	0.66	0.0
July	2.50	0.0
August	2.61	0.0
September	2.06	0.0
October	1.31	0.5
November	0.52	0.7
December	0.98	2.0
Annual Average	12.90	8.0
Annual Maximum	20.24 (1986)	37.0 (1987)
Annual Minimum	3.35 (1956)	0.0 (1993)

Source: National Climatic Data Center, n.d.

Federal and State of New Mexico ambient air quality standards reflect the maximum levels of air pollutants permitted in the atmosphere in the project vicinity. The standards for the types of emissions anticipated from the Copper Flat Project operations are shown in Table 3-11, Summary of Ambient Air Quality Data, that includes carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), and particulate matter (Total Suspended Particulates [TSP], and particulate matter [PM_{10}] less than 10 microns in diameter).

Ambient air quality standards are applied to air contaminants that exhibit known detrimental health effects and can be traced to direct emissions from a source (CO, SO_2, TSP, PM_{10}), or from chemical reactions between emitted pollutants downwind of a facility (NO_2, O_3, PM_{10}). The latter class of air pollutants is referred to as "secondary" pollution source, because they result not from direct emission from a pollution source, but from chemical reactions of "precursor" pollutants. Since it is not possible to regulate the emission of these secondary air pollutants, air quality regulatory agencies focus their regulations upon precursor pollutant emissions.

Most of the particulate matter suspended in the air in the vicinity of the project area and surrounding region is caused by gusty winds acting on unpaved roads and bare land. Monitoring sites maintained by NMED at Truth or Consequences, Hatch, and Las Cruces, New Mexico, have on occasion observed levels of particulate matter that exceed the National Ambient Air Quality Standards. The highest seasonal concentrations, area-wide, occur during the spring months and are a result of gusty winds and lack of rainfall. The lowest concentrations occur during the rainy summer months. These data indicate a common desert environment condition where high levels of blowing dust can occur naturally during windy periods.

The primary pollutant of interest at the mine site is fugitive dust since the emissions of other pollutants are quite small. Fine particulate data collected at Gold Hill by the New Mexico Air Quality Bureau from 1990 to 1992 are presented in Table 3-12. Although Gold Hill is located more than 30 miles west of the Project area, operations occurring at Gold Hill are similar to those proposed for Copper Flat. Data collected at Gold Hill are assumed to be representative of a rural site in southwestern New Mexico similar to the project site. No TSP data were collected in the region. High winds sometimes have created local dust storms which result in higher short-term concentrations; nonetheless, Sierra County has been designated as an attainment area which means that the area meets all applicable air quality standards. Because there are no other significant pollution sources in the area, the overall air quality in the vicinity of the project site is expected to be quite good.

3.9 SOCIAL AND ECONOMIC VALUES

The history of this region can be traced to the 16th century when the Spanish first settled in the area. It was during this time that copper was first discovered and subsequently mined. The United States took possession of the region in 1846 and, shortly thereafter, gold and silver were discovered. Towns and trading centers were established and the population grew, reaching a peak in the 1880s and 1890s. Sierra County was formally established in 1884. Along with mining, ranching and development of the hot springs near Truth or Consequences, New Mexico, contributed historically to the regional economy. It is important to note that the area has a history linked to traditional resource-based production sectors. Dependence on

Table 3-11

Summary of Ambient Air Quality Standards

Pollutant	Averaging Time	New Mexico Standards[1] Concentration[3]	National Standards[2,3] Primary[4]	National Standards[2,3] Secondary[5]
Sulfur Dioxide	Annual Arithmetic Mean	54 µg/m³ (0.02 ppm)	80 µg/m³ (0.03 ppm)	---
	24 hours	261 µg/m³ (0.10 ppm)	365 µg/m³ (0.14 ppm)	---
	3 hours	---	---	1,300 µg/m³ (0.5 ppm)
TSP	Annual Geometric Mean	60 µg/m³	---	---
	24-hour average	150 µg/m³	---	---
PM_{10}	Annual Arithmetic Mean	50 µg/m³	50 µg/m³	50 µg/m³
	24 hour	150 µg/m³	150 µg/m³	150 µg/m³
Ozone[7]	1 hour	118 µg/m³ (0.06 ppm)	235 µg/m³ (0.12 ppm)	235 µg/m³ (0.12 ppm)
Carbon Monoxide	8 hours	9,667 µg/m³ (8.7 ppm)	10,000 µg/m³ (9.0 ppm)	10,000 µg/m³ (9.0 ppm)
	1 hour	15,000 µg/m³ (13.1 ppm)	40,000 µg/m³ (35.0 ppm)	40,000 µg/m³ (35.0 ppm)
Nitrogen Dioxide	Annual Arithmetic Mean	100 µg/m³ (0.05 ppm)	100 µg/m³ (0.05 ppm)	100 µg/m³ (0.05 ppm)
	24 hours	200 µg/m³ (0.10 ppm)	---	---

[1]New Mexico standards are values that are not to be exceeded where the general public has access.

[2]National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

[3]Concentration expressed first in the micrograms per cubic meter (µg/m³), units it was promulgated in, and are based upon a reference temperature of 25°C and a reference pressure 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to part per million (ppm) by volume, or micromoles of pollutant per mole of gas.

[4]National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than 3 years after that state's implementation plan is approved by the EPA.

[5]National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the EPA.

Source: NMED 1994.

Table 3-12

Particulate Matter (PM_{10}) Concentrations for Gold Hill, New Mexico ($\mu g/m^3$)[1]

Description	1990	1991	1992
Highest 24-hour average	74	20	34
2nd highest 24-hour average	45	20	24
Total number of samples	53	58	58
Number of samples > 150 $\mu g/m^3$	0	0	0
Annual arithmetic mean	17	11	11

[1]Micrograms per cubic meter.

Source: Air Sciences, Inc. 1995.

these sectors fosters a condition where communities become vulnerable to outside conditions. More specifically, these communities can be impacted by the fluctuation of national and world mineral prices. Changes in prices coupled with other economic variables (i.e., changes in the lending rate) can have dramatic affects on the mineral extraction sector and the economic condition of the community. Examples of these affects are characterized by the "boom-bust" economy, that is rapid economic expansion and, when prices drop, rapid economic decline.

In the early 1980s, construction began at the Copper Flat mine. In April 1982, the Copper Flat mine began production with 226 workers, however, low copper prices and high interest rates forced the mine to close in July of 1982. The shutdown and subsequent loss of employment was a significant economic disruption for the community (SCEDO and GEC 1993). However, the City and County with the aid of the New Mexico Department of Labor provided social support to reassimilate laid-off workers. An additional response to the potential vulnerability associated with dependence on resource sectors is to diversify. Local government and business groups have extended efforts to diversify the economic activity in the region with success, thereby reducing the potential for boom-bust economic conditions (Chance 1995).

This section describes social and economic conditions in the project study area. For the purposes of the social and economic analysis, the general study area is Sierra County, New Mexico, and the county seat of Truth or Consequences. Peripheral analysis of Dona Ana, Socorro, and Grant Counties and the communities of Hillsboro, Kingston, and Williamsburg is also included in this assessment. Issues discussed include population and demographics, economy and employment, housing, communities services and facilities, public administration, and transportation.

The following description of the affected environment for social and economic values was developed through review of existing literature, statistical data, and through direct contact with area representatives, elected officials, and various local, State, and Federal agencies.

3.9.1 Population and Demography

Sierra County is a rural county. Table 3-13 indicates that county population grew 17 percent from 8,454 in 1980 to 9,912 in 1990 (U.S. Department of Commerce 1991). Population estimates indicate that Sierra County then grew slightly but decreased to 9,845 in 1992. According to the 1990 census, 24 percent of the population in Sierra County were between the ages of 45 to 64 years, and 32 percent were 65 years and older. The median age in the county is 51 years old. Of the county population, 64 percent have at least a high school diploma (U.S. Department of Commerce 1991). Sierra County's population is distributed over 1,927,489 acres for an average density of approximately 0.005 persons per acre with higher concentrations in community settings and lower densities in unincorporated regions. The population of Truth or Consequences is 6,216, or 59 percent of the total county population.

Table 3-13 also provides population estimates for the adjacent counties of Dona Ana, Socorro, and Grant. Dona Ana, with its larger municipality of Las Cruces, is the most populous county in the region. Table 3-13 further indicates that as a region, the area had a 1990 population of 188,878 and a 1995 estimate of 214,232. Regional population is expected to grow at an average annual rate of 2.3 percent until 2010.

Table 3-13

Study Area Population Growth Characteristics

	1980[1]	1990[2]	1991[2]	1992[2]	1995[3]	2000[3]	2010[3]	Average Annual Rate of Growth 1990-2010
New Mexico	--	1,519,834	1,547,422	1,581,830	1,643,580	1,763,742	1,996,688	1.6%
Municipality								
Truth or Consequences	5,219	6,221	N/A	N/A	N/A	N/A	N/A	--
County								
Sierra County	8,454	9,912	10,050	9,845	10,559	11,190	12,325	1.2%
Dona Ana County	97,200	136,487	141,042	146,619	159,848	183,602	230,634	3.5%
Socorro County	12,800	14,787	14,701	14,983	15,355	16,037	17,281	<1%
Grant County	26,204	27,692	28,013	28,621	28,470	29,301	30,818	<1%
Regional Total	144,658	188,878	193,806	200,068	214,232	240,130	291,058	2.3%

[1]U.S. Department of Commerce, Bureau of the Census 1991.

[2]U.S. Department of Commerce, Bureau of the Census 1994.

[3]University of New Mexico, Bureau of Business and Economic Research 1994.

The Bureau of Business and Economic Research, located at the University of New Mexico (1994), has generated population projections for New Mexico counties. These have also been provided on Table 3-13. Projections for Sierra County indicate relatively slow population growth through the year 2010. The projections estimate an increase in population of 6.2 percent from 1990 to 1992, an increase of 1.2 percent annually from 1995 to 2000, and an increase of 1.0 percent annually from the year 2000 to 2010. Relatively slow growth is projected for Socorro and Grant Counties, while substantially faster growth rates are projected for Dona Ana County at an average annual rate of 3.5 percent from 1990 to 2010.

3.9.2 Economy and Employment

Historically, this region of New Mexico was an agricultural and ranching community. In Sierra County, there are about 420 farms and ranches with 8,880 acres of irrigated land and 146 ranches raising livestock (Truth or Consequences/Sierra County Chamber of Commerce 1994). Truth or Consequences has also long catered to visitors interested in the thermal mineral pools located in the area. Employment statistics reveal that the government, retail, and service sectors are the largest non-agricultural employers, providing 24, 21, and 17 percent of employment positions, respectively, in 1993. Table 3-14 indicates the breakdown of employment by commercial and government sector for Sierra County. Table 3-14 reflects that many of the sectors have been fairly stable over the 4-year period from 1990 to 1993. Agriculture and construction appear to have had substantial fluctuations, but this is likely due to seasonal variation in data reporting. Sierra County's mining sector is currently small, providing 1 percent of the county's employment. This indicates that the county's economy is not dependent on this resource-based sector and, therefore, as a whole is insulated from the boom-bust affects associated with dependence on these vulnerable sectors. Furthermore, recent county growth trends indicate that four-fifths of the total job growth between 1980 and 1991 has been concentrated in government, trade, services, and manufacturing, evidencing economic diversification (Bennet 1995).

Table 3-15 indicates the trends from 1990 to 1993 for Sierra County's labor force, total employment and unemployment. The labor force has increased by 2 percent over the 4-year period from 1990 to 1993. The labor force accounts for less than 50 percent of the County population and indicates that a substantial portion of the population is not in the labor force. It is likely that the high occurrence of retirees in the area would explain the lower labor force participation rates. Employment has increased over the period by less than 1 percent to 3,140, thereby causing the unemployment rate to increase by more than one point to a 1993 average annual rate of 5.9 percent. Workforce in the four-county region (Sierra, Dona Ana, Socorro, and Grant) totaled 78,855 in 1992, with an average unemployment rate of 8.1 percent (SCEDO and GEC 1993)

Sierra County per capita income has increased at an average annual rate of 6.5 percent from 1987 to 1992. In 1992, per capita income was $13,911 for Sierra County, higher than per capita income reported for Dona Ana ($13,016), Grant ($12,639), and Socorro ($11,783), but lower than the State average of $15,458 (University of New Mexico 1994). According to the 1990 U.S. Census, 20 percent of those sampled in Sierra County lived below the poverty level.

Table 3-14

Employment by Sector - Sierra County

	1990[2]	1991[2]	1992[2]	1993[3]
Agriculture, Forestry, Fisheries	97	93	304	194
Mining	N/A	N/A	34	28
Construction	102	68	126	264
Manufacturing	N/A	N/A	15	13
Transportation, Communication & Utilities	114	107	94	117
Wholesale Trade	43	45	42	50
Retail Trade	473	433	487	516
FIRE[1]	132	113	116	137
Services	396	433	394	415
Government	709	698	674	721
Total	2,066	1,990	2,286	2,463

[1]Finance, Insurance, Real Estate.

[2]Average Fourth Quarter.

[3]Average Second Quarter.

Source: New Mexico Department of Labor, Economic Research and Analysis 1994.

Table 3-15

Civilian Labor Force, Employment, Unemployment and Unemployment Rate
1990 - 1993 Annual Averages

Sierra County	1990	1991	1992	1993	% Change 1990 - 1993
Civilian Labor Force	3,268	3,262	3,307	3,336	2%
Employment	3,127	3,068	3,121	3,140	<1%
Unemployment	141	194	186	196	39%
Unemployment Rate	4.3%	5.9%	5.6%	5.9%	--

Source: New Mexico Department of Labor, Economic Research and Analysis 1994.

3.9.3 Housing

According to the U.S. Department of Commerce (1991), there are 6,457 housing units in Sierra County. Of these, 25 percent were built in the 1970s, and 46 percent were built before 1970. Seventy-seven percent of the houses are connected to a public or private water system, while 23 percent are served by individual wells. Sewer service is provided to 58 percent of the homes, while 41 percent are connected to a septic system or cesspool.

The Truth or Consequences/Sierra County Chamber of Commerce (1994) states that there are an average of 400 homes for sale on the local market annually. A 2-bedroom mobile home starts at approximately $25,000, while a 2-bedroom home begins at $35,000 and averages approximately $55,000. Housing prices vary with housing location and condition. A two-bed apartment rents for $250 to $400 per month, with a median rent of $226 (U.S. Department of Commerce 1991). There are approximately 554 apartments within a 30-mile radius of the Copper Flat Mine site (SCEDO and GEC 1993). Rental units of 2-bedrooms and larger are scarce in the county. According to local realtors, occupancy rates range from 95 to 100 percent (Dusing 1995; Ryals 1995). Efficiency units or one-bedroom units are much more plentiful. Additional rental units are available in Dona Ana County, particularly in the municipality of Las Cruces. Sierra County also supports three low-income housing complexes and three senior citizen complexes.

Temporary housing includes hotel/motel units and recreation vehicle (RV) and mobile home spaces. According to the Truth or Consequences/Sierra County Chamber of Commerce, there are approximately 370 hotel/motel units and 200 RV or mobile home spaces in the area. The tourist season is not limited to one season. Winter months attract retired persons from northern regions. During the summer months, the area attracts visitors to the nearby lakes and State parks. Summer weekends may see hotel/motel occupancy rates of 90 to 100 percent with rates ranging from $30 to $60 for double occupancy (Guston 1994). Camping is available in several locations including State parks (Elephant Butte, Caballo, and Percha Dam), with rates ranging from $6 to $12 per day.

3.9.4 Community Facilities and Services

3.9.4.1 Utilities and Services

Electricity, water, and wastewater services are provided by the municipality of Truth or Consequences. According to the superintendent of utilities, all services can be expanded to accommodate population growth (Hoskinson 1995). Presently, both water and wastewater systems are being expanded; the first phase of a five-phase, $7-million water system expansion project has begun. This project will include additional wells, storage, treatment and distribution. The wastewater system is also being renovated and upgraded to better handle current waste and accommodate growth (Hoskinson 1995).

There are several water districts extending water service to unincorporated communities in the county. One district is the Hillsboro Mutual Domestic Water Consumers Association. This district supplies water to approximately 62 active meters from 3 wells. The system includes 3,000 gallons in storage capacity and could probably handle an additional 20 or 30 metered customers (Roach 1995). There are no plans for expansion. During periods of drought, the three wells serving the association experience decreased pumping volumes. During the 1994 drought, the association initiated a conservation program until rains replenished wells (Roach 1995).

Hillsboro residents are all on private septic systems and during periods of heavy rain, potable drinking water is of questionable quality (Roach 1995). A possible cause is waste from septic systems reaching ground water. There are no plans, however, to install a wastewater system.

Electric power in the county is provided by Sierra Electric Co-op. Gas service is provided by Southern Union Gas in the Rio Grande Valley from Truth or Consequences, southward through Williamsburg, Las Paloma, Arrey, and Derry. Gas is supplied by El Paso Natural Gas company. All other communities and residents in Sierra County utilized propane (SCEDO and GEC 1993).

3.9.4.2 Landfill

Sierra County and the Truth or Consequences landfills are located north of Truth or Consequences. Those are fully permitted landfills. According to the County landfill supervisor, at least 10 years of available capacity remain at the Sierra County landfill (Millard 1994). Hillsboro residents either utilize the Sierra County landfill directly or the Arrey transfer station, which eventually transports waste to the Sierra County landfill. The nearest hazardous waste landfill is located in southern Dona Ana County, approximately 100 miles south of Truth or Consequences.

3.9.4.3 Schools

The Truth or Consequences Municipal School District is the only school district in Sierra County. It consists of three elementary schools, the Truth or Consequences Middle School, and the Hot Springs High School. The schools are located in Truth or Consequences with the exception of Arrey Elementary, which is approximately 20 miles south of Truth or Consequences. Current enrollment and school capacity are indicated in Table 3-16.

During the 1993-94 school year the district spent $3,260 per child, and in 1994-95 spent $3,505 per child for educational costs. It is anticipated that the district will spend $3,462 per child in the 1995-96 school year (Jones 1995). According to the District Superintendent, 100 additional students are expected to enroll in the 1994-95 school year. and capacity constraints are being experienced in the district (Ryan 1994). It is estimated that the district facilities can absorb approximately 100 kindergarten through fifth graders, 50 middle school students, and 50 high school students before capital improvements would be necessary. The school will seek a bond issue in 1995 to construct six to eight elementary classrooms and six to eight science and vocational education facilities at the high school (Ryan 1994). These expansions will, in effect, expand school capacities.

New Mexico Tech is a newly developed community college in Truth or Consequences. This college offers a variety of programs. Current enrollment is approximately 220 students (SCEDO and GEC 1993).

Table 3-16

Truth or Consequences Municipal School District Enrollment

School	Enrollment				1993-1994 % of Capacity
	1991-1992	1992-1993	1993-1994	Capacity[2]	
Elementary					
Truth or Consequences	708	695	450	600	75
Arrey	79	84	111	150	74
Sierra[1]	-	-	250	330	76
Middle School					
Truth or Consequences	330	360	407	450	90
High School					
Hot Springs	393	403	394	500	79

Source: Ryan 1994.

[1]Sierra Elementary is a new school.

[2]Sierra County Economic Development Organization and Gold Express Corporation 1993.

3.9.4.4 Law Enforcement and Fire Protection

Law enforcement is provided to the area by the City of Truth or Consequences Police Department, the Sierra County Sheriff's Department, and the New Mexico State Patrol. The Truth or Consequences Police Department has 13 police officers. The Sheriff's Department has seven deputies, a sheriff, and an undersheriff. At this time, service in Truth or Consequences is deemed adequate and could absorb moderate population growth (Fisher 1994). The Sierra County Sheriff's Department is currently understaffed. According to Undersheriff La France (1994), Federal guidelines stipulate a target of 3 deputies per 1,000 persons, the State of New Mexico guidelines target 2 deputies per 1,000 persons. Sierra County has 0.80 deputies per 1,000 persons. The budget for the Sheriff's Department is allocated by the County Commissioners and at this time will not permit expansion of the Department.

According to Sierra County Fire Marshall, fire protection is provided to county areas by a system of volunteer departments (Millard 1995). There are volunteer fire departments in Truth or Consequences, Hillsboro, and Williamsburg. Stations at Hillsboro and Caballo provide fire and emergency medical services. All volunteers have some training in hazardous waste response. These stations and their volunteer staff provide adequate service to their jurisdictions which include the proposed mine site (Millard 1994).

3.9.4.5 Medical Services

The only hospital in Sierra county is Sierra Vista Hospital located in Truth or Consequences. Sierra Vista Hospital is a small, rural acute care hospital. The hospital is comprised of 26 acute care beds and 11 skilled nursing beds, with a full-time Orthopedic Surgeon on staff. The laboratory is accredited by the College of Pathology and has a full range of diagnostic equipment available to service 98 percent of tests normally ordered by a physician. A reference lab in El Paso serves unusual requests. The Radiology Department is staffed full time and includes CT Scan, Ultrasound and weekly MRI. The Surgery Department has the capability for a wide range of general surgery and is serviced primarily by local surgeons.

Sierra Vista Physician's Clinic, with resident staff physicians, is also housed in the Sierra Vista Hospital facility. In addition to staff physicians, it also provides service through a large specialist consulting staff to include cardiology specialists from the New Mexico Heart Clinic (SCEDO and GEC 1993).

Other health care facilities in the area include the Sierra Health Care Center and the New Mexico Veterans Center. The Sierra Health Care Center is a 110-bed nursing home and the New Mexico Veterans Center provides intermediate and domiciliary care.

First response emergency services are provided by Sierra Emergency Medical Services administered by Sierra County. The Sierra Vista Hospital Emergency Department provides 24-hour per day coverage, 7 days per week. The department has facilities to handle all types of trauma and the capability to stabilize patients for transport. The hospital has arrangements with "PresAir" Ambulance from Presbyterian Hospital in Albuquerque and "Lifeguard" from University Hospital in Albuquerque. The military helicopter from El Paso is also available from Sierra County Emergency Medical Services (SCEDO and GEC 1993).

3.9.4.6 Social Services

Truth or Consequences, as the County-seat provides the standard array of social services including job service, financial assistance to needy families, mental health referral services, recreation, and library facilities (Chance 1995). No deficiencies in these services were identified.

3.9.5 Public Administration

The primary governing body in Sierra County is the Board of County Commissioners. The County Commissioners oversee county operations, which include roads, the sheriff's office, volunteer fire departments, judicial offices, the assessor, clerk and recorder. Truth of Consequences has a mayor/city manager form of government. The school district is governed by an elected body which administers schools and support services. Hillsboro is not incorporated and does not have an official governing body.

The largest portion of county revenue is derived from property taxes and State and Federal transfers. Net taxable value for Sierra County (total assessed value x 0.3333) was $106,252,922 in 1993. This represents an increase of approximately 3 percent since 1991. The property tax rate in 1993 for Sierra County averaged 19.225 per $1,000 of taxable value for residential property and 23.717 for non-residential property (Whitehead 1994). Property tax revenue in the County was $1,971,517 for 1992, $2,344,097 for 1993, and $2,362,458 for 1994. The sales tax also generates revenue for County and City taxing jurisdictions. The 5.85 percent County tax is split by the City of Truth or Consequences, the environmental fund, the hospital, County general fund and the State. Sales tax in the City of Truth or Consequences is 6.3125 percent (Chatfield 1995).

Mineral extraction is assessed at the State level. All minerals are assessed according to formulae by the Property Tax Division at the State Department of Revenue. Copper extraction in particular is assessed an ad valorem tax equal to the county property tax rate assessed on the market value of the resource extracted. All tax proceeds are returned to the County to be distributed to the general fund, schools and special taxing districts (Bonney 1995). For example, extracted copper sold for $1,000 on the market would generate $23.72 in tax revenue for the County.

3.10 TRANSPORTATION

Access to the Copper Flat Mine is provided via Interstate 25 (I-25), New Mexico State Route 152, and a gravel road. The gravel access road from Route 152 to the intersection north of the tailings impoundment is maintained by Sierra County under a ROW agreement (Parshley 1995b). I-25 is the primary north-south highway in New Mexico and connects the Truth or Consequences, New Mexico area with Las Cruces, New Mexico and El Paso, Texas, to the south, and with Albuquerque, New Mexico and other destinations farther north. State Highway 152 (formerly State Route 90) is a two-lane paved road that runs from east to west from I-25 connecting the communities of Hillsboro, Kingston, and Silver City, New Mexico; it intersects I-25 approximately 15 miles south of Truth or Consequences. Highway 152 is a designated Back Country Byway (see Section 3.12, Recreation).

Travel distance on Highway 152 to the Copper Flat Mine from I-25 is approximately 10 miles. This portion of the highway traverses a gradual uphill grade to the west, contains no sharp turns, and has a posted speed limit of 55 miles per hour (mph). Highway 152 west of the Copper Flat Mine area, however, has relatively steep grades and several tight turns that require vehicles to slow to as little as 30 mph.

I-25 is the most travelled road in Sierra County with approximately 3,300 vehicles per day traveling in both directions near its junction with Highway 152. Highway 152 from I-25 west toward the Copper Flat Mine area was estimated to have carried 532 vehicles per day in 1994 (NMSHTD 1995).

According to the New Mexico State Highway and Transportation Department Transportation Planning Bureau, Highway 152 is a lightly traveled roadway with a level of service rating of "A", a free traffic flow condition that allows the highest level of service. Average daily traffic on Highway 152 is 532 vehicles. This lack of traffic makes Highway 152 attractive to touring bicyclists, even though the highway lacks adequate shoulders and, as such, presents a safety hazard to bicyclists. No improvements are planned or proposed for that portion of the highway east of Hillsboro (Koglin 1995).

Other transportation serving the Truth or Consequences area includes bus service and the Truth or Consequences Municipal Airport. The airport can be reached by private airplane charter and is the only major public airstrip in Sierra County (BLM 1987). An airstrip is located immediately east of the existing tailings impoundment on State-owned land (Section 32, T155, R6W). A second airstrip is located on the Ladder Ranch northeast of the proposed project area. The closest commercial air service is located in Las Cruces, New Mexico. No railroad service is available in the project area or at Truth or Consequences. The closest rail depot is approximately 25 miles to the south, near the intersection of State Highways 26 and 27.

3.11 LAND USE

The purpose of the land use investigation was to identify and describe all major land uses and current public access that may be affected by the Proposed Action. Access and land use information was compiled from maps and existing literature from public and private agencies. Data sources for the baseline inventory included interpretations from U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle sheets, BLM surface management quadrangle maps, BLM Master Title Plats, aerial photographs, and review of BLM planning documents. The baseline data were supplemented by contacts with the BLM and Sierra County and verified by ground reconnaissance during the spring of 1995.

3.11.1 Land Use

Approximately 70 percent of Sierra County is under Federal custodianship. The three major Federal resource agencies having land management responsibilities in the County include: the Bureau of Land Management (BLM), the U.S. Forest Service, and the Department of Defense. Forest Service-managed lands are primarily confined to the Gila National Forest in western Sierra County. Approximately 500,000 acres of Federal land within the County have been withdrawn as part of the White Sands Missile Range. Lands administered by the BLM comprise the majority of public lands in the County (approximately 37 percent, or 1,109,905 acres). Private lands comprise approximately 17 percent of Sierra County (BLM 1994c).

Land use within the study area consists primarily of livestock grazing, oil and gas exploration and mineral development, and dispersed recreational use. Public and private land ownership status in the vicinity of the study area is shown in Figure 2-1. The proposed mine and associated operations would be on private lands controlled by Alta and public lands administered by the BLM. No State lands would be directly affected by the Proposed Action, although a portion of the mine access road, which is owned and maintained by Alta, passes through State land (Section 32, T15S, R6W) and a section of the existing water pipeline that runs from the production wells to the mine passes through State Trust Lands. State land sections also occur immediately south of the tailings impoundment dam (Section 6, T16S, R6W) and west and east of the existing well field (Section 36, T15S, R6W and Section 32, T15S, R5W; respectively).

Few residences were identified within 5 miles of the Copper Flat Mine. Two ranches (Coalson Ranch and Clark Ranch) lie to the southeast within 4 miles of the Proposed Action. The Golddust Ranch, located approximately 0.1 mile south of the mine and north of Highway 152, was used by Quintana Gold Corporation as an office, and is currently leased by Alta for storage. Two private homes are located along Highway 152, approximately 7 and 8 miles east of the Copper Flat Mine area. The town of Hillsboro is located approximately 5 miles southwest of the mine site. Hillsboro contains approximately 100 residences and mobile homes, a church, a post office, a museum, 4 restaurants, 3 antique stores, 2 art galleries, a general store and cafe, and a bed-and-breakfast. A single residence lies 0.8 mile east of Hillsboro along Highway 152 in Warm Springs Canyon.

Livestock grazing occurs throughout the region on private and public lands. The Proposed Action is located in BLM grazing allotment number 6079, which currently supports 133 animal units (cow-calf) annually. This allotment covers approximately 13,000 acres of private and public lands. This allotment supported 151 animal units in 1981 and was reduced in 1983 to account for development of the Quintana Minerals mine. Livestock grazing is permitted in areas adjacent to the mine site.

The Copper Flat Mine is located within the historic Hillsboro (Las Animas) Mining District. This district has been mined intermittently for gold and silver since 1877. The project area contains numerous shafts and placer workings. Gold and silver mining operations ceased in the area in the 1950s and gave way to copper exploration. Mining for copper on the project site began in 1982 by Quintana Minerals but was short-lived (3 months) as a result of falling copper prices. The Copper Flat Mine has not been used for mining purposes since that time. At present, the site contains major remnants of this previous mining activity and includes waste rock disposal areas, an open pit, a tailings impoundment, numerous buried building foundations, and ancillary facilities (decant towers, roads, electrical transmission lines, etc.).

A small currently active placer operation (S & S Mining) is located approximately 1 mile northeast of the Copper Flat area, near Dutch Gulch (Section 25, T15S, R7W). This activity occurs on public lands and operates under a notice for operations less than 5 acres in size filed with the BLM. There are three other active notices on file with the BLM for small placer operations within 3 miles of the Copper Flat Mine. These include: one operation located north of the S & S operation, in the northwest quarter of Section 24; one operation located southeast of Copper Flat in Section 5, T15S, ROW; and one operation in the southwest quarter of Section 1, T16S, R7W, south of State Highway 152. Only the operation near Highway 152 is currently active. Other industrial/mining uses in the region include the Saint Cloud Mining Company's zeolite mine, located near the town of Winston, approximately 30 miles northwest of the Copper Flat Mine. Oil and gas exploration occurs occasionally throughout the region; however, there are no active oil and gas leases in Sierra County.

Although limited in number, dispersed recreational use occurs throughout the project region. These uses include hunting, horseback riding, camping, picnicking, sightseeing, rockhounding, and off-road vehicle use. State Highway 152 is a designated Back Country Byway that passes through the picturesque Black Mountains and the historical towns of Hillsboro and Kingston. Section 3.12, Recreation, contains a description of recreational uses in the project area.

3.11.2 Rights-of-Way

An existing 115-kV transmission line, which would be reactivated for use in the Proposed Action, is located within a utility corridor that parallels State Highway 152 from the Caballo Switching Station to the mine site (see Figure 1-2). A 20-inch water line and 25-kV transmission line that serve the existing production wells (Sections 30 and 31, T15S, R5W) would also be reactivated as part of the Proposed Action. A portion of the existing water pipeline crosses State Trust Lands. Rights-of-way (ROW) are in place and current with the exception of the water pipeline ROW and an amendment that must be made to the transmission line ROW with Plains Electric and Sierra Electric. This amendment involves the rebuilding of both the 1/8 mile transmission lines to the substation and the substation itself. The water pipeline was abandoned by its former owner, Gold Express Corporation. Its ownership reverted to the government (BLM) and would be leased to Alta.

3.11.3 Relevant Plans and Policies

Sierra County currently has no master land use plan or zoning ordinance to guide development of private lands within the county. The Sierra County Interim Land Use Policy Plan (1991) was developed to guide the use of public lands and public resources in the county. The Interim Plan promotes responsible development of the county's mineral resources. County Commissioners and the City of Truth or Consequences each have passed resolutions in support of the reactivation of the Copper Flat Mine (Chance 1995).

Public lands under BLM jurisdiction are managed for the multiple uses of recreation, range, forestry, mineral extraction, watershed, fish and wildlife habitat, wilderness, and natural, scenic, scientific, and historical values. The study area is contained entirely within BLM's Caballo Resource Area, Las Cruces District. The current operational land use plan for this region is the 1986 White Sands Resource Management Plan (RMP). This plan covers all BLM-administered lands in Sierra and Otero counties and supersedes the Southern Rio Grande Management Framework Plan (BLM 1981a). Public lands are generally open to mineral entry and development except for specific areas withdrawn from mineral location (BLM 1985). The White Sands RMP identifies the Copper Flat Mine as a mineral resource and recognizes that it could again become a producing mine in the future.

3.11.4 Access

Primary access within Sierra County is furnished by interstate highways, State highways, county roads, and public access roads (see Section 3.10, Transportation). The majority of the public lands are accessible to the general public via one of these roads.

Access routes for the proposed project would use existing roads (see Figures 1-1 and 1-2). Regional access routes include I-25 and New Mexico State Highway 152. Travel distance along Highway 152 from I-25 to the mine entrance is about 10 miles. Highway 152 passes within 0.50 mile of the site and access to the mine area is provided by a publicly maintained, improved dirt and gravel road. The existing tailings area is currently fenced to limit movement of people and cattle, and the mine road is gated near the former mine entrance to discourage vehicle access. Several other unimproved roads provide access, although circuitous, to portions of the Copper Flat Mine area when they are not gated.

3.12 RECREATION

A variety of outdoor recreational opportunities exist within Sierra County. These recreational opportunities are in two forms: dispersed and developed. Dispersed recreational activities in the project area occur mostly in the Black Range and Caballo Mountains located west and east of the project area, respectively, and include hunting, hiking, horseback riding, camping, picnicking, sightseeing, rockhounding, and off-road vehicle (ORV) use.

Recreational use within the vicinity of the Copper Flat Mine is limited as a result of low population levels in the surrounding area. A lack of improved roads in the region also inhibits recreational access.

The region provides hunting opportunities for a variety of game animals, including bear, elk, mule deer, pronghorn, cougar, turkey, rabbit, scaled quail, dove, and waterfowl. Mule deer hunting is the predominant type of hunting in the Copper Flat Project area, which is located within the New Mexico Department of Game and Fish's, Deer Hunting Unit J. The number of deer hunters in the area, however, are low (BLM 1985). Hunting statistics compiled by Game and Fish indicate that 1,685 deer were harvested in Deer Hunting Unit J during the 1993-94 season (NMDGF 1995).

There are many active rockhounding groups in Sierra County that rely on public lands for their activities. The BLM's Draft Grazing EIS for the Southern Rio Grande Planning Area (BLM 1981a) identifies the Copper Flat Mine as part of a larger hobby rock and mineral collecting area, which comprises most of the historic Hillsboro/Las Animas Mining District. The area immediately north of the mine is considered a prime area for casual use prospecting (i.e., recreational gold panning). This use occurs within the arroyos and along Greyback Wash on both private and public lands (Kelley 1995).

Most of the region is designated as open to use by off-highway vehicles. The Copper Flat Mine area currently is restricted by a locked access road gate to prevent entry by unauthorized personnel.

No designated wilderness areas or Wilderness Study Areas (WSAs) exist within 10 miles of the proposed project area. The closest designated wilderness is the Aldo Leopold Wilderness, located in the Gila National Forest approximately 16 miles to the west. This wilderness is approximately 211,300 acres in size and is administered by the U.S. Forest Service. The Aldo Leopold Wilderness provides outstanding opportunities for solitude and recreational uses such as hiking, backpacking, hunting, and primitive camping. Use of motorized vehicles is prohibited in wilderness. The Continental Divide National Scenic Trail traverses the crest of the Black Range through the Aldo Leopold Wilderness. Lower slopes of the Black Range within the Wilderness are used extensively during the autumn deer hunting season. Winter use in the Wilderness, although low in numbers, includes winter camping and nordic skiing along the Divide Trail (Pane 1995).

The closest WSA is the Las Uvas Mountains WSA, located in northwest Dona Ana County, approximately 28 miles southwest of the Copper Flat Mine. This WSA, administered by the BLM, has limited recreational opportunities (BLM 1991).

No developed recreational facilities exist within close proximity to the Copper Flat Mine. Developed recreational facilities within Sierra County include: Elephant Butte Lake State Park, Caballo Lake State Park, and Percha Dam State Park. These facilities provide the largest water-oriented recreational areas in New Mexico. No BLM-administered recreational sites exist within Sierra County.

Elephant Butte Lake State Park, located 7 miles north of Truth or Consequences, is the largest and most popular State park in New Mexico. Elephant Butte Reservoir, created by a dam constructed in 1916 across the Rio Grande, is 40 miles long and contains more that 200 miles of shoreline. The 36,000 surface-acre reservoir offers many water sport activities including boating, swimming, fishing, and water skiing. The park has over 200 camping and picnicking sites, three developed boat ramps, a visitor's center. playground, concession-operated marinas and stores. Opportunities for primitive camping, hiking, and hunting are also available (USDA 1995). Boating and fishing are popular year-round activities. Sport fish at Elephant Butte Lake State Park include largemouth and smallmouth bass, striped bass, walleye, channel catfish, crappie, white bass, and bluegill. Visitation at Elephant Butte Lake State Park approaches 100,000 persons during the Memorial Day weekend (New Mexico State Parks 1992).

Caballo Lake State Park is located on the Rio Grande 16 miles south of Truth or Consequences. Water sports such as swimming, fishing, boating, and water skiing are recreational activities available at the reservoir. Developed facilities include picnic/camp sites, a playground, and a visitor's center. Opportunities also exist for primitive camping, hiking, and hunting (USDA 1995).

Percha Dam State Park is located farther downstream on the Rio Grande, approximately 21 miles south of Truth or Consequences. Fishing is the only water-oriented recreational activity available at this park. Developed facilities include picnic/camp sites and a playground. Opportunities for primitive camping and hiking are also available (USDA 1995).

New Mexico State Highway 152, which passes near the Copper Flat Project, has been designated a Back Country Byway by the BLM and is designated as the Lake Valley Back Country Byway. The Byway starts at the junction of I-25 and travels west through the historic town of Hillsboro. The route then heads south on State Highway 27 towards Lake Valley and Nutt. The Back Country Byway features some of the most scenic views in southern New Mexico, including the Black Range, Caballo Mountains, Cooke's Peak, and Las Uvas Mountains. This driving route emphasizes the historical contributions of ranching and mining to the region from the historic settlement period through the modern era (BLM 1993). A roadside pullout, located along the Byway across from the Proposed Action, features an interpretive kiosk which describes the former Copper Flat Mine and historic mining in the region.

The Iron Creek Campground, administered by the U.S. Forest Service, is the closest developed camping facility. It is located along State Highway 152, approximately 18 miles west of the Copper Flat Mine in the Gila National Forest. This facility contains restrooms and 10 designated camping sites. The campground is closed in the winter.

Developed urban recreational facilities in Sierra County are located within Truth or Consequences and include two softball fields, five tennis courts, two golf courses, a horse riding path, one swimming pool, and eight parks. The town of Hillsboro has one tennis court.

3.13 VISUAL RESOURCES

The objectives of the visual resources investigation were to identify and describe important visual resources that could be affected by the construction and operation of the Proposed Action and related facilities. Important visual resources are defined for this study as visually sensitive use areas where the maintenance of the surrounding visual environment is important to people's enjoyment of using an area, and unique or unusual landscapes having natural scenic value. The study area was defined to include landscapes in which viewers may travel, recreate, or reside where existing views may potentially be affected by the Proposed Action or ancillary facilities.

The BLM initiated visual resource management (VRM) to manage the quality of the landscape by minimizing impacts to visual resources resulting from development activities, while maintaining the effectiveness of all BLM resource programs. In determining VRM class designations, the inventory process considers the scenic value of the landscape, viewer sensitivity to the scenery, and the distance of the viewer to the subject landscape. These management classes identify various permissible levels of landscape alteration, while protecting the overall visual quality of the region. Management classes are broken down into four levels (Classes I to IV), with Class I designated as most protective of the visual resources. The objectives of these classes vary from very limited management activity to activity that allows major landscape modifications.

3.13.1 Landscape Characteristics

Landscape character type is a unit of physiographic area having common characteristics of land forms, rock formations, water forms, and vegetation patterns. The study area is located in the Basin and Range Physiographic Province. Lands within the Copper Flat Mine are typical of Basin and Range province landscapes with broad, open, basins bounded by prominent mountain ranges generally covered by pinon-juniper vegetation. The site is located within the foothills of the Black Range, which is a major north-south mountain chain in south-central New Mexico. To the west, the Black Range rises sharply above the Rio Grande Valley and Caballo Reservoir, which lie east of the Copper Flat Mine. Elevation at the mine site ranges from approximately 5,200 feet to 5,500 feet above mean sea level (MSL), with Las Animas and Black peaks reaching elevations of 6,170 and 6,280 feet MSL, respectively.

As described in Section 3.12, Recreation, New Mexico State Highway 152, which passes less than 0.50 mile south of the Copper Flat Mine area, is a designated Back Country Byway. Interpretive displays along this driving route emphasize the historical contributions of ranching and mining to the region. A kiosk, located within view of the Copper Flat Mine, describes the former Quintana Minerals operation.

Clear skies with broad, open landscapes characterize the regional landscape setting of southern New Mexico, including the project area. This type of landscape allows for long viewing distances. Consequently, maintenance of visual resources is a concern from nearby and distant viewing locations, including views from Federal lands with high visual resource values, Federally-designated wilderness areas, recreation areas, major transportation routes, and population centers.

3.13.2 Existing Visual Impacts

When compared within the physiographic region for scenic values, the scenery of the Copper Flat Mine is rated below average (BLM 1978). The area is identified as a Class III visual management class. Class III guidelines state that 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 (form, line, color, texture) found in the predominant natural features of the characteristic landscape (BLM 1986b).

The study area is located within gently rolling to hilly terrain which has been disturbed extensively as a result of historical mining activities. Vegetation in the area is generally dominated by creosote bush, tarbush, mesquite, littleleaf sumac, sideoats grama, and snakeweed. Existing visual contrasts generated by the open pit, waste rock disposal areas, and tailings impoundment dam constructed during past mining activities are historical features of the local topography and can be observed from many viewpoints in the vicinity.

In order to assess the degree of visual contrast that would result from implementation of the Proposed Action, key observation points (KOPs) were selected from which changes to the characteristic landscape could be compared. KOPs are typically chosen along commonly traveled routes or at other likely observation points (BLM 1986b). For the purposes of this analysis, two KOPs were chosen that provide views toward the Copper Flat Mine: the south-bound Interstate 25 rest stop located approximately 3 miles north of the Caballo Lake exit (KOP 1), and the State Highway 152 interpretive kiosk, located adjacent to the Copper Flat Mine (KOP 2). KOP 1 is located 10.5 miles east-northeast of the mine; KOP 2 is located less than 1 mile to the east of the mine site.

From KOP 1 the existing Copper Flat Mine appears in background views to the west as a lightly colored band at the base of the Black Range foothills. The appearance of a light band is a result of earth disturbance associated with the existing eastern ore disposal area and tailings impoundment. Views of the plant area and pit are blocked by Animas Peak. From KOP 2 the mine appears in foreground-middleground views against a backdrop formed by Animas Peak. The eastern ore disposal area contrasts moderately with the color and form of the natural landscape and tends to attract the attention of motorists on Highway 152. A dark horizontal line is created by dead vegetation along the east face of the tailings dam. Man-made structures are visible and include a decant tower, twin water storage tanks, and a single-story structure. Appendix C contains BLM Visual Contrast Rating Worksheets that include descriptions of the existing visual environment as viewed from these two KOPs.

The transmission and water supply lines east of the Copper Flat Mine cross a landscape dominated by the alluvial plains of the Rio Grande Valley. This area is relatively flat and dissected by small arroyos. Dominant vegetation includes creosote bush and tarbush. This area remains relatively natural in appearance, with the exception of State Highway 152, three transmission lines (including two related to the Proposed Action), and a windmill. This area is also classified by the BLM for Class III visual management.

3.14 CULTURAL RESOURCES

Cultural resources consist of prehistoric and historic archaeological deposits; structures of historic or architectural importance; and Native American traditional ceremonial, ethnographic, and burial sites. Analysis of cultural resources can provide valuable information on the cultural heritage of local citizens and regional populations. Cultural resources are nonrenewable resources, which are afforded protection by Federal, State, and local laws, ordinances, and guidelines. The Antiquities Act of 1906 and the following Federal legislation, policies, regulations, and guidelines have been enacted to protect cultural resources and have been considered during review of the proposed project:

- The Antiquities Act of 1906 (PL 59-209) and the Archaeological Resources Protection Act of 1979 (PL-96-95) (ARPA).

- National Historic Preservation Act of 1966 (NHPA), as amended; Section 106 Compliance; 16 United States Code 470 et seq., and implementing regulations 36 CFR 800.

- American Indian Religious Freedom Act of 1978 (AIRFA); requires Federal agencies to evaluate their policies and procedures with the objective of protecting the religious freedoms of Native Americans.

- Native American Graves Protection and Repatriation Act of 1990 (NAGPRA); although specific actions are required in this Act, to date, no implementing regulation has been promulgated.

The Antiquities Act of 1906 was the first general act providing protection for cultural resources. It provided for protection of all historic or prehistoric ruins or monuments or any object of antiquity on Federal lands, and established criminal sanctions against the injury, destruction, or unauthorized excavation of such resources. ARPA supplements the provisions of the Antiquities Act of 1906 in securing the protection of archaeological resources and sites on public lands. It stipulates that no person may excavate, remove, damage, or otherwise alter or deface any archaeological resource on public lands unless such activity has been permitted in accordance with the Act.

NHPA established the National Register of Historic Places (NRHP) and the Advisory Council on Historic Preservation. In Section 106 of NHPA, a five-stage process, which involved the appropriate State Historic Preservation Officer (SHPO), Advisory Council, and appropriate Federal agency, was detailed to ensure that effects on historic properties are fully considered in the planning and execution of Federal projects (defined as projects involving Federal lands, funding, or licensing). Executive Order 11593 of 1971 specifically invoked NHPA and directed Federal agencies to inventory their lands for cultural properties and make appropriate nominations to the NRHP.

Consideration for listing on the NRHP is given to "districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association" and a) that are associated with events that have made a significant contribution to the broad patterns of history; or b) that are associated with the lives of persons significant in our the past; or c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or d) that have yielded, or may be likely to yield, important information in prehistory or history (Parker and King no date). Burials are not generally eligible to the NRHP by definition.

AIRFA mandated that Federal agencies and departments protect and preserve Native American religious cultural rights and values. In practice, AIRFA has established a set of procedures where tribal representatives are notified and asked to comment on Federal actions that may adversely affect known sites of religious or cultural value. ARPA specifically references AIRFA with respect to protection of culturally significant sites.

NAGPRA was implemented to ensure proper and timely repatriation of Native American human remains housed in museums and other institutions. NAGPRA also mandates that Federal agencies establish procedures for responding to unanticipated discoveries of human remains and related cultural materials on Federal and tribal lands. Graves on private land are not protected under NAGPRA; however, they can be protected under State laws regarding treatment of human burials. In New Mexico, burials on private and State lands are protected under the State Burial Act; burials on Federal lands are protected under NAGPRA.

3.14.1 Cultural Setting

Archeological evidence suggests that Paleo-Indian hunters who utilized grasslands in the project vicinity during the Pleistocene (12000 to 8000 before present [B.P.]) were some of the first people to occupy the area. Sierra County is believed to have supported only a limited population of these early hunters whose economic base was focused on large, now extinct, Pleistocene fauna such as mammoths (Evaskovich and Higgins 1991; Laumbach and Kirkpatrick 1983).

During the drier period following the Pleistocene, known as the Altithermal (8000 to 2000 B.P.), data suggest that there was a gradual increase in human population in the area. The archaeological remains of the hunting and gathering groups who lived during this period are referred to collectively as the Archaic. The drier climate of this period forced an increased use of plant foods and smaller game animals not affected by the climatic change. As a result, canyons in the project vicinity with reliable water sources became more attractive to Archaic Period hunters and gatherers (Laumbach and Kirkpatrick 1983). Agriculture appears to have become an important component of the economy late in the Archaic Period. Permanent villages, composed of pithouses, and the manufacture of brownware pottery mark these agricultural beginnings (Wheat 1955).

By 1000 B.P., masonry pueblos and a stylistically unique black-on-white pottery had been developed. Collectively defined as the Mimbres Branch of the Mogollon culture, sites with masonry pueblos and Mimbres black-on-white ceramics are found over a wide area in southwestern New Mexico. Western Sierra County contains many Mimbres Period sites. Major drainages in the area contain one or more sites and are associated with a number of smaller, satellite field house sites. These sites are found wherever sufficient soil development occurred to allow agriculture and appear to have been used on a seasonal basis. The intensive, yet widespread placement of these sites suggests a population attempting to maximize usage of all available arable land. This effort appears to have eventually failed; by about 850 B.P., the Mimbres sites throughout southwestern New Mexico, including those in western Sierra County, were no longer occupied (Laumbach and Kirkpatrick 1983).

Within a few years, drainages in the northern Black Range appear to have been reoccupied by a population that produced the ceramics and masonry architecture characteristic of the Tularosa phase, Cibola Branch of the Mogollon culture. This reoccupation appears limited to the larger Mimbres sites; the extensive field house system of the Mimbres Period was not reimplemented. By about 700 B.P., this new population had also vacated their sites (Laumbach and Kirkpatrick 1983).

Southern drainages in western Sierra County began housing pueblo populations whose sites displayed architecture and ceramics of the El Paso phase of the Jornada Branch of the Mogollon, originally defined by Lehmer (1948) in the Chihuahua Desert of southcentral New Mexico. The sites are similar to those found across northern Chihuahua and southeastern Arizona. Sites often include field house systems similar to the Mimbres system. The question of whether these sites reflect a Mimbres population adopting new cultural traits or a new population entering the area continues to be debated. The most recent of these sites appears to have been abandoned around 600 B.P., although none of the sites has been accurately dated (Laumbach and Kirkpatrick 1983).

None of the pueblos found in the area were occupied when the Spanish arrived in the late 1500s. By 1621, "Apaches de Gila" were noted by Fray Alonzo de Benavides as living in the area (Forrestal 1954). During the 1700s, a number of Spanish military expeditions observed evidence of Apaches living in the Black Range. Apaches in the project vicinity have been referred to as the Gila, Mimbres, or Warm Springs Apache.

They also have been defined as the Eastern Chiricahua. They call themselves the Tcihine or Chiende, which translates as "Red Paint People" (Sechrist and Laumbach 1995).

Western Sierra County was not settled by Europeans until 1859, primarily as a result of the Apache threat (Sechrist and Laumbach 1995). The first community, Alamosa, was located near the mouth of Alamosa Creek on the Rio Grande. At some point between 1860 and 1870, a portion of the original population began settlements along the upper Alamosa and Cuchillo Negro drainages. Other settlements were started along the Rio Grande as far south as present day Hatch, then called Santa Barbara. The early settlers maintained an uneasy peace with the Apache, often trading with them, but also suffering from raids (Laumbach and Kirkpatrick 1983). Under U.S. government, a series of reservations for the Apache were created, culminating with the Warm Springs Apache Reservation in 1874. The headquarters for this reservation was on Alamosa Creek in Socorro County, although the reservation extended south into northern Sierra County.

Mining in Sierra County boomed in the late 1870s after the discovery of several ore bodies. In 1877, two gold prospectors founded the community of Hillsboro (Evaskovich and Higgins 1991). In April of that same year, placer gold was discovered in Rattlesnake and Wicks Gulch (Bussey and Naylor 1975). The Hillsboro area was soon inundated with prospectors searching for gold, and by 1879 the population had reached 400. Hillsboro became a stop for the Kingston to Lake Valley Stageline and flourished until the early 1900s. The community, which still exists today, was listed on the State Register of Cultural Properties as the Hillsboro Historic District (District 1304) on October 24, 1986 (Evaskovich and Higgins 1991).

Mining camps in the area, including those in the vicinity of Hillsboro, were often the focus of raids by small bands of reservation Apaches. These actions probably contributed to the sentiment that the Apache should be moved from the Warm Springs Reservation; the reservation was closed in December of 1878 and the Apaches were relocated to the San Carlos Reservation in Arizona (Bussey and Naylor 1975). In 1879, after rejecting several attempts to move them onto the San Carlos Reservation, the Chiende leader, Victorio, led his people in a desperate bid for freedom. After almost 1 year, the Victorio War ended when most of the band was killed by Mexican cavalry in northern Mexico. The remainder of the band, led by aging Nana, made one last raid through New Mexico in 1881. Ultimately the Chiende were captured and were scattered on Apache reservations in Arizona, New Mexico, and Oklahoma (Laumbach and Kirkpatrick 1985; Sechrist and Laumbach 1995).

Since the 1870s, mineral development has been the primary focus of activity in the area, however, homesteading laws encouraged the development of small ranches and farmsteads along the Black Range drainages. Today most have been abandoned or consolidated.

3.14.2 Cultural Resources Identified in the Project Area

Several regional archaeological surveys were conducted in the general vicinity of the proposed Project area in the early 1900s (Lekson 1985) and in the 1980s (Evaskovich and Higgins 1991) without identifying specific sites within the Project area. Four archaeological surveys specific to the project area have been conducted as a result of recent and proposed mining activities at the site. Cultural resources identified during these surveys fall into two general categories; mining-related sites and artifacts and a limited number of prehistoric sites and artifacts. Mining-related sites and artifacts span the period from the 1870s to the present. No ceramics were found in the prehistoric sites even though the adjacent Percha and Animas drainages contain ceramic period sites. The lack of ceramics is interpreted as a reflection of the scarcity of developed soils in the project area (Sechrist and Laumbach 1995, in preparation).

The first surveys in the mine area were performed in 1975 and 1977 by the Cultural Resources Management Division (CRMD) of New Mexico State University who conducted a two-phased cultural resources survey for Quintana Minerals Corporation's Hillsboro-Copper Flat Project (Bussey and Naylor 1975; Brethauer and Hoyt 1977). The CRMD surveys covered the majority of the area around and including the Hillsboro Mining District (approximately 3,360 acres). The CRMD surveys identified 26 sites during the 1975 survey within an approximate 1-mile radius of the proposed mine area and four sites during the 1977 survey, including three sites previously recorded during the 1975 survey and one new site (QMCS 2-1), along the proposed power lines, the water line, an access road, and other related industrial sites. Because Federal agencies and the archaeological profession were still in the process of developing procedures and policies to manage cultural resources at that time, the CRMD surveys do not meet current standards of coverage for archeological surveys. Sites identified during the CRMD surveys generally cannot be relocated since the original site locations were plotted on 15-minute topographic maps that resulted in inaccurate placement. The CRMD reports were also never reviewed by the Historic Preservation Division and no NRHP-eligibility determinations were made for located sites. For these reasons, the CRMD survey was minimally used in this EIS for evaluation purposes and only as a supplement to current surveys that were required for all potential disturbance areas to meet current standards. Six CRMD sites (QMCS-4, QMCS-13, QMCS-14, QMCS-18, QMCS-20, QMCS-21) that were relocated during recent surveys are identified on Table 3-17, Cultural Site Summary. Nine sites identified during CRMD surveys are located outside of the proposed direct disturbance area and have not been resurveyed (QMCS-1, QMCS-6, QMCS-7, QMCS-8, QMCS-9, QMCS-19, QMCS-22, QMCS-23, QMCS-24). Seven sites identified by CRMD (QMCS-2, QMCS-3, QMCS-5, QMCS-11, QMCS-12, QMCS-17, QMCS-2-1) were mapped in areas disturbed during the 1982 mining operation and are assumed to have either been destroyed and/or mis-mapped by CRMD. Five sites identified by CRMD as being located in the proposed disturbance area were not relocated during the MAI and HSR surveys and are also assumed to have been destroyed or incorrectly mapped (QMCS-10, QMCS-15, QMCS-16, QMCS-25, QMCS-26).

Although the CRMD surveys included the currently proposed Project area, new surveys are required to meet current archeological survey standards for all areas of potential disturbance. Accordingly, Mariah Associates Inc. (MAI) conducted a 364-acre Class III cultural resource inventory in 1990 for the proposed East Waste Rock Disposal area associated with the proposed copper mine expansion. Cultural sites identified during this survey included numerous isolated occurrences and 14 historic sites associated with mining activities. Three of the 14 historic sites also contained a prehistoric component (MA 558-5, MA 558-7, MA 558-9). Cultural resources encountered in the 14 historic sites included remnants of structures, historic trash, a cemetery, and man-made rock concentrations. Cultural materials found in the prehistoric sites are primarily lithics. Five of the 14 sites (MA 558-1, MA 558-2, MA 558-4, MA 558-9, MA 558-10) had been previously recorded by CRMD and had been assigned Laboratory of Anthropology (LA) numbers; the remaining 9 sites (MA 558-3, MA 558-5, MA 558-6, MA 558-7, MA 558-8, MA 558-11, MA 558-12, MA 558-13, MA 558-14) were assigned new LA numbers. CRMD sites QMCS-13, QMCS-14, QMCS-18, QMCS-20, and QMCS-21 correspond to MAI sites MA 558-10, MA 558-9, MA 558-4, MA 558-2, and MA 558-1, respectively. Seven of the 14 sites identified by MAI are eligible for the NRHP (MA 558-2, MA 558-3, MA 558-6, MA 558-7, MA 558-8, MA 558-9, MA 558-11) (Evaskovich and Higgins 1991). Four sites were judged ineligible with SHPO concurrence (MA 558-1, MA 558-5, MA 558-10, MA 558-12) and three potential grave sites (MA 558-4, MA 558-13, MA 558-14) are not eligible to the NRHP by definition, but are protected under State and Federal burial statutes.

In September 1995, Human Systems Research, Inc. (HSR), conducted a Class III inventory of undisturbed areas within the proposed mine development site not evaluated during the 1990 MAI survey. Areas surveyed included locations adjacent to the pit, the tailings impoundment, topsoil stockpiles, the waste rock disposal areas, and buffer zones on the periphery of several disturbance areas. Areas exhibiting extensive disturbance from previous mining operations conducted in 1982 were not resurveyed; it was assumed that cultural resources that may have existed in these areas had been destroyed and the potential for finding intact cultural remains was low.

The total area surveyed by HSR was approximately 565 acres; 245 acres were on public lands administered by the Bureau of Land Management, Las Cruces District, while the remaining 320 acres were privately-owned. Cultural resources recorded during this survey included 16 sites and 197 isolated occurrences (Sechrist and Laumbach 1995). Five of the sites are prehistoric, consisting of four lithic sites and a petroglyph site. The remaining 11 sites are related to historic mining and include one standing structure, one rock cabin foundation, one tent camp, several historic artifact scatters, one mine tunnel, and two locations containing possible historic graves. One of the sites (HSR 9523-6) had been previously recorded and incorrectly located by the 1975 CRMD survey (QMCS-4) and had been assigned a LA number of 13121. The remaining 15 sites were assigned LA numbers 110752 through 110766 (see Table 3-17).

Nine of the sites located by HSR are considered to be potentially eligible to the National Register of Historic Places (NRHP) pending further evaluation (see Table 3-17). Three of the sites are judged eligible to the NRHP (pending SHPO concurrence) (9523-2, 9523-6, 9523-13). Two of the sites are judged ineligible to the NRHP (pending SHPO concurrence) (9523-11, 9523-12). The two suspected grave locations, (9523-15, 9523-16) which are located on private and Federal land, are not eligible to the NRHP by definition but, under State and Federal laws regarding treatment of human burials, would require testing if disturbance from the proposed Project is a potential, and, if burials are present, removal and reinterment of the remains.

Table 3-17 summarizes the sites identified by recorded and prior site number, site type, project association, NRHP potential, potential impact of the proposed project, and proposed mitigation. LA numbers have been assigned to sites identified during the MAI and HSR surveys and are provided on Table 3-17.

Of the 30 sites identified in the mine area by MAI and HSR, 7 are eligible for the NRHP; 3 are judged eligible pending SHPO concurrence; 2 are judged ineligible pending SHPO concurrence; 4 have been found not eligible for the NRHP; and 9 are eligible pending further evaluation. Five grave sites are ineligible to the NRHP as defined but are protected under State and Federal burial protection statutes (see Table 3-17).

3.14.3 Ethnography

Western Sierra County was an important residential area of the Tcihine Apaches, historically called the Gila, Mimbres, and Warm Springs Apache. The Tcihine were the easternmost of three bands of the Chiricahua Apache tribe. The Tcihine Apache apparently were organized into local groups of 10 to 30 extended families, with each group of families subsisting in a given portion of the band's territory. The Tcihene were mainly hunter/gatherers who focused on deer, small game, and seasonal gathering of a variety of wild plants, although they may have planted corn and other grains near villages. Primary food plants included mescal, acorns, mesquite, pinyon, datil, tunas (fruits of prickly pears), and walnuts (Lekson 1985).

The Tcihine moved seasonally, spending winters in the southern portion and summers in the northern portion of their territory. This seasonal pattern probably ceased in the late 1800s following the destruction of Victorio's band by Mexican forces and the subsequent movement of the remaining Tcihine onto reservations.

On July 12, 1994, notification and requests for comment (scoping) letters were sent to the Tribal Chairs of the Mescalero Apaches in Mescalero, New Mexico; the San Carlos Apaches in San Carlos, Arizona; the Jicarilla Apaches in Dulce, New Mexico; the Piro-Manso-Tiwa in Las Cruces, New Mexico; and the Tribal Governor of Isleta del Sur Pueblo in El Paso, Texas. The letter notified the respective Native American groups of the proposed project and potential impacts to proto-historic cultural resources, and provided the Native American groups with an opportunity to express their comments or concerns regarding the Proposed Action. No response to the letters had been received as of this printing.

3.15 PALEONTOLOGICAL RESOURCES

No paleontological resources of critical or educational value have been identified within the proposed mine area. Known fossil-bearing formations occur in the vicinity of the Proposed Action, including Mississippian period strata near Lake Valley and Pennsylvanian limestones near the town of Derry, New Mexico. The nearest significant fossil assemblage is located at Percha Box (Section 14, T16S, R7W) approximately 2.5 miles south of the Proposed Action area. The Devonian period exposures found in this narrow canyon contain well-preserved invertebrate fossils, including brachiopods and corals (Ratkevich and LaFon 1978).

Table 3-17

Cultural Site Summary

Site Number	Site Description	Artifactual Evidence	Project Association	NRHP Potential	Project Disturbance	Mitigation
QMCS-2 LA13119	Historic Gravesite	Headstone	Pit	Not Eligible (by definition)*	Presumed destroyed **	NA
QMCS-3 LA13120	Historic Building Site	--	Pit	***	Presumed destroyed **	NA
QMCS-4 9523-6 LA13121	Historic Habitation Prehistoric Artifact Scatter	Domestic Trash Scatter, chipped stone tool and debris	North Waste Rock Disposal Area	JE	Direct	DR (depending on SHPO determination)
QMCS-5 LA13122	Historic Building Site	Boards, Iron Pipe, Tin Cans	West Waste Rock Disposal Area	***	Presumed Destroyed **	NA
QMCS-11 LA13128	Historic Building Site	Trash Scatter	Tailings Impoundment	***	Presumed Destroyed **	NA
QMS-12 LA13129	Historic Structures, Possible Grave Sites	Trash Scatter	Haul Road	***	Presumed Destroyed **	NA
QMCS-13 MA 558-10 LA13130	Historic Habitation	Trash Scatter	Adjacent to Access Road	NEL	Indirect	AV
QMCS-14 MA 558-9 LA13131	Historic Habitation, Building Sites Historic Gravesite (John Betake) Prehistoric Lithic Scatter	Trash Dumps and Scatter, Lithic Scatter	East Waste Rock Disposal Area	E	Indirect	AV
QMCS-17 LA13134	Historic Habitations	Trash Scatter	Tailings Impoundment	Unknown	Presumed Destroyed **	NA
QMCS-18 MA 558-4 LA13135	Historic Cemetery	None	Adjacent to County Road	Not Eligible (by definition)*	Indirect	--
QMCS-20 MA 558-2 LA13137	Historic Habitation Mine Site	Trash Scatter	East Waste Rock Disposal Area	E	Indirect	AV
QMCS-21 MA 558-1 LA13138	Contemporary Habitation	Tools, Cisterns	East Waste Rock Disposal Area	NEL	Indirect	AV
LA26332	Historic Building Site	Trash Scatter	Access Road	***	Presumed Destroyed **	NA
MA 558-3 LA82276	Mine Shaft and Debris	Trash Scatter	East Waste Rock Disposal Area	E	Indirect	AV
MA 558-5 LA82277	Prehistoric Lithic Scatter, Historic Building Site	Lithic Scatter, Trash Scatter	Access Road/Plant	NEL	Indirect	AV
MA 558-6 LA82278	Historic Building Site, Prospecting Site	Trash Scatter	Adjacent to Access Road	E	Indirect	AV

Table 3-17 (Continued)

Site Number	Site Description	Artifactual Evidence	Project Association	NRHP Potential	Project Disturbance	Mitigation
MA 558-7 LA82279	Prehistoric Lithic Scatter, Historic Building Site	Lithic Scatter, Trash Scatter	Adjacent to Access Road	E	Direct (may be impacted by road work)	DR or AV (if not affected by road work)
MA 558-8 LA82280	Historic Building, Habitation Site	Trash Scatter	East Waste Rock Disposal Area	E	Indirect	AV
MA 558-11 LA82281	Prehistoric Isolates, Historic Building Site, Road, and Prospecting Site	Two Prehistoric Metates, Trash Scatter	Adjacent to Access Road	E	Indirect	AV
MA 558-12 LA82282	Contemporary Mine and Machinery Shed	Mine Shaft, Machinery, Trash	East Waste Rock Disposal Area	NEL	Indirect	AV
MA 558-13 LA82333	Grave Site	Possible Headstone	East Waste Rock Disposal Area	Not Eligible (by definition)*	Indirect	AV
MA 558-14 LA82334	Possible Grave Site	Tin Can	East Waste Rock Disposal Area	Not Eligible (by definition)*	Indirect	AV
9523-1 LA110752	Archaic lithic site	Chipped-stone tools and debris, ground stone tool	Pit/Diversion	NEV	Direct	DR
9523-2 LA110753	Tony House and environs	Domestic artifacts	Tailings Impoundment	JE	Direct (surrounding site may be impacted by tailings impoundment; Tony House will be avoided)	DR (for environs); AV (for Tony House)
9523-3 LA110754	Prehistoric chipped-stone scatter	Chipped-stone tools and debris	Topsoil Storage Area North Side of Tailings Impoundment	NEV	Direct	DR
9523-4 LA110755	Historic mine tunnel and tent bases	Domestic artifacts, stove parts, roofing tin	Access Road	NEV	Direct (may be impacted by road work)	DR or AV (if not affected by road work)
9523-5 LA110756	Historic tent base and test pit	Domestic artifacts, nails, horse shoes	Diversion	NEV	Direct	DR
9523-7 LA110757	Historic placer-mining activity area	Domestic artifacts, nails, hardware, horse shoes	Tailings Impoundment	NEV	Direct	DR
9523-8 LA110758	Prehistoric lithic scatter	Chipped-stone debris	Tailings Impoundment	NEV	Indirect	AV
9523-9 LA110759	Domestic artifact scatter below Hillscher House	Domestic artifacts, roofing tin, cairns, equipment, parts, tires, fence posts, lumber	Tailings Impoundment	NEV	Direct	DR

Table 3-17 (Continued)

Site Number	Site Description	Artifactual Evidence	Project Association	NRHP Potential	Project Disturbance	Mitigation
9523-10 LA110760	Historic leveled pad	Domestic artifacts, nails, metal scraps, lumber	Tailings Impoundment	NEV	Direct	DR
9523-11 LA110761	Historic roads and artifact scatter	Domestic artifacts, horse shoes, metal scraps	Tailings Impoundment	JI	Direct	NA or DR (depending on SHPO determination)
9523-12 LA110762	Historic mine tunnel and artifact scatter	Domestic artifacts, lumber	East Waste Rock Disposal Area	JI	Indirect	AV
9523-13 LA110763	Petroglyph site	None	Diversion	JE	Indirect	AV
9523-14 LA110764	Possible prehistoric camp	Chipped-stone tool and debris	Diversion	NEV	Direct	DR
9523-15 LA110765	2 possible historic graves	Cobble mound, plank-lined pit	Tailings Impoundment	Not Eligible (by definition)*	Direct	DR and reinterment if identified as burial
9523-16 LA110766	3 possible historic graves	Cobble mounds, domestic trash, ore slag, .44 Henry casing	Tailings Impoundment	Not Eligible (by definition)*	Direct	DR and reinterment if identified as burial

* Grave sites are not eligible by NRHP definition, but should be tested if they will be directly impacted to verify that they are graves. If they contain human remains, removal, analysis, and reinterment elsewhere is required by state law.

** CRMD sites that were originally located in disturbed areas that weren't relocated during later surveys either because they were mismapped or no longer exist.

*** QMCS sites were not assessed for eligibility to the NRHP by CRMD or the SHPO.

[1]QMCS denotes sites identified during CRMD surveys.
MA denotes sites identified during Mariah survey.
9523 denotes sites identified during HSR survey.

LA = the site number assigned by the Museum of New Mexico, Labratory of Anthropology; the centralized database and curator facility for New Mexico.
E = eligible (SHPO concurrence).
JE = judged eligible (pending SHPO concurrence).
JI = judged ineligible (pending SHPO concurrence).
NEL = not eligible (SHPO concurrence).
NEV = eligible pending further evaluation.
AV = avoid.
DR = data recovery.
NA = no action.

Sources: Brethauer & Hoyt 1977; Bussey 1975; Evaskovich & Higgins 1991; Sechrist and Laumbach 1995 (in preparation).

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discusses anticipated direct and indirect impacts of the Proposed Action (Section 4.1), the No Action Alternative (Section 4.2), and two alternatives for the Copper Flat Project (see Sections 4.3, Reduced Stripping Ratio Alternative, and Section 4.4, Consolidated Waste Rock Dump Alternative).

Wilderness resources would not be affected by the proposed mining area since none are present in the area, and therefore are not addressed in the EIS. BLM is also required to assess impacts to prime or unique farmlands, floodplains, wild and scenic rivers, minority or low-income population or communities, and areas of critical environmental concern; however, none occur within the proposed mining area. This elimination of nonrelevant issues follows the Council on Environmental Quality (CEQ) policy as stated in 40 CFR 1500.4.

Potential mitigation measures developed in response to anticipated impacts are discussed in Section 4.5, Potential Mitigation and Monitoring. These measures could be required by BLM or other regulatory agencies as conditions or stipulations of approval and authorization of the Plan of Operation.

Cumulative impacts are discussed in Section 4.6. Unavoidable adverse impacts are described in Section 4.7; short-term uses compared to long-term productivity are discussed in Section 4.8; irreversible or irretrievable commitments of resources are presented in Section 4.9; and energy consumption for the Copper Flat Project is summarized in Section 4.10.

4.1 Proposed Action

4.1.1 Geology and Minerals

4.1.1.1 Mine Development/Operation

Approximately 60 million tons of copper-bearing ore would be mined under the Proposed Action between 1997 and 2010. This would yield approximately 480 million pounds of copper at an average mining grade of 0.4 percent copper. Approximately 51 million tons of waste rock would be left on site along the southeast slope of Animas Peak and in waste rock and lean ore piles around the perimeter of the pit (Figure 2-1). This would be in addition to the approximately 3.0 million tons of waste rock currently on site. Approximately 11 million tons of low grade ore (less than 0.18 percent copper) would be stockpiled on site in the lean ore pile and milled if copper prices warrant. An estimated 69 million tons of tailings would be added to the existing tailings facility during the 10 to 12 year life of the proposed mining operation. The estimated copper resource at Copper Flat would decrease from the present resource estimate of 500 million pounds of copper to approximately 20 million pounds or less of recoverable copper.

Expansion of the tailings facility to accommodate the additional 69 million tons of tailings would not impact any known recoverable resource. The current tailings facility, comprising approximately 1.2 million tons, already covers most of the historic placer workings. The estimated remaining resources in these workings are not economically recoverable at current gold prices. The area proposed for waste rock disposal would not impact any known copper or gold resource. The proposed plant facility would occupy the area of the former plant facility constructed by Quintana and would not impact any known resource.

Because of the possibility of a major earthquake within 100 miles of the project site, Sergent, Hauskins, and Beckwith (SHB 1980) evaluated the potential for earthquake damage to the proposed tailings impoundment. They estimated that a magnitude 6.0 earthquake 15 miles from the site is the most conservative maximum credible earthquake predicted for the project area. This would result in an estimated P-wave acceleration of 0.15 times the acceleration of gravity at the site of the tailings impoundment. The evaluation of SHB (1980) compared the proposed tailings impoundment dam at Copper Flat to similar Chilean tailings dams and hydraulic fill and sandy embankments that have experienced earthquakes. Their evaluation indicated that the proposed tailings dam should experience only cracks and that major liquefaction flow would not be expected under the maximum credible earthquake for the project site. Buildings and structures located at the mine site would be designed to meet the New Mexico State Engineer's Office seismic design criteria.

4.1.1.2 Mine Closure and Reclamation

Closure of the Copper Flat Mine would involve reclaiming and revegetating waste rock disposal areas to minimize water influx to the waste rock, installation of drains to keep storm water runoff away from pits and waste rock, draining and reclamation of the tailings facility, and removal of plant facilities. The production wells in the Palomas Basin would be closed in accordance with New Mexico regulations governing well abandonment, and all pumping facilities removed. No impacts to geology or mineral resources are anticipated as a result of mine decommissioning, removal of facilities, dewatering of the tailings facility, or reclamation of waste rock dumps. A permanent pit lake would remain that would be considerably larger than the present pit lake. This lake would cover part of the estimated remaining resource of copper in the mined area.

4.1.2 Water Quantity and Quality

4.1.2.1 Mine Development/Operation

Components of the Proposed Action that could affect water resources include: 1) pit dewatering and withdrawal of groundwater in the mining district to ensure slope stability during mining; 2) disposal of tailings in the expanded tailings impoundment; 3) disposal of waste rock along the southeast slope of Animas Peak and around the pit perimeter; 4) placement of lean ore on the south side of the pit; 5) continued diversion of Greyback Wash; 6) withdrawal of an average of 2,000 gpm from groundwater in the Palomas Basin for production use at the mine site. Potential impacts of the Proposed Action on area hydrology can be divided into: 1) those that would affect the existing mined area, and 2) those that would affect the Palomas Basin, Caballo Reservoir, and the Rio Grande.

4.1.2.1.1 Potential Impacts to the Mining District

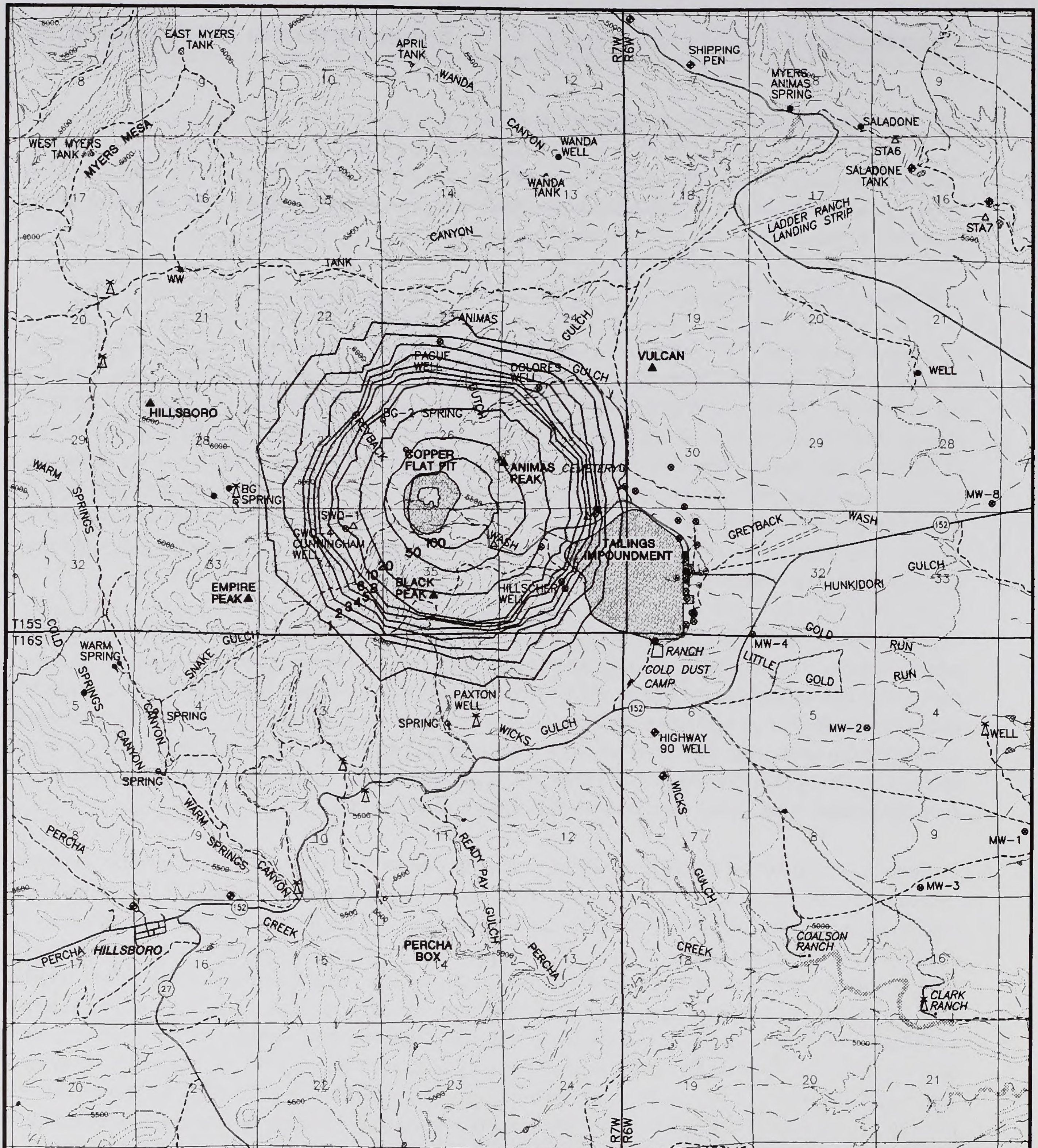
The potential areas of impact to the existing mined area and the historic Hillsboro Mining District include: 1) pit expansion and dewatering; 2) waste rock disposal; 3) tailings impoundment; 4) continued diversion of Greyback Wash.

Pit Expansion and Dewatering

The mine pit at Copper Flat would be expanded under the Proposed Action from its current catchment area of approximately 101 acres (diameter of 2,000 feet) and depth of 40 to 50 feet to encompass a surface catchment area of 111 acres (diameter of 2,700 feet) and a depth of 640 feet. The pit lake would expand in area from the current 40 to 50 acres to approximately 75 acres. The pit bottom would be at an elevation of 4,780 feet above mean sea level (msl), which is approximately 800 feet below the present land surface. This pit expansion and deepening would require continuous dewatering of the pit and pumping of groundwater adjacent to the pit in order to keep the pit dry for mining and to maintain slope stability during mining. The anticipated pumping rate would range from an initial rate of approximately 64 gpm to an estimated maximum rate of 600 gpm when the pit is near its maximum depth (SRK 1995).

Impacts of pit expansion and dewatering would include: 1) expansion of the current pit to encompass a larger portion of the valley occupied and drained by Greyback Wash, 2) temporary drawdown of the water table within and adjacent to the mining district, 3) redirection of groundwater flow within the mining district due to the creation of a pit lake that would act as an evaporative sump for groundwater, and 4) permanent lowering of the water table within and adjacent to the mining district. The Proposed Action would continue to divert the flow in Greyback Wash around the pit, as shown in Figure 2-1. At the cessation of mining, the Proposed Action would leave the diversion of Greyback Wash in place.

To determine the potential effects to groundwater from pit dewatering, SRK (1995) conducted groundwater modeling for the project area. The approach and results of the modeling are detailed in the Copper Flat Hydrogeologic Report on file in the BLM's Las Cruces, New Mexico District office and summarized in Appendix A - Hydrology Data. SRK and ABC evaluated several different groundwater scenarios as part of their modeling effort. These basically included two-dimensional unconfined groundwater flow models (vertically down and horizontal water flow with no geologic restrictions, such as a clay layer, on movement), two-dimensional confined groundwater flow models (horizontal flow only with geologic restrictions), and three-dimensional unconfined groundwater flow models (vertically down, up and horizontal water movement with no geologic restrictions). Based on the modeling results and review of area geology, it appears that the most likely groundwater flow model for the pit dewatering scenario would be a two-dimensional unconfined case (2-D unconfined) since, except for areas of faulting within the mining district, the bedrock in the Animas Uplift and between the mining district and Warm Springs Canyon is layered rock that consists of andesitic volcanics (mining district) or Paleozoic carbonate and clastic rocks (Warm Springs Canyon). These layered rocks should inhibit vertical flow due to the layering and favor horizontal flow along the more permeable layers. The only recharge to the water table in this scenario would be from infiltrating precipitation. The estimated drawdown in groundwater within and immediately adjacent to the mining district at the end of mining as a result of pit dewatering is illustrated in Figure 4-1. After 10 years of dewatering, no impact on



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FEET

NORTH

LEGEND:

- MONITORING WELL
- WELL
- IRRIGATION WELL
- WINDMILL
- SPRING
- STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

SOURCE: SRK (1995)

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FIGURE 4-1
EXPECTED GROUNDWATER DRAWDOWN FROM PIT DEWATERING 10 YEARS AFTER MINING (2-DIMENSIONAL UNCONFINED CASE)

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Warm Springs Canyon is expected; however, drawdown in the Pague and Delores wells could be up to 10 feet. Wells within the mining district belong to Alta and impacts to these wells should only affect the mining company. Pit dewatering and drawdown may affect the 3 seeps located along Greyback Wash and their associated riparian vegetation. Supplemental watering of the riparian areas committed to by Alta should eliminate any potential effects during mine operation.

The model used to indicate potential drawdown effects has a margin of error due to the uncertainty in hydrologic conductivity values used in the modeling; drawdown effects may be more or less than what the model indicates.

Waste Rock Disposal and Lean Ore Stockpiling

Approximately 51 million tons of waste rock covering 189 acres of land would be generated by the Proposed Action and disposed of along the southeast slope of Animas Peak by expansion of the existing East Waste Rock Disposal area left at that location by Quintana and by expansion of two waste rock disposal piles on the west and north sides of the pit perimeter (Figure 2-1). This waste rock would consist mainly of unoxidized pyrite-bearing quartz monzonite and andesite, but some transitional waste rock containing partially oxidized pyritic quartz monzonite is expected to be included in the West and North Waste Rock Disposal areas (SRK 1995).

The unoxidized pyritic waste rock, (the bulk of the waste rock expected to be left on site by the Proposed Action), would have a pyrite content averaging around 1.0 percent. Several tests to identify acid-generating potential were conducted on unoxidized waste rock similar to that which would be placed in the East Waste Rock Dump. The acid-base accounting (ABA) tests reported by SRK (1995) and summarized in Table 3-5 indicated that the waste rock may have the potential to generate acid rock drainage. However, pulsed column kinetic tests of the unoxidized rock, designed to simulate the alternating wet and dry cycles of southern New Mexico, showed little oxidation after 20 weeks (see Appendix A-3 for test results); the paste pH values on existing unoxidized sulfide-bearing waste rock that has been on site for 10 years showed values generally in the 6.0 to 8.0 range. Partially oxidized (transitional) waste rock and oxidized waste rock can have paste pH values in the 2.0 to 4.0 range. The arid environment of southern New Mexico appears to inhibit the generation of acid rock drainage due to the infrequent precipitation and the high evaporation rate. Although the pyritic waste rock would have the chemical potential to generate acidic seeps containing metals and sulfate, field tests and laboratory kinetic tests indicate that the generation of acid rock drainage is not likely (SRK 1995).

Examination of the existing East Waste Rock pile along Animas Peak by SRK (1995) showed no indications of seeps or acid rock drainage, except for a small sulfate precipitate area was located by SRK near the base of the existing East Waste Rock Disposal area beneath a portion of the dump containing transitional waste rock (Parshley 1995b). Construction of the waste rock piles as described under the Proposed Action should mitigate this area and limit the likelihood of similar seeps occurring in the future. This waste rock pile has been in place for 10 years and consists of unoxidized pyritic waste rock representative of what would be left on site by the Proposed Action.

The oxidized and partially oxidized, or transitional, waste rock that currently exists on site and in pit walls is the result of oxidation over geologic time (millions of years). In some areas of the current pit wall, generally oxidation is the result of a past attempt to leach copper with sulfuric acid (SRK 1995). This oxidized and partially oxidized (transitional) waste rock has the potential to generate acid rock drainage and paste pH values from existing waste rock piles of this material have shown values below a pH of 3.0 (Table 3-5), suggesting current onsite acid generation. Thus, the transitional waste rock appears to be the only acid-generating material onsite that could pose a potential problem for waste rock disposal.

The Proposed Action would segregate transitional waste rock and place it in the West and North Waste Rock Disposal areas (Figure 2-1; Section 2.2.5, Waste Rock Disposal Area and Lean Ore Pad). These waste rock piles may require special handling and reclamation to prevent the generation and seepage of acid rock drainage (Section 4.1.2.2.1, Potential Impacts in the Mining District).

The potential for the waste rock disposal areas to generate acidic effluents is considered to be low and potential impacts to the mining district from ARD are considered to be minimal. The waste rock disposal areas would be located in areas disturbed by past mining and the proposed reclamation of the waste rock piles by compacting the top surfaces and covering them with 6 to 12 inches of cover material (Section 2.2.13, Closure and Reclamation) should limit the potential seepage from the waste rock piles to a maximum of 3 to 4 gpm (SRK 1995). The expected seepage rate should be between 0.50 and 3.0 gpm, depending on the average climatic conditions. If an acidic seep should be generated from the waste rock areas, it should be low in volume and affect areas already impacted by past mining. The waste rock disposal areas containing transitional material, (the areas most likely to have acidic seeps of any form), would be located adjacent to the pit lake. In the unlikely event that acid generation occurs following complete reclamation of the transitional waste rock area, the runoff would flow into the pit lake where it would be diluted and prevented from entering groundwater through the evaporative action occurring in the pit lake that causes groundwater to flow into the pit (see Section 4.1.2.2.1, Potential Impacts in the Mining District). Flow into the pit lake from groundwater would exceed any possible seepage from the waste rock areas; volume dilution should keep any waste rock seepage from affecting the chemistry of the pit lake. Management of the lean ore stockpile, which would also be located adjacent to the pit, would be identical to that proposed for the waste rock disposal areas. In the event that the lean ore stockpile remains in place following closure, it would be compacted and reclaimed in a manner similar to that proposed for the waste rock dumps. These actions should prevent any potential for water degradation from the lean ore stockpile.

Tailings Impoundment

The Proposed Action would add approximately 69 million tons of tailings to the existing tailings impoundment facility, which would be expanded to accommodate the additional tailings. These tailings would consist mainly of sand and silt-sized material with a composition comparable to the quartz monzonite host rock of the copper ore, and would contain approximately 50 percent water by weight. The tailings facility would be unlined and could potentially leak tailings fluid to groundwater. The existing tailings facility is unlined and after 3 months of operation in 1982 leaked sufficient fluid to groundwater to cause a rise in water levels in monitor wells located east of the tailings dam and cause an increase in sulfate and TDS in monitor wells installed along the front of the tailings dam (Section 3.2, Water Quantity and Quality).

Detailed studies of the geology and hydrogeology of the tailings area by SRK (1995) have shown that there are two main aquifer units located beneath the tailings facility. The upper aquifer consists of 30 to 50 feet of gravels on top of a thick clay base. These gravels are probably paleo-stream terrace gravels that were historically mined for placer gold. The clay base separates these gravels from underlying upper Palomas Formation gravels. Because the clay unit thins to the west under the tailings facility, the lower confined gravel unit comes into contact with the western half of the tailings facility and thus can be contaminated with tailings seepage along with the upper gravel unit. Contamination of the lower confined groundwater zone with tailings seepage occurred during the 1982 operation and it is expected that tailings left by the Proposed Action could also affect this lower gravel unit (SRK 1995).

The expected composition of the tailings fluid is calcium sulfate-dominated water with high TDS, a pH between 6.0 and 8.0, and manganese values in the range of 1.5 mg/l. With the exception of manganese, metals are expected to be within New Mexico human health and domestic use water quality standards based on the Modified EPA 1312 tests reported by SRK (1995). Sulfate values are expected to be in the range of 900 to 1,000 mg/l and TDS in the range of 1,300 to 1,500 mg/l, outside of State human health and domestic use standards, but within acceptable limits for livestock and wildlife. Tailings decant water sampled by Quintana in 1982 during the 3-month operation of the tailings facility gave sulfate in the range of 400 to 500 mg/l, a pH of 10 to 11, and TDS in the range of 700 to 1,130 mg/l (SRK 1995). TDS and pH were above State human health and domestic use standards.

Infiltration into the tailings impoundment after reclamation was estimated by SRK (1995) to be about 1 inch per year. This would give a long-term seepage rate of 20 gpm for the tailings. This seepage would migrate mainly to the lower gravel aquifer and mix with groundwater (SRK 1995). The estimated sulfate content of this mixed water at the face of the tailings impoundment would be approximately 450 mg/l, which is below the New Mexico water quality standard of 600 mg/l. These analytical calculations and estimates of SRK (1995) were based on a linear mixing model assuming seepage at 20 gpm with up to 2,000 mg/l sulfate and groundwater flow at 94 gpm with 240 mg/l sulfate.

The Proposed Action would collect this impacted groundwater with capture trenches installed in front of the tailings dam and pumpback wells, as shown in Figure 2-3. This fluid would be recycled for use in the plant facility, thus reducing the demand for water from the production well field in the Palomas Basin. Depending on the depth to clay and the possible presence of basalt flows, the trenches would fully penetrate the upper gravel unit and capture wells would be installed in the lower gravel unit to collect contaminated groundwater. Analytical calculations by SRK (1995) showed that a capture well spacing of 250 to 500 feet should be adequate to capture most of the tailings seepage. This capture system would operate during mining and would remain in place for a short time after mining during the draining of the tailings. Any seepage through the toe of the tailings dam would be captured by a lined surface channel that would be constructed along the toe of the tailings dam, as outlined in Section 2.2.7.1, Tailings Impoundment Design.

Pit lake drawdown modeling indicates that drawdown levels in the tailings area from pit dewatering would be approximately 20 feet on the west side of the tailings impoundment and 1 foot on the east side. The 1-foot drawdown should not affect groundwater flow under the impoundment or the operation of the pumpback system. The 20-foot drawdown would be occurring at sufficient depth and distance from the pumpback system that no effects are anticipated.

A very low frequency (VLF) study of the tailings impoundment area by SRK (1995) showed the existence of two linear anomalies, which have been interpreted to be main fault sets, as discussed in Section 3.1, Geology and Minerals. This study suggested the possibility that the northwest-southeast fault set, which parallels the Hunter-Lewellyn fault system found in the mining district (Figure 3-4) and appears to control paleo-drainages, may also be a conduit for plume movement in the upper gravel zone. This fault was detected at 20 to 75 feet beneath the surface, according to the SRK (1995) study. Plume movement along the northwest-southeast trending fault NW-1 (Figure 3-9) may have been blocked by north-south trending fault NS-1, causing the mounding of water along the face of the tailings dam that led to artesian flow in some of Quintana's monitor wells. However, additional drilling programs conducted by SRK, which were designed to test the "preferential pathway" hypothesis, did not identify preferential flow along the possible fault sets (Parshley 1995b). In either case, the interceptor trench system planned in the Proposed Action to capture contaminant flow in the upper gravel zone should be able to capture tailings fluid seepage along the northwest-southeast faults. The well capture system planned for the lower gravel zone may have more difficulty in controlling and capturing tailings seepage that is localized along a fault plane. The Proposed Action would space capture wells closer together near the faults to ensure capture of any contamination that may preferentially follow either a fault zone or a paleo-drainage that occupies a fault zone (SRK 1995). Backup monitor wells, installed to the east and downgradient of the proposed seepage capture system, would insure that the capture system was adequately collecting seepage.

The proposed tailings facility is not expected to have an adverse impact on the environment of the Palomas Basin if the proposed trench and capture well system operates properly and captures seepage as outlined by SRK (1995). Although the tailings impoundment would be unlined and seepage would occur, the tailings seepage should be adequately captured by the proposed trench and well system, provided the upper and lower seepage zones are reasonably homogeneous and isotropic in their hydraulic properties and there is no preferred flow through buried paleo-channels. Also, fault NS-1 may be a barrier to fluid flow in the upper gravel unit and may aid in controlling seepage flow and capture. The design and spacing of the capture well pumpback system for the lower aquifer considered three primary inputs. The first was the maximum seepage the tailings could release based on the data collected during previous operations and the 1994 tailing borings. The second was the maximum amount of water the lower zone could transmit based on the extensive drilling program performed during 1994, the construction of the dam, and the results of the GWQ94-17 pump test. The final consideration was the drawdown effectiveness in the lower zone, which was based on the pump test. The capture system was then designed to collect the maximum amount of water that could be released by the tailings without exceeding the capacity of the sediments to transmit the water.

Based on the effect of the pump test on wells 700 feet from the pumping well, it was determined that wells spaced approximately 500 feet apart would allow 100 percent overlap in drawdown. The total capacity of the system operating at the lower end of the pumping rating of the proposed pumps will exceed the maximum amount of seepage that could be released by the tailings.

It was determined that the design of the system would probably require modification after installation based on the results of initial operation. The basic design would allow for modification primarily through varying pumping rates and installing additional wells. With the addition of backup monitor wells, the proposed system should be sufficient to be used for monitoring purposes and to capture all seepage from the tailings.

Diversion of Greyback Wash

Greyback Wash supplies a limited amount of recharge to the upper Palomas Formation just east of the Animas Uplift. Water flowing in the stream infiltrates into and through the alluvium and eventually reaches the water table in the Palomas Formation. The annual flow in Greyback Wash is not known because the flow is intermittent and limited to periods of snow melt and heavy precipitation. The maximum flow rate reported was 12.5 gpm (Newcomer et al. 1993). Presently, the stream is diverted around the pit. Water quality in Greyback Wash degrades as the water flows past the pit and through the mining district, as shown by Newcomer et al. (1993) and discussed in Section 3.2, Water Quantity and Quality. After cessation of mining, Greyback Wash would continue to be diverted.

The Proposed Action should not impact Greyback Wash beyond the existing level of impact to water flow and water quality created by the diversion of this wash that is presently in place as a result of mining by Quintana. Water quality should continue to be affected in water that flows through and past the mining district, as it does now. However, water quality in Greyback Wash should not become any worse as a result of the Proposed Action. Thus, water flowing out of the mining district in this wash should continue to have TDS values around 3,000 mg/l. This water rapidly infiltrates into alluvium or evaporates. There is no evidence that infiltration of Greyback Wash water has contaminated groundwater over the past 10 years and attenuation of contaminants by at least 300 feet of alluvium is expected to continue to protect groundwater from any contamination by water from this wash. Therefore, continued diversion of Greyback Wash in the mining district as a result of the Proposed Action should not impact surface water beyond the present level of water quality in the wash and should not impact groundwater in the western part of the Palomas Basin immediately adjacent to the mining district.

4.1.2.1.2 Potential Impacts to the Palomas Basin and the Rio Grande

Potential impacts to the Palomas Basin and the Rio Grande from the Proposed Action include groundwater withdrawal in the production well field located in Sections 30 and 31, T15S, R6W with depression of water table levels within the basin and a possible reduction in stream flow along the lower reaches of Las Animas and Percha Creeks, and possible withdrawal of water from the Caballo Reservoir and the Rio Grande system to replace groundwater withdrawn by pumping and supplied to the mine site for processing of ore and tailings. In order to assess these potential impacts, a groundwater model was developed for both the Palomas Basin and the mine area (SRK 1995). A summary discussion of the model is provided in Appendix A; a detailed discussion of the model is found in the Copper Flat Hydrogeologic Report on file with the BLM in its Las Cruces, New Mexico, district office.

Like the modeling done for the mine site, several versions of three modeling scenarios were evaluated for the Palomas Basin; 2-D confined, 2-D unconfined, and 3-D unconfined. Based on area geology, known hydrogeologic regimes along the Rio Grande near Las Cruces (Nickerson and Myers 1993) and modeling results, the most likely flow model scenario for well production pumping and the resultant dewatering in the Palomas Basin would be the 2-D confined model. The alluvium at the river and the reservoir is probably only 100 to 150 feet thick. The flow from the river or reservoir alluvium to the Palomas Basin aquifer is probably into the gravels of the aquifer that are interbedded with clays, as shown in Figure 2-4. Thus, it is expected that the interaction between the Palomas Basin aquifer and the Rio Grande system may be one of a confined to semi-confined aquifer interacting with a thin veneer of river alluvium. Therefore, the 2-D confined modeling scenario (Case B) of SRK (1995), which predicts a maximum withdrawal of water from the Caballo Reservoir of 2,101 acre-feet/year at year 10 and a total withdrawal of 13,318 acre-feet of water up to and including year 10, is considered to represent the most probable model for estimation of impacts due to well field pumping.

The estimated drawdown in groundwater levels within the Palomas Basin at the end of mining (year 10) is illustrated in Figure 4-2. Initial pumping during the first year would be at a rate of approximately 6,700 acre-feet/year (approximately 4,000 gpm) and cause a maximum drawdown of the water table of 18 to 26 feet in the well field. The pumping rate in the subsequent 9 years would be approximately 3,200 acre-feet/year (approximately 2,000 gpm).

For the 2-D confined modeling case (Case B; SRK 1995), drawdown of the water table would be approximately 21 feet in the well field after 10 years of pumping with drawdown at the Caballo Reservoir being 1 to 2 feet or less (Figure 4-2). Drawdown at Percha Creek could be 3 to 5 feet and drawdown at Las Animas Creek across from the well field could be 10 to 12 feet after 10 years of pumping. Drawdown for wells between the well field and Caballo Reservoir could be 2 to 10 feet.

Private wells in the Palomas Basin may experience a drawdown between 2 to 8 feet during groundwater withdrawal from the production well field. Thus, some decline in water levels is expected in these wells. Some of these wells are artesian and derive water from sand/gravel layers confined between clay beds in the eastern half of the Palomas Basin. The present artesian flow rates may be reduced during the 10-year period of well field pumping. Also, some private wells that have low productivity may need to be deepened to offset the drop in the water table level.

Percha Creek is a losing stream in the area covered by the drawdown contours. The increased depression in the water table in the Palomas Basin during production well field pumping should only slightly enhance the loss of water from Percha Creek to alluvium and eventually groundwater. A field study by SRK (1995) showed that Las Animas Creek directly opposite the well field and in the area encompassed by the drawdown contours has no direct interaction with groundwater in the Palomas Formation. The groundwater table lies approximately 80 feet below the water level in the stream alluvium and is separated from the stream alluvium by 60 to 80 feet of clay. Thus, no impact is expected to Las Animas Creek flow or to wells screened in the stream alluvium.

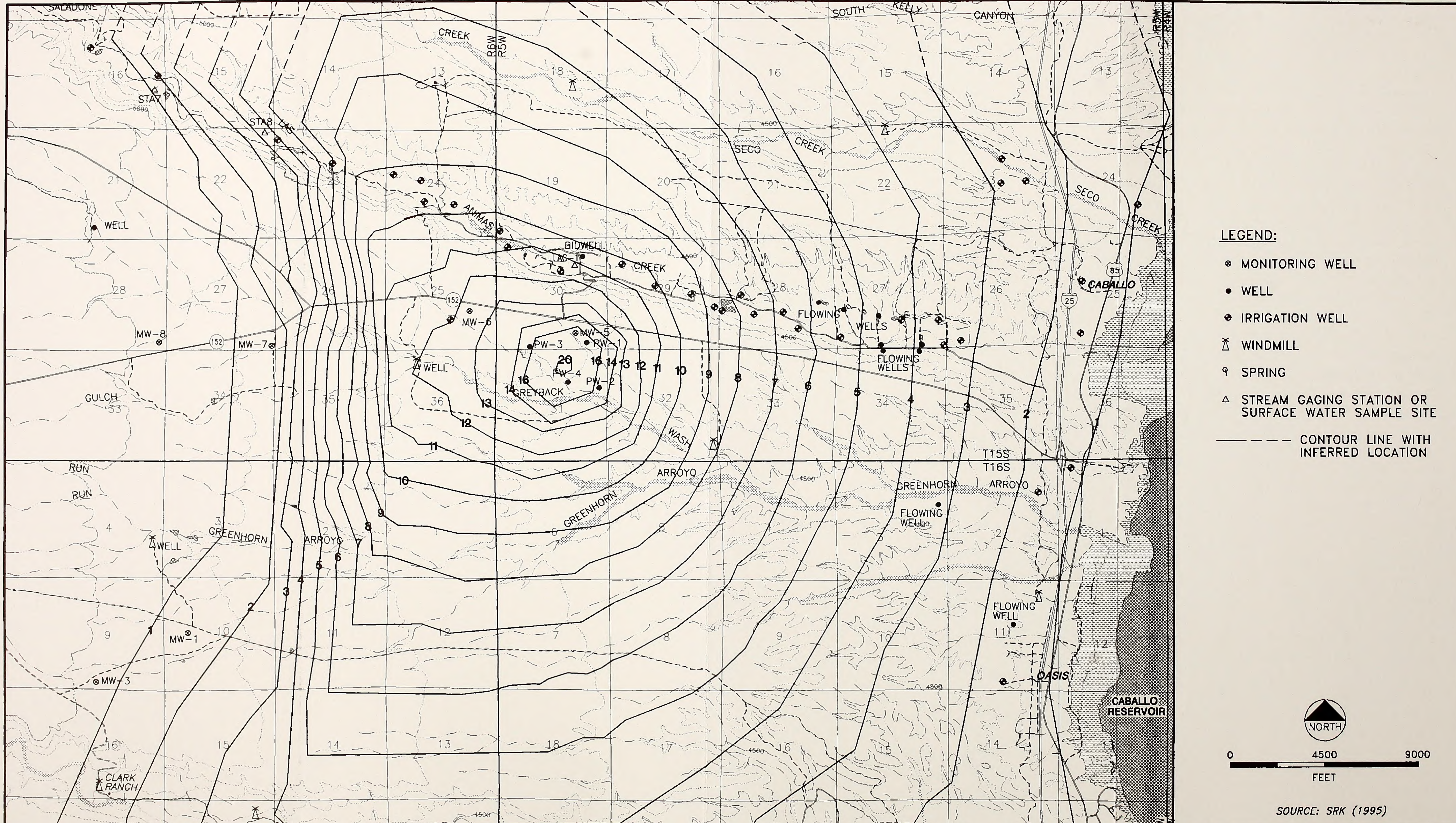

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FIGURE 4-2
EXPECTED GROUNDWATER DRAWDOWN FROM PRODUCTION WELL PUMPING IN THE PALOMAS BASIN 10 YEARS AFTER MINING
(2-DIMENSIONAL CONFINED CASE)

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The main impact of groundwater withdrawal from the production well field would be reversed flow of water from Caballo Reservoir, and ultimately the Rio Grande system, towards the well field to replace the groundwater pumped to the mine for processing. Most of this replacement water should come from Caballo Reservoir. Groundwater currently recharges the reservoir because groundwater in the Palomas Formation flows downgradient from west to east and terminates its flow in the reservoir, as indicated by the groundwater contours in Figure 3-11. When pumping begins in the well field, groundwater recharge of the Caballo Reservoir in the area of the production well's influence should decrease and eventually cease. Furthermore, groundwater withdrawn from the Palomas Basin would be replaced by flow from the reservoir into the aquifer. This reversal of flow, with water now flowing from the reservoir into the aquifer, should begin during the first year of pumping and continue throughout the pumping period. An amount of water equivalent to <1 percent of the total annual flow of the Rio Grande would be obtained each year by the Proposed Action from its pumping of the production wells (approximately 10 years) and then for at least 100 to 150 years after pumping ceases.

4.1.2.2 Mine Closure and Reclamation

4.1.2.2.1 Potential Impacts in the Mining District

Potential impacts in the mining district related to mine closure and reclamation include creation of a permanent pit lake and resultant depression of the water table, reclamation of waste rock disposal areas, and potential impacts to groundwater quality as a result of tailings impoundment closure.

Permanent Pit Lake and Depression of the Water Table

A permanent pit lake would remain at the cessation of mining. This lake surface would be approximately 150 to 200 feet below the present surface, at an elevation of 5,250 feet (msl), would occupy a surface area of about 75 acres and is expected to be approximately 640 feet deep (SRK 1995).

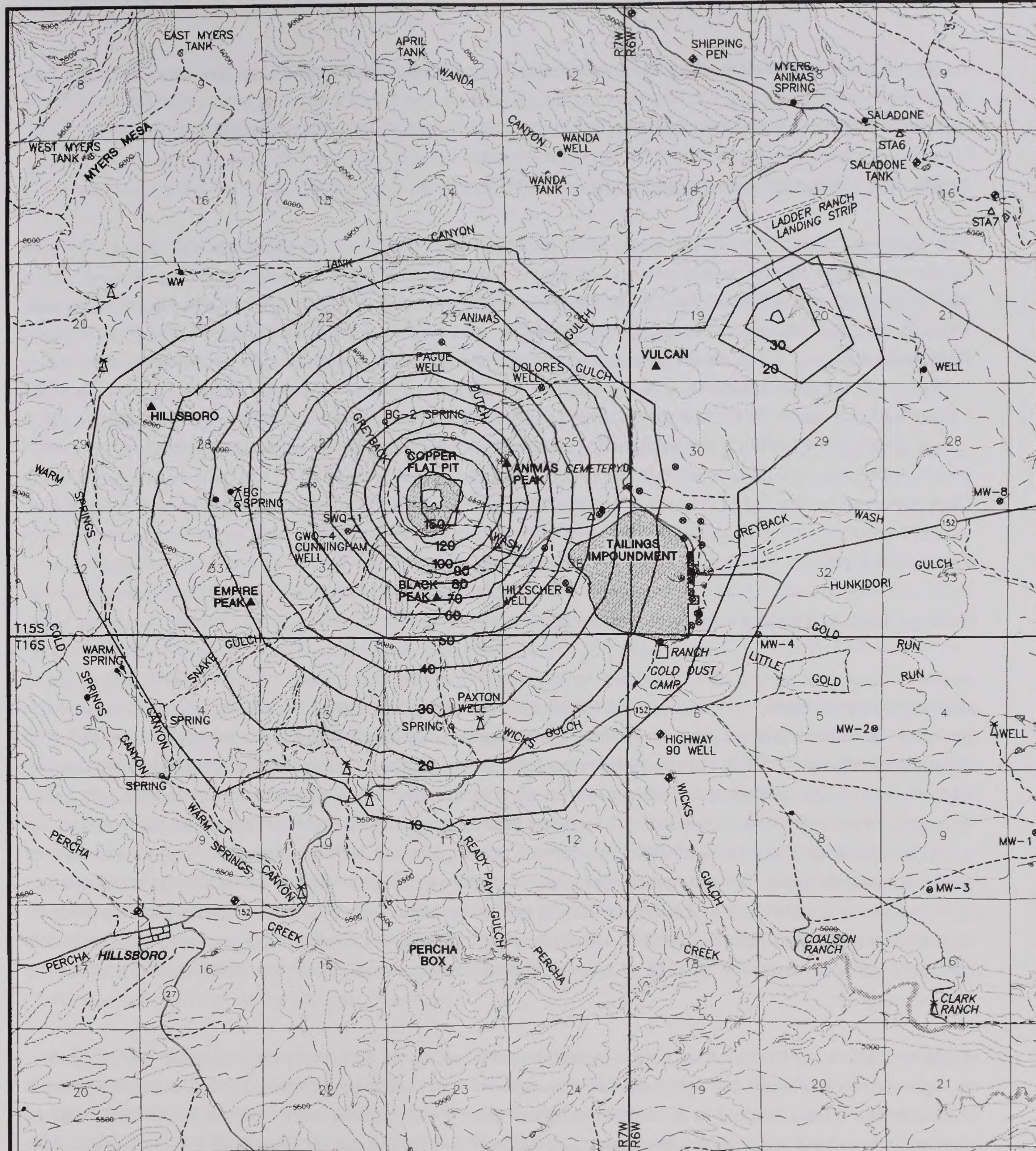
The current pit lake is 40 feet deep and its water quality appears to be the result of equilibration between the unoxidized pyritic wall rock and groundwater in the mining district (SRK 1995). The chemistry of this lake was discussed in Chapter 3 and water quality is dominated by calcium sulfate with high sodium, magnesium, fluoride, and total dissolved solids (TDS). Metals are generally within or only slightly elevated above New Mexico human health and domestic use water quality standards and the pH is usually between 6.0 to 8.0 (SRK 1995; Newcomer et al. 1993). The expected pit lake chemistry at the cessation of mining outlined in the Proposed Action would be similar to the current pit lake chemistry (SRK 1995), based on equilibrium chemical modeling and the fact that the current pit lake has been in place for 10 years and appears to be in chemical equilibrium with wall rock that is similar to material that would remain at the cessation of mining. Over time, the sulfate levels and the TDS in the lake may increase due to evaporation concentrating dissolved constituents in the lake.

The probability that rock in the pit area could cause acidification of pit lake water is remote. Studies of pit lakes in Nevada have shown that during the first 3 to 5 years of pit lake formation, (following mine closure) water flowing through the pit walls and pit bottom to the pit lake can be somewhat acidic. This is due to oxidation of pyrite in the walls and floor of the pit producing acidic pore water that mixes with the inflowing groundwater. After approximately 5 to 7 years, the pyrite is coated by iron oxides and can no longer oxidize. Also, the rising pit lake covers the pyrite in the floor and walls of the pit and forces out oxygen, causing the walls and floor to become anoxic. Usually after 7 to 10 years of pit lake formation, the inflowing water has the composition of the groundwater and the pit lake chemistry begins to approach that of the groundwater. Usually by the 10th year, the pit lake chemistry is stable and does not change much in future years, except by evaporative concentration of constituents.

No environmental impact is expected as a result of pit lake chemistry that would remain after mine closure. The pit lake would serve as a sump for groundwater flow due to the high evaporation/low recharge rate in the area, and thus would not contaminate groundwater. The pit lake water quality should be similar to existing pit lake water quality, suggesting that TDS, sulfate, and fluoride may exceed New Mexico human health and domestic use water quality standards; pH and metals should be close to or within these standards (see Tables 3-4 and 3-5).

After cessation of mining, the mine pit would fill with water to a level approximately 150 to 200 feet below the present land surface (SRK 1995). This would put the pit lake surface at an elevation of 5,250 feet (asl) and create an evaporative sump that would focus groundwater flow and control permanent water table levels within and adjacent to the mining district. The expected scenario for permanent decline in the water table due to the presence of the proposed pit lake expansion would be the 2-D unconfined modeling case, for the reasons discussed in Section 4.1.2.1.1, Potential Impacts to the Mining District. The anticipated permanent decline in water table levels relative to present levels after groundwater has returned to a steady-state level (99 percent recovery), which would occur around year 140 after cessation of mining, is illustrated in Figure 4-3. Figure 4-3 illustrates the anticipated depression in the permanent water table below the present level at 140 to 190 years after cessation of mining, which represents a 99 percent recovery of groundwater and what should be permanent steady-state groundwater levels. This impact, caused by the presence of the permanent pit lake, is more pronounced than that due to pit dewatering.

For the 2-D unconfined case (Figure 4-3), the drawdown at the Highway 90 well would be about 10 feet 130 years after cessation of mining; Tank Canyon would have a drawdown in the water table of 20 to 30 feet from the present level, and Warm Springs Canyon would experience a permanent drawdown of 10 feet in the water table. This drawdown is expected to impact existing seeps in the Warm Springs drainage. The extent of this effect is still being determined; consultations are ongoing with the BLM, the State of New Mexico, Alta, and private landowners to determine if mitigation in Warm Springs Canyon is necessary and appropriate. Any mitigation that is needed would be developed in agreement with the landowner, the State, Alta, and BLM. The Pague and Dolores wells, located north of the pit, would experience a permanent drawdown of 40 to 50 feet. The Paxton Well, located south of the pit would experience a permanent decline of 10 feet in the water level. The 10-foot drawdown contour would be located approximately 1 mile north of Percha Box, suggesting that areas immediately south of the 10-foot drawdown contour could experience a permanent water table decline of approximately 1 to 2 feet. Fault systems such as the Snake Fault, separate the southern extent of the volcanic andesites from the bedrock carbonates in the area immediately north of Percha Box. These fault systems could prevent the drawdown cone from reaching Percha Box, however, the current hydrologic data available for the area does not clearly indicate this. The Ladder Ranch



LEGEND:

- ⊗ MONITORING WELL
- • WELL
- ◈ IRRIGATION WELL
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

NORTH

0 5,825 11,650

FEET

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE 4-3
EXPECTED GROUNDWATER DRAWDOWN FROM PIT DEWATERING 140 YEARS AFTER MINING (2-DIMENSIONAL UNCONFINED CASE)

DATE: NOV/17/1995 12-476\401\CASE-A2

would experience a decline of 10 to 40 feet in the water table in its southwest corner near the mine. As mentioned in Section 4.1.2.1.1, Potential Impacts to the Mining District, there is a potential for error in the drawdown effects due to the uncertainty in the hydraulic conductivity values used in the modeling.

Waste Rock Disposal Area Reclamation and ARD Potential

The proposed reclamation of the waste rock disposal areas most likely to produce ARD (the transitional waste rock areas located east and north of the pit area) would involve compacting the transitional waste rock and covering it with 12 inches of reclamation material, or, in some cases, adding unoxidized waste rock material over the transitional material, compacting it, and adding reclamation material. The North Waste Rock Disposal area, which would contain both transitional waste rock and unoxidized waste rock, would be designed to locate transitional and unoxidized material in areas that would reduce their chance for interaction with each other and direct drainage from the area into the pit lake. According to studies conducted by SRK (1995), these reclamation procedures, coupled with the area's low precipitation and high evaporation rates should be sufficient to prevent significant levels of ARD. The East and North Waste Rock Disposal areas would be constructed so that all drainage from these areas would flow into the pit lake, where it would be diluted and prevented from interacting with groundwater due to the evaporation sump action of the pit lake that would draw groundwater into the pit lake.

Tailings Impoundment and Groundwater Quality

At the cessation of mining, the Proposed Action would drain the tailings facility and reclaim the tailings to minimize surface water and rain water infiltration. The tailings pumpback wells would be shut down in accordance with conditions set forth in Alta's State Groundwater Discharge Permit, which is currently being finalized by Alta and NMED. Seepage from the tailings impoundment area would continue to permanently filter down to groundwater at an estimated rate of 20 gpm based on precipitation rates for the area. This is based on an estimated infiltration of 1 inch per year through the reclamation materials (SRK 1995). As discussed above, when this estimated 20 gpm of seepage mixes with groundwater flowing eastward at approximately 94 gpm, the expected concentration of sulfate in the groundwater at the tailings impoundment dam would be approximately 450 mg/l and thus below the New Mexico State human health domestic use standard of 600 mg/l (NMWQC 1993). This estimation is based on a linear mixing model, but represents the worst-case scenario for dilution of tailings impoundment seepage with up to 2,000 mg/l sulfate by groundwater.

Because calculating the length of time required to drain the tailings to a permanent seepage rate of 20 gpm would currently be based on highly variable assumptions that could significantly impact the accuracy of the estimate, Alta would commit to a monitoring-based groundwater quality performance standard that would determine how long the pumping system should be operated following mine closure (Parshley 1995b). This system would also identify when water quality met New Mexico human health and domestic use water quality standards and would include placement of a monitoring well system installed downgradient of the proposed seepage capture system (see Section 4.5.1, Hydrology).

4.1.2.2.2 Potential Impacts to the Palomas Basin, Caballo Reservoir, and the Rio Grande Valley

Potential impacts to the Palomas Basin, Caballo Reservoir, and the Rio Grande Valley following mine closure and reclamation could include continued groundwater drawdown effects from production well pumping that occurred during the life of the mine.

Impacts to the Palomas Basin

The groundwater levels in the Palomas Basin should return to a steady-state condition that has water levels within 1 to 2 feet or less of the present water levels 30 to 40 years after cessation of mining (SRK 1995). Most of the water table recovery would occur within 40 to 50 years after cessation of pumping. Ten years after cessation of pumping, water levels should be within 5 feet or less of the present levels. Thus, no permanent impact is expected for the Palomas Basin due to the Proposed Action. Ten years after cessation of pumping, most private wells should have returned to within 1 to 5 feet of pre-mining water table levels.

Impacts to the Caballo Reservoir and the Rio Grande Valley

Groundwater levels in the area should begin recovery following mine closure. When the groundwater level in the Palomas Basin has returned to approximate steady state, which should occur around year 100 to 150 after pumping ceases, the Caballo Reservoir would continue to loose water to the aquifer at a rate of approximately 60 to 150 acre-feet per year, according to the computer modeling by SRK (1995).

The total estimated removal of water from the Caballo Reservoir ranges from approximately 9,800 to 29,600 acre-feet by year 150 to 200. This includes water removed during pumping and water that flows from the reservoir into the aquifer to replace water removed from storage by pumping. Table A-2 in Appendix A-1 gives the estimated loss of water under the 2-D confined hydrology model from the Caballo Reservoir by year from the start of pumping until the groundwater level in the Palomas Basin has returned to near steady-state, which should occur at approximately year 150 to 200. The well field would withdraw approximately 34,000 acre-feet of water during the 10 years of proposed mining. Under the 2-D confined modeling case (Table A-2, Appendix A-1), approximately 25,000 acre-feet of water would be removed from the Caballo Reservoir by the Proposed Action by the time the Palomas Basin aquifer returns to near steady-state water levels. This would suggest that 73.5 percent of the water pumped by the Proposed Action would come from the Caballo Reservoir.

The groundwater modeling presented by SRK (1995) suggests that even at year 150 to 200, which is approximately 140 to 190 years after cessation of mining, water would continue to flow from the Rio Grande system and the Caballo Reservoir into the Palomas Basin aquifer at a rate of approximately 60 to 150 acre-feet/year, as shown in Table A-4 and Figure A-15 in Appendix A-1. This implies a permanent reversal in the relationship between the basin aquifer and the Caballo Reservoir. At present, the basin aquifer recharges the reservoir. But after mining and groundwater withdrawal in the well field, the reservoir would recharge the basin aquifer and flow from the basin to the reservoir would thus stop.

Although the modeling suggests this would happen, this scenario is considered to be unlikely. There is a strong groundwater gradient from the Animas Uplift to the Caballo Reservoir. The present gradient is approximately 54.7 feet/mile. Evaporation of water from the permanent pit lake might reduce this gradient somewhat after the cessation of mining due to a permanent estimated decline of approximately 30 feet in the water table just east of the Animas Uplift, but it is considered unlikely that this gradient would be reduced to the point that water would permanently flow from the Caballo Reservoir to the basin aquifer. The decline in the gradient is estimated to be no more than 3 to 4 percent. Therefore, the groundwater modeling should be viewed with caution for long-term predictions that suggest a permanent reversal of flow between the basin aquifer and the reservoir. It is expected that by year 150, if not sooner, the present relationship between the basin aquifer and the Caballo Reservoir should be re-established.

The flow of water from Caballo Reservoir into the Palomas Basin aquifer could temporarily alter the chemistry of the groundwater between the Caballo Reservoir and the well field. The reservoir water is sodium bicarbonate-dominated with sulfate around 110 mg/l, bicarbonate slightly higher and around 180 mg/l, chloride values generally somewhat less than 100 mg/l, and a TDS of approximately 440 mg/l. Groundwater in the eastern part of the Palomas Basin is sodium-calcium bicarbonate dominated with a TDS in the 200 to 500 mg/l range, sulfate less than 100 mg/l, and low chloride values in the 15 to 70 mg/l range. The chemistry of groundwater may fall between these two values until the water that has moved into the aquifer from the reservoir has equilibrated with the sediments in the aquifer. This could lead to a temporary increase in sodium, sulfate, and possibly TDS in the groundwater, but all values for these and other constituents should remain within New Mexico human health and domestic use water quality standards. It is not possible to estimate the time for this equilibration, but commonly groundwater can take thousands of years to reach equilibrium with surrounding rocks.

4.1.3 Soils

4.1.3.1 Mine Development/Operation

The soils analyses for the Proposed Action were based upon operation descriptions outlined in Chapter 2.0 and the following information:

- Soil yardage calculations in this section were derived using information provided in the general NRCS soil survey information for Sierra County. Soil types and depths may vary within the mine area.
- Waste rock and growth medium would not be mixed; salvaged soil would be layered on top of the waste rock.
- Growth medium obtained from the tailings impoundment area would be salvaged to supplement soil surface amounts required for areas with insufficient volumes of growth medium to meet reclamation requirements.

Implementation of the Proposed Action would result in the disturbance and alteration of in-place, native soils from vegetation clearing; construction activities; excavating, salvaging, and storing reclamation growth material (including topsoil and suitable subsoil); cut and fill/grading, development of storage areas, and minor ancillary facilities, such as monitoring wells; and recontouring slopes.

Approximately 414 acres of previously undisturbed native soils would be disturbed in the proposed mine area. This total consists of 244 acres that would be disturbed during construction of the proposed tailings impoundment and 170 acres that would be disturbed by construction and mining activities associated with the haul roads, open pit area, fresh water storage area, topsoil stockpiles, and West, North, and East Waste Rock Disposal areas (Table 4-1).

Prior to construction and mining activities, a total of approximately 1.74 million cubic yards of suitable reclamation material would be available for salvage from 414 previously undisturbed acres (Table 4-1). This includes approximately 1.5 million cubic yards that would be available from 214 acres within the tailings impoundment with an average reclamation material depth of 60 inches and 200 acres in other associated project components with an average reclamation material depth of 14 inches.

Approximately 0.8 to 1.6 million cubic yards of reclamation material would be required to achieve a reclamation materials layer of 6 to 12 inches on all disturbed areas. In some areas, the volume of salvageable reclamation material could be limited by shallow soil depth, previous disturbance, or other limiting physical properties, and consequently would not provide 6 to 12 inches of reclamation material for revegetation as specified in the Reclamation Plan. As discussed in Section 4.1.3.2, Mine Closure/Reclamation, those areas with insufficient amounts of recoverable reclamation material would have their reclamation materials supplemented with appropriate material from other areas, such as the tailings impoundment. Wherever possible and available, additional suitable reclamation material would be obtained from previously disturbed areas.

Reclamation test plots would be established and evaluated during mine operation to assess reclamation success, as discussed in Section 2.2.13, Closure and Reclamation. Reclamation practices that were successful during the test plot program would be incorporated into the final Reclamation Plan to optimize the potential for reclamation success.

Stockpiling of reclamation material as discussed in Section 2.2.13, Closure and Reclamation, would temporarily impede soil development, including soil structure and horizonation (profile) development. Alteration of biological and nutrient conditions would occur in soil stockpiled for extended periods. Soil biological activity (especially with the mycorrhizae-root association) would be substantially reduced or eliminated during stockpiling as a result of anaerobic conditions created in deeper portions of the stockpiles. After soil redistribution, biological activity would slowly increase and eventually reach pre-salvage levels. The duration of these temporary effects would depend on the duration of the construction activities and the ability to apply reclamation measures during or immediately after the completion of construction activities.

Construction and operation activities also would permanently alter soil profiles and development in the mine area, particularly in the tailings impoundment area. Placement of soils over waste rock or tailings would change the character and texture of the original soil profiles. New soil profiles would develop over time for the area; however, the original character of the native soil would permanently be changed.

Table 4-1

Estimated Acres of Disturbance and Growth Medium Volumes for the Proposed Mine Area[1]

Mine Component	Newly[2] Disturbed Soils (acres)	Previously[3] Disturbed Soils (acres)	Total Acres to Be Reclaimed	Reclamation[4] Growth Medium Needed (million cubic yards)	Growth[5] Medium Available (million cubic yards)
Haul Roads[6]	4	4.2	46	0.04-0.07	0.004
Open Pit area	10	101	0	0	0.009
Tailings Impoundment	214	241	455	0.4-0.7	1.5
Access Roads[6]	0	40	40	0.03-0.06	0
Freshwater[6] Storage Area	0	4	4	0.003-0.006	0
Tailings Impoundment Topsoil Stockpiles	30	9	39	0.03-0.06	0.1
East Waste Rock Disposal Area Topsoil Stockpiles[6]	5	2	7	0.006-0.01	0.005
Lean Ore Stockpile[6]	0	21	21	0.02-0.03	0.0004
West Waste Rock Disposal Area[6]	1	15	16	0.01-0.02	0.001
North Waste Rock Disposal Area[6]	28	16	43	0.03-0.07	0.02
East Waste Rock Disposal Area[6]	122	8	130	0.1-0.2	0.1
Diversion Structures	0	31	0	0	0
Plant Facilities[6]	0	74	74	0.06-0.12	0
Miscellaneous Areas[6,7]	0	86	86	0.07-0.14	0
TOTAL	414	690	961	0.80-1.55	1.74

[1]Reclamation acreage totals do not include the open pit area or diversion structures since these areas would not be reclaimed.

[2]Soil available for salvage.

[3]No soil available for salvage.

[4]Figures derived using the following equation:

Total acres to be reclaimed x 43,560 sq ft/acre x 0.5 ft or 1 ft/ 27 cu ft./cubic yd

[5]Figures derived by multiplying the acreage of each soil association found in a mine component area, by the percentage of each soil type in the association by square feet in an acre (43,560 sq ft) by depth of soil growth medium available for that association. This amount was then divided by the number of cubic feet in a cubic yard (27).

[6]Additional soil required for reclamation of these mine components would be obtained from the tailings impoundment area, if needed.

[7]Miscellaneous areas include: outlying areas around pit, plant area, and waste rock disposal areas.

Compaction of soil materials would occur during construction and/or mining activities, especially along access and haul roads. Ripping or loosening of compacted surfaces in disturbed areas other than the waste rock disposal areas prior to placement of growth medium and reclamation seeding, as discussed in Section 2.2.13, would aid in reclamation.

Exposure and disturbance of soils could increase the potential for accelerated soil erosion from sites affected by construction. Excavation, transportation, and placement of reclamation material also could promote the breakdown of soil aggregates into loose soil particles and increase the potential for wind and water erosion on the stockpiles. Blading and/or excavation of remaining subsoil materials to achieve desired grades and soil conditions could result in steeper slopes on exposed soils, mixing of soil materials, and the additional breakdown of subsoil aggregates. Measures to stabilize and protect growth medium stockpiles and embankments, as described in Section 2.2.13, Closure and Reclamation, and the Reclamation Plan (on file with BLM in Las Cruces, New Mexico), would be implemented to minimize soil loss and additional disturbance to soils on-site.

Potential indirect effects of soil destabilization and erosion would include dust generation and off-site deposition. Off-site stream sedimentation should be eliminated by using the erosion control practices described in Section 2.2.13, Closure and Reclamation, and the approved Reclamation Plan. Increased sediment loads and deposition in streams below the areas of disturbance are not anticipated, as there are no perennial streams in the vicinity of the new disturbance and sediment catchment berms would be placed at the base of the downstream side of the tailings embankment, around the soil stockpiles, and at the base of waste rock disposal areas. Dust generated by vehicular traffic would be reduced by using dust abatement techniques, such as wetting and binding agents, on the haul roads. Movement of exposed soil particles from stockpiles and disturbed areas by surface winds could reduce air quality and/or result in the deposition of soil particles on surfaces off-site. Wind erosion abatement measures, such as temporary seeding of stockpiles as discussed in Section 2.2.13, Closure and Reclamation, and the Reclamation Plan, would help to reduce soil losses.

Direct effects to soils from operation of the constructed facilities could result from releases of fuel, mill reagents, concentrate, and tailings, and from windblown tailings and concentrate. Spill prevention and dust control measures, as discussed in Section 2.2.12.5, Spill Prevention and Containment, would be implemented at the mine and should help reduce the potential for direct effects.

4.1.3.2 Mine Closure/Reclamation

Salvaged reclamation material would be utilized as the primary plant growth medium on reclaimed areas. Soil would be redistributed to depths of 6 to 12 inches on all graded areas within the tailings impoundment area, the waste rock disposal areas, and on all other mine areas affected by the Proposed Action, as available. Since the soil associations in the area are shallow with the exception of soils in the tailings impoundment area, salvaged soil from the impoundment may be used to supplement reclamation material amounts in other mine areas. Reclamation material salvaged from the tailings impoundment area could provide a 6-inch cover of growth medium for all project components to be reclaimed, if necessary. Areas that may require supplemental growth medium include: roads; the fresh water storage area; the lean ore stockpile; the West, North, and East Waste Rock Disposal areas; plant facilities; and other miscellaneous areas (Table 4-1).

Test plots would be used to evaluate amendments to improve properties of the plant growth medium. Since test plots have not been completed, potential impacts from use of the reclamation material as a plant growth medium are unknown.

Although stripping, stockpiling, and redistribution adversely affect soil characteristics, including alteration of soil profiles and soil structure, the benefits of using soil for revegetation outweigh the adverse effects of soil handling. Interim and final reclamation/revegetation efforts would return some areas of soil disturbance not involved with operations to productivity following construction, thereby reducing the duration and magnitude of impact. Loss of soil or discontinuation of natural soil development, decreases in infiltration and percolation rates, decreases in available water-holding capacities, breakdown of soil structures, and loss of organic material occurring as a result of mine operation activities would be reversed by natural soil development over an unknown amount of time following reclamation. Loss of soil fertility and soil microorganisms, and loss of vegetative productivity could be reversed after successful reclamation.

Revegetation and recontouring of the tailings impoundment area using methods presented in the Reclamation Plan would assist in minimizing soil loss due to erosion. Soil losses due to erosion would be evaluated following the test plot studies, and erosion control measures would be implemented accordingly.

4.1.4 Vegetation

Direct impacts to vegetation would result from the disturbance or removal of vegetation during mine development and construction. Direct impacts include the loss of vegetation, vegetative productivity, and forage for livestock and wildlife use. The impacts to vegetation directly affect other resources, such as soil, water, wildlife, and watershed.

4.1.4.1 Mine Development/Operation

The major effect of mine development on vegetation would be direct removal or disturbance within the mine area. Vegetation present in the mine area, which would be directly affected by mine construction and operation, includes native desert grassland plant communities located on previously undisturbed land and reclaimed and unreclaimed plant communities present on previously disturbed land. Table 4-2 lists the mine components and acreage of undisturbed desert grassland and previously disturbed land to be affected during mine development and operation. Project components that would impact desert grassland include the haul roads; open pit area; tailings impoundment area; fresh water storage area, topsoil stockpiles; and East, West, and North Waste Rock Disposal areas. Project components that would disturb reclaimed and unreclaimed plant communities include haul roads, the open pit area, tailings impoundment area, access roads, topsoil stockpiles, waste rock disposal areas, diversion structures, plant facilities, and other ancillary facilities.

Table 4-2

Estimated Acreage of Vegetation that would be Disturbed Within the Proposed Mine Area

Mine Component	Desert Grassland (acres)	Previously Disturbed Land (acres)	Total Acres to be Disturbed	Total Acres to be Reclaimed	Total Acres Not to be Reclaimed
Haul Roads	4	42	46	46	0
Open Pit area	10	101	111	0	111
Tailings Impoundment	214	241	455	455	0
Access Roads	0	40	40	40	0
Freshwater Storage Area	0	4	4	4	0
Tailings Impoundment Topsoil Stockpiles	30	9	39	39	0
East Waste Rock Disposal Area Topsoil Stockpiles	5	2	7	7	0
Lean Ore Stockpile	0	21	21	21	0
West Waste Rock Disposal Area	1	15	16	16	0
North Waste Rock Disposal Area	28	16	43	43	0
East Waste Rock Disposal Area	122	8	130	130	0
Diversion Structures	0	31	31	0	31
Plant Facilities	0	74	74	74	0
Miscellaneous Areas[1]	0	86	86	86	0
TOTAL	414	690	1,103	961	142

[1]Miscellaneous areas include outlying areas around the pit, plant area, and waste rock disposal area.

Development of the mine area would remove or disturb approximately 414 acres of desert grassland vegetation located on previously undisturbed land. The loss of this vegetation is considered minimal since this vegetation type is widely distributed throughout the region. Native shrub species would regenerate approximately 40 to 60 years after mine closure.

Approximately 690 acres of previously disturbed land would be redisturbed during development of the mine area (Table 4-2). Project components that would be developed solely or predominantly on previously disturbed land include haul roads, pit area, access roads, West and North Waste Rock Disposal areas, lean ore stockpile, diversion structures, plant facilities, and miscellaneous areas. The expansion area for the tailings impoundment area is the largest area (241 acres of redisturbed land) that would remove or disturb vegetation on previously disturbed land.

Based on the protection measures presented in Section 2.2.14, Summary of Environmental Protection Measures, impacts to vegetation present in the riparian area and to the water supply for the seep area located south of the Plant Area are not anticipated to occur as a result of mine development and operation. Water would be artificially supplied to these areas during operation activities. In addition, riparian vegetation located in the seep area downstream of the riparian area would not be impacted during mine development and operation activities since groundwater levels are anticipated to drop only 1 to 2 feet after 10 years of mine operation. Due to the extensive root systems of cottonwoods and willows, the lowering of the groundwater level would not affect the continued existence of these tree species. Supplemental water during operation should allow existing and new riparian vegetation to grow. The supplemental water will be discontinued upon closure, however, and establishment of riparian species seedlings following mine closure is expected to be limited due to the lowered water table.

Normal operation of the facilities is not expected to have any additional direct impacts to vegetation; impacts could occur in the unlikely event of a tailings dam failure. Failure is highly unlikely because of the design of the facility, monitoring of the facility during operation, and other features. If the tailings dam failed, dam material, tailings, and tailings solution would be deposited downstream in and near drainage channels and floodplains. Some vegetation would be affected and sedimentation would result down-drainage from the mine area.

Impacts to vegetation may also occur in the unlikely event of an accidental release of hazardous materials along the haul or access roads. Vegetation within the spill area would be lost for several years following the spill until toxicity levels were reduced. A spill also could affect the physiological condition of the affected vegetation for several years, depending on the materials spilled.

Forage produced by native plant communities and reclaimed and unreclaimed plant communities, potentially used by livestock and wildlife, would be reduced during mine operation.

The project design includes numerous features to reduce erosion-related impacts to vegetation and control erosion and sedimentation in all drainages, including locating facilities away from streambeds and shallow groundwater, use of diversion structures to route surface drainage around the facility, using erosion control structures, and implementing interim and final reclamation measures as stated in the approved Reclamation Plan on file in the BLM's office in Las Cruces, New Mexico.

An increase in weedy species may occur in disturbed areas as a result of mine construction and operation, however, the existing mine area currently supports populations of weedy species. Additional weed invasions that may result from proposed mining activities are not expected to substantially increase weed infestations within the mine area.

4.1.4.2 Mine Closure/Reclamation

After mining activities have been completed, the majority of the mine area would be reclaimed. Approximately 961 (87 percent) of the 1,103 acres disturbed during mine development and operation would be reclaimed after mine closure (Table 4-2). Project components that would not be reclaimed include the open pit area (111 acres) and diversion structures (31 acres). The diversion structures were reclaimed during 1986 and 1987 and additional reclamation activities in these areas should not be necessary. Reclamation objectives; contemporaneous, interim, and final reclamation activities; reclamation material and revegetation management; seedbed preparation techniques; specific reclamation activities for specific project components; post reclamation monitoring and maintenance; and standards to evaluate reclamation success are described in Section 2.2.13, Closure and Reclamation, and the Reclamation Plan.

Construction activities and reclamation material salvage operations would permanently alter the existing soil profiles in the mine area. This alteration could affect the type of vegetation that would re-establish on the disturbed soil since native plant species are adapted to particular soil types. Species composition for reclaimed plant communities are likely to be slightly different than existing plant communities due to changes in surface and subsurface soils.

Following closure and reclamation of the mine area, plant communities in the area are expected to be dominated by native and introduced herbaceous species (grasses and forbs) characteristic of the desert grassland community for the first 5 to 10 years. Depending upon climatic conditions and land use following reclamation, mature shrubs would become more dominant after 10 to 15 years. Species characteristic of the desert grassland are currently the dominant species present in the mine area.

Reclamation would be conducted as outlined in the approved Reclamation Plan, and standards outlined in this Plan would be used to judge reclamation success. The successful reclamation of disturbed lands could replace or potentially exceed the amount of forage produced by native plant communities prior to mine development.

Potential effects to riparian systems and their associated vegetation from groundwater drawdown have been determined, based on the hydrology analysis presented in Section 4.1.2, Water Quantity and Quality. Indirect impacts that may result after mine closure include the potential for hydrologic impacts to riparian vegetation established in Warm Springs Canyon to the west of the mine site. Based on a hydrologic model completed for the mine, the water table in Warm Springs Canyon may be lowered by 10 feet approximately 140 years following mine closure. Although riparian vegetation is limited in Warm Springs Canyon, the vegetation would be affected by the Proposed Action. Pit lake dewatering could result in a long-term 1-foot drawdown of groundwater within 1 mile of Percha Creek. No impacts to Percha Creek or its riparian vegetation would be expected, however, since a fault system located north of Percha Box may block the drawdown cone. No impacts to Las Animas Creek are expected to occur.

Following mine closure and reclamation, Alta has committed to restore topographic features in the Greyback Wash area as closely to pre-mining conditions as possible in an attempt to recreate hydrologic conditions existing at that time that created riparian areas and seeps in the drainage. Impacts to vegetation resulting from poor water quality (i.e., low pH, toxic elements, etc.) are not anticipated to occur as a result of mine closure and reclamation since water quality is expected to be similar to existing conditions.

4.1.5 Wildlife and Fisheries Resources

4.1.5.1 Mine Development/Operation

General Impacts

The Proposed Action would result in both direct and indirect impacts to wildlife resources and their associated habitats. The degree of impacts would depend on the relative sensitivity of the species, the resource issue, the duration of the activity, and the period of disturbance. The Proposed Action would result in the loss of approximately 414 acres of previously undisturbed desert grassland habitat. This anticipated habitat disturbance and loss would result in three primary impacts to wildlife resources: 1) direct loss or disturbance to forage, breeding areas, and thermal cover; 2) indirect impacts from displacement of animals from the Proposed Action area into adjacent habitats, which are potentlally at their associated carrying capacities; and 3) further fragmentation of the habitats from project implementation. No additional disturbance to native vegetation would be expected from operation of the proposed transportation routes.

Of the 1,103 total acres of vegetation disturbed by the Proposed Action, 961 acres would be reclaimed, leaving 142 acres in the open pit and diversion structure areas that would not be reclaimed for post-mining use. Based on the proposed Reclamation Plan for the Proposed Action (Section 2.2.13, Closure and Reclamation), native shrub species would regenerate over a long period of time (40 to 60 years) after mine closure, resulting in a long-term impact to forage and thermal cover availability on the 961 acres of disturbed habitat to be reclaimed.

Of the 961 acres of vegetation reclaimed, the Proposed Action would result in the reclamation of 558 acres of land disturbed by previous mining activities. This reclamation would be a long-term beneficial impact to wildlife resources by improving forage and cover sources in these areas. However, because of the long-term loss of woody species, the reclamation of this previously disturbed land would benefit those species typically associated with herbaceous vegetation.

Disturbance of the native habitats would result in the direct loss of less mobile species (e.g., small mammals, bird nestlings, reptiles) and the displacement of more mobile species (e.g., medium-sized mammals, adult birds, and big game animals). Habitat removal and disturbance to area wildlife species from mine development would affect nesting or breeding habitat, foraging areas, and cover. Direct effects to important habitat would result in displacing animals, increasing competition, and exceeding the carrying capacities within the adjacent habitats. Loss of habitat and effects to carrying capacities would occur for the life of the project and until successful reclamation is achieved. Displaced individuals may or may not be able to establish territories in adjacent habitats, depending on variables such as the species' behavior, density, and individual habitat requirements and availability. Habitat fragmentation from the Proposed Action would limit use by wildlife species.

The hunting territories of raptors and mammalian predators would be reduced by the amount of disturbance of native habitats associated with the mine area expansion, likely affecting small numbers of local predators (e.g., coyote, badger, red-tailed hawk, great-horned owl). Because most predators are wide-ranging, it is not likely that the loss of hunting range and associated prey base of this magnitude would result in long-term effects.

Project-related truck use of Highway 152 is estimated to be approximately 8 trucks per day along the highway route. Based on the existing traffic levels along this corridor (see Section 4.1.10, Transportation), additional mining truck traffic should not substantially increase the potential for increased wildlife mortalities along the highway; however, vehicle-related mortalities from increased general mine traffic, including employee commuting, could increase during operation.

The peak work force is estimated to be 170 employees during mine operation (see Section 4.1.9, Social and Economic Values). Indirect impacts to area wildlife during project development and operation would result from increased human presence and activities in the overall project region. Construction, mine development, and operation would generate increased traffic and noise, potentially resulting in increased legal and illegal hunting, and wildlife harassment. Increased hunting (both legal and illegal), due to the number of mine employees and their families, could result in increased law enforcement responsibilities for the NMDGF (see Section 4.1.9.4, Community Facilities and Services). The most visible wildlife species would be the most prone to these types of impacts.

Noise levels generated during project development and operation are presented in Section 4.1.7, Noise. The anticipated levels would result in minor impacts to area wildlife. Common responses of animals to noise disturbances are either avoidance or accommodation. Except at extreme levels, the more secretive and smaller animals would coexist with the noise sources. Other animals, particularly those that rely most on vocal and auditory cues (e.g., passerines) for communication and orientation, would avoid the vicinity of a noise source, moving out of the area until the source dropped to an acceptable background level for that species. After initial avoidance of human activity and noise-producing areas, some wildlife species may acclimate (e.g., mule deer, some passerines) and begin to reinhabit adjacent areas formerly vacated. Abrupt and intermittent noises (e.g., blasting) are less likely to be accommodated than are the more steady, continuous noises (e.g., truck traffic).

No major issues relative to area game species were identified for the proposed Copper Flat Project. As discussed above, individuals would move out of the mine area during operation into adjacent habitats, which may or may not be available. However, due to the limited use of the habitats in and around the Proposed

Action area, few game species would be directly or indirectly affected. The loss and disturbance of the habitats associated with the mine area would affect the scattered mule deer, Gambel's quail, scaled quail, mourning dove, and various migrant waterfowl and shorebirds that may periodically use the area. However, no primary breeding, foraging, or roosting sites for game species would be impacted by the Proposed Action.

Of the three existing raptor nests located within the mine area, the north-facing cliff nest located south of the existing mine pit would be removed by pit expansion. The other two nest sites would not be directly affected by mine expansion; however, they would be indirectly impacted by mining activities associated with increased noise, harassment, and human presence associated with mining activities. Because of the high profile of most raptor species, raptors frequenting the mine area could also be affected by illegal shooting. Although no birds appeared to occupy three nests during the 1994 breeding season, raptor species often alternate between nest sites, and these existing nests may be occupied in the future. In addition to the indirect impacts to these known nest sites, the Proposed Action would restrict any raptor nesting and foraging in and near the mine area during the life of the project, resulting in short-term habitat loss for breeding and foraging raptors.

No impacts to raptor species would result from the operational use of the 25-kV distribution line located within the mine area. As presented in Section 2.2.9, Electrical Power, the distribution line structures would incorporate standard raptor-proof designs to prevent electrocution of resident or migratory birds attempting to perch on the line.

Also, no impacts to raptor species from the operation of the 115-kV transmission line would be likely since electrocution of raptors is not considered a problem with transmission lines of this size. The physical dimensions and configuration of the structures and conductors of the 115-kV line would meet or exceed design requirements for raptor protection (Olendorff et al. 1981) and would not introduce an electrocution hazard. The potential for avian line strikes would be the same as the current level, since existing lines occur in the open, flat topography to the mine east of the site.

Shafts, adits, or other underground workings that are associated with past mining activities may support bats, in addition to other nongame species, such as passerine birds, amphibians, and reptiles. Loss of underground openings occupied by bats could be important, particularly if any of the six sensitive bat species identified as potentially occurring in the area were present (see Section 4.1.6, Threatened, Endangered, and Other Sensitive Species). The disturbance of underground openings from either direct (e.g., removal or closure) or indirect (e.g., noise from blasting) mining-related activities could result in abandonment of important roost sites. Since little is known about bat use of the Proposed Action area, roost sites important to resident bat species could include maternity colonies, hibernacula, and/or bachelor roosts. An existing shaft, located on the northeast corner of the existing pit area, would be removed under the Proposed Action, possibly resulting in impacts to bats in the area.

Another issue that is becoming prominent in the United States is the impact to breeding birds, including neotropical migrants, from habitat alteration or destruction. This issue is often emphasized, relative to passerines, as annual bird surveys continue to record declining songbird populations. A number of birds return to southwestern New Mexico to breed. These birds are typically present within the desert grassland habitat from spring through fall, migrating to the subtropics and tropics for the winter period. The anticipated loss of the 414 acres of desert grassland within the undisturbed habitats would reduce the amount of potential nesting habitat for ground-nesting birds and those that typically nest in low shrubs. However, this anticipated habitat loss would not be considered significant to either resident or migratory avian populations because neither of these habitat types are limited in extent within the project region.

Water Quality Impacts

Impacts to area wildlife species related to water quality issues associated with the Proposed Action are based on the hydrology analysis presented in Section 4.1.2, Water Quantity and Quality. Waterfowl have been reported sporadically using the existing pit lake, and deer use the pit as a water source.

The depth of the pit lake would prevent the rooting of aquatic plants and limit the development of benthic organisms. These factors, along with the lack of terrestrial vegetation on the surrounding sidewalls, should limit use by wildlife. Therefore, it is not expected that the future pit lake would constitute a major nesting or foraging area for waterfowl or encourage extensive use by mammals. The Proposed Action would remove the small area of emergent vegetation (approximately 15 square feet) that currently exists along the west margin of the pit lake, which is located along the original channel of Greyback Wash. However, the anticipated loss of these emergents would not be considered important to area wildlife, because of its small size and because the lack of a natural aquatic system in the pit lake limits its use by wildlife resources.

Water would pool at various locations in the tailings impoundment, which could attract wildlife species, including birds, bats, and other mammals (e.g., mule deer). Large and medium-sized mammals (e.g., mule deer, bobcat, coyote) may use the tailings impoundment as an occasional source of drinking water during mine operation. There is a low potential for animals to become mired in the tailings, which could result in individual mortalities. However, occurrences would be unusual and rare. The tailings pool would cease to exist once the deposition of tailings ended, the pool level pumped down, and the pool evaporated in preparation for reclamation activities.

Future water quality in the pit and tailings impoundment areas was evaluated and modeled by SRK (1995). According to SRK's evaluation, future pit water quality would be similar to existing conditions in the pit lake. Based on these findings, samples from the pit lake and tailings impoundment collected in February 1991 and November 1994 (Table 4-3A), were evaluated to determine existing concentrations of various metals. The majority of samples were collected from the pit itself, however, one sample was also collected from the tailings area (Tailings Decant). All water quality data were examined to determine what analytical data were available. If a metal were undetectable in all or most samples it was not included on Table 4-3A. Seven metals were selected for evaluation.

The data in Table 4-3A were compared against the best available standards or other benchmark toxicity values (Table 4-3B). These standards or benchmark values represent water concentrations below which no adverse effects should occur. The standards or values that were examined include:

Table 4-3A

Concentrations of Selected Metals Measured at Various Locations in the Pit and Tailings Areas (mg/l)

Parameter	Sample Location and Date							
	Tailings Decant 05/07/93	Pit Shore 2/11/91	Pit Shore 2/11/91	Pit Shore 2/12/93	Pit 40 feet 04/01/93	Pit 10 feet 04/01/93	CF-Pit 2 11/16/94	CF-Pit 11/16/94
Fluoride	1.46	4.58	4.77	6.21	5.28	5.34	8.10	8.10
Copper	Non-detect	--	--	2.60	1.63	1.45	0.03	0.03
Manganese	Non-detect	1.82	1.84	4.90	4.17	4.26	3.60	3.40
Zinc	0.03	--	--	1.80	1.45	1.48	0.10	0.09
Nickel	--	--	--	Non-detect	0.03	0.03	Non-detect	Non-detect
Cadmium	--	0.035	0.015	Non-detect	0.030	0.030	0.017	0.017
Aluminum	Non-detect	--	--	2.0	0.7	0.7	Non-detect	Non-detect

Source: SRK 1995.

Table 4-3B

Standards and Effects Levels for Adverse Effects on Wildlife (mg/l)

Parameter	New Mexico Livestock/ Wildlife	NRC MTLs[1]	Benchmark Toxicity Values for Consumption of Water[2]				
			Little Brown Bat	Cottontail Rabbit	Whitetail Deer	American Robin	Red-tailed Hawk
Fluoride	--	40	985.426	305.569	126.526	75.123	75.072
Copper	0.50	25	367.846	114.065	47.230	457.089	456.779
Manganese	--	400	1954.948	606.208	251.019	--	--
Zinc	25	300	3554.450	1102.196	456.398	50.788	50.754
Nickel	--	50	888.613	275.549	114.099	1208.209	1207.401
Cadmium	0.05	0.5	1.889	0.586	0.243	25.728	25.711
Aluminum	5	200	19.060	5.910	2.447	1019.383	1018.700

[1] National Research Council Maximum Tolerable Levels for Domestic Livestock (1980).
[2] Opresko et al. (1994).

- The State of New Mexico Standards for Livestock and Wildlife
- National Research Council Maximum Tolerable Levels for Domestic Animals
- Benchmark toxicity values for water consumption for three mammals and two birds (Opresko et al. 1994)

The first two of these literature sources are generally targeted to domestic livestock. However, because large herbivores, such as deer, have habits similar to livestock, these toxicity standards can be applied to wildlife. Opresko (et al. 1994) lists levels of selected organic and inorganic constituents in diet and water that may cause adverse effects if exceeded. To establish these benchmark levels, experimental data, usually on standard laboratory species (e.g., rats, mallards), were used to estimate concentrations that would effect wildlife species by adjustments according to body weight. The wildlife species for which benchmark effects levels were determined represent a range of body sizes and trophic levels. For this analysis three mammals (little brown bat, cottontail rabbit, and whitetail deer) and two birds (American robin and red-tailed hawk) were chosen. Benchmark values for consumption of water only were evaluated.

In the samples collected prior to 1994, only copper exceeded New Mexico Livestock/Wildlife water quality standards. The highest concentration was 2.60 mg/L, which is roughly 5 times the standard of 0.50 mg/L. An important consideration in the interpretation of these results is that New Mexico standards are based on dissolved metals, which are generally thought of as being bioavailable. Analytical results, however, are typically based on total metals (although it is not known whether the analytical results examined here were total or dissolved), which would include particulate material as well as dissolved material. Therefore, the dissolved copper portion of the pre-1994 samples could be less than 0.50 mg/L. The benchmark toxicity values developed by Opresko et al. (1994) are adjusted specifically for wildlife species and are therefore probably better indicators of concentrations that may affect wildlife. Since measured copper concentrations are substantially below the wildlife benchmark concentrations for water consumption, it is highly unlikely that copper levels in the water should have any adverse impacts. In addition, the 1994 samples showed copper concentrations of only 0.03 mg/L, well below the New Mexico livestock/wildlife standard.

Water Quantity Impacts

The potential for drawdown of natural springs from mine operation is discussed in Section 4.1.2, Water Quantity and Quality. As presented in Section 3.5, Wildlife and Fisheries Resources, springs, seeps, and the associated riparian habitat support a higher diversity and density of wildlife species than any other habitat type occurring in the project region.

No impacts to the perennial flow sections Las Animas Creek, located approximately 5 miles northeast of the mine area are expected (see Section 4.1.2, Water Quantity and Quality). Potential effects to the riparian systems associated with Percha Creek and Warm Springs Canyon are also discussed in Section 4.1.2, Water Quantity and Quality. Based on the current hydrological models, dewatering activities could result in a long-term, 1-foot drawdown of groundwater within 1 mile of Percha Box and a long-term, 10-foot decrease in groundwater levels in Warm Springs Canyon. Review of geology in the area north of Percha Box indicates that drawdown may potentially be blocked to the north of the Box by a fault system (see Section 4.1.2.2.1, Potential Impacts in the Mining District). This should prevent drawdown effects on Percha Box. Therefore no impacts to riparian vegetation are anticipated in the Percha Box area. In addition, no impacts to aquatic organisms dependent on this system would likely occur. The projected drawdown of groundwater in Warm Springs Canyon would affect water flow in this area, reducing the amount of available water for wildlife use and the support of riparian vegetation. Because this area is degraded from heavy livestock grazing, the primary impacts to wildlife species would be the loss of available water. Minimal riparian vegetation is currently functional for wildlife use.

The projected changes to the groundwater levels within the mine area would likely affect the riparian habitat and existing seeps along Greyback Wash, possibly resulting in important habitat loss for area wildlife. The small seep located downstream of the riparian zone could be impacted during project operation; however, the habitat provided by this seep is not extensive. Based on the protection measures presented in Section 2.2.14, Summary of Environmental Protection Measures, Alta has committed to providing supplemental water during mining operation to the riparian area and open-water seep located near the process water reservoir.

This analysis is based on the predicted drawdown contours from mine operation. In the event that future drawdown levels exceed these estimates, potentially significant impacts to these riparian drainages and the wildlife resources associated with them could result.

Hazardous Materials Spill Impacts

The probability of a release of hazardous materials (e.g., diesel fuel, sodium hydroxide, MIBC, sulfuric acid) into a sensitive receptor along the transportation route is discussed in detail in Section 4.1.10, Transportation. As presented, the probability of a diesel fuel spill was calculated to be <0.1 spill during the 10-year project operation (Section 4.1.10, Transportation). The level of impact from a hazardous spill or release to wildlife resources would depend on the size of the spill, time of year, physical characteristics of the site, cleanup and control techniques, and susceptibility of the dominant or important terrestrial or aquatic organisms. The short- and long-term effects to an aquatic system would depend on the amount of material spilled; the buffering capacity of the water, soils, and associated vegetation; and the recharge or dilution of the system. Impacts from a hazardous materials spill could range from temporary loss of vegetation to the widespread loss of riparian habitat and the organisms that are associated with it. Site remediation would be important in keeping adverse impacts short-term and re-establishing the riparian system. Ephemeral or intermittent drainages would not be as sensitive to a release as perennial systems. The extent that upland areas could be affected would depend primarily on the spill response and cleanup plan.

4.1.5.2 Mine Closure/Reclamation

No additional adverse impacts to wildlife are likely to result from mine closure and reclamation. As vegetation is re-established, habitat quality would improve, resulting in a beneficial impact to wildlife over time. One of the goals of revegetation is re-establishment of wildlife habitat by use of appropriate native species. Restoration of wildlife habitat would be enhanced through use of some native species, development of shrub cover, and creation of habitat diversity. As human activity in the area decreased and revegetation occurred, wildlife use of the area would likely increase. As stated above, the re-establishment of woody species would be a long-term process; therefore, site reclamation would favor wildlife resources associated with grasses and forbs until natural shrub regeneration began.

As discussed for water quality impacts to wildlife, the creation of a pit lake following site closure is not anticipated to impact resident or migratory wildlife from the ingestion of pit water. The pit water quality is anticipated to be similar to that sampled in the current pit. Following mine closure and subsequent reclamation, Alta has committed to restore the topography associated with the seeps located near the process water reservoir in a manner that would parallel existing conditions (see Section 2.2.14, Summary of Environmental Protection Measures). This restoration would attempt to retain the current drainage patterns to the riparian zone and open-water seep in order to maintain valuable wildlife habitat. Alta has also committed to monitor water quality within the mine area after mine closure. In the event that water chemistry analyses indicated degrading water quality, these structured seeps would not be maintained to minimize potential short- and long-term effects to both terrestrial and aquatic organisms. If this were to occur, the loss of the water sources for the riparian zone and open-water seep would constitute a long-term, adverse impact to wildlife.

4.1.6 Threatened, Endangered, and Other Sensitive Species

4.1.6.1 Mine Development/Operation

The impact assessment for sensitive wildlife species focuses on the potential effects to the species identified in Section 3.6.1, Wildlife and Fisheries; therefore, only the applicable project components are discussed for each species examined. The impact analysis associated with water quality effects is tiered from the analysis presented for general wildlife species in Section 4.1.5, Wildlife and Fisheries Resources.

Only one special status plant species, the grama grass cactus was identified by the USFWS, NMNHP, and BLM as potentially occurring within the mine area and along the transportation route. Potential habitat for this species was identified within the mine area; however, the cactus does not appear to be present within the mine area, based on recent ground surveys conducted in the area, database review, and discussions with agency specialists.

These impact assessments incorporate the resource analyses conducted for the EIS (e.g., water quality, water quantity) and are summarized from the Biological Assessment prepared for the proposed Copper Flat Project. The BLM, as the Federal lead agency, is coordinating the preparation of the Biological Assessment with the USFWS, in accordance with Section 7 of the Endangered Species Act.

Mammals

No impacts to the jaguar or Arizona black-tailed prairie dog are anticipated from the Proposed Action. As discussed in Section 3.6.1, Wildlife and Fisheries, the jaguar is thought to be extirpated from the State. No prairie dog colonies have been recorded for the mine area, and no historical sightings of the Arizona black-tailed prairie dog have been reported for the vicinity of the Proposed Action.

Seven sensitive bat species were identified for the EIS analysis. These species include the greater western mastiff bat, occult little brown bat, spotted bat, fringed myotis, long-legged myotis, Yuma myotis, and pale Townsend's big-eared bat. Of these seven species, the long-legged myotis would not be impacted, since this species' primary habitat does not occur in or near the Proposed Action area, and the pale Townsend's big-eared bat has been documented near the mine site. Although the presence/absence of the other five bat species cannot be confirmed, it is not likely that the greater western mastiff bat or spotted bat would occupy the Proposed Action area and therefore be affected by mine development. This probability is based on species' distribution and known occurrence data.

Based on known roosting requirements, the four bat species that could be present could be both directly and indirectly impacted by the Proposed Action if any of these species occupied the abandoned mine shaft, that would be removed during the Proposed Action, small crevices in the existing mine pit walls, or other appropriate habitat (e.g., rock outcrops) surrounding the mine area. The proposed expansion of the tailings facility would avoid the existing structure referred to as the Tony House, which provides roosting for the pale Townsend's big-eared bat; although the Proposed Action may result in secondary impacts to these bats from operational noise. Bats could be affected by loss of roosting habitat from mine expansion (direct impacts) or by disturbance to roosting and foraging activities from noise and increased human presence (indirect impacts). Sensitive roosts that may be affected could include maternity colonies, bachelor roosts, and hibernacula.

Birds

Based on existing agency data, no impacts to either the American or arctic peregrine falcon are anticipated. No peregrine eyries occur in the Proposed Action area, no extensive riparian habitat would be removed that could support primary prey species for the peregrine, and both migrant and foraging birds would likely avoid the mine area during project development and operation.

No direct or indirect impacts to nesting or wintering bald eagles would result from mine development, since no habitat would be affected by the Proposed Action that supports breeding or wintering birds, including Caballo Reservoir. The probability of a hazardous materials release along the proposed transportation routes is discussed in Section 4.1.10, Transportation. No adverse impacts to eagles have been identified, based on the low spill probability during the life of the project and the proposed development of a Emergency Response Plan. Finally, no increased strike hazard was identified from the orientation of the existing transmission and distribution lines in the Proposed Action area, and no increased electrocution potential would occur, based on the committed measure to retrofit the existing 25-kV distribution line structures in accordance with the Rural Electric Association standards and other raptor-proof designs suggested by Olendorff et al. (1981).

Based on the BLM's survey results along Percha and Las Animas Creeks, no direct or indirect impacts to the southwestern willow flycatcher are expected. Although unconfirmed sightings of this species have been reported for the vicinity of the Proposed Action, no individuals were recorded during the 1994 presence/absence surveys. In addition, no long-term effects to the riparian vegetation associated with Percha or Las Animas Creeks have been identified from the groundwater and surface water analyses.

Habitat associated with Warm Springs Canyon that may be affected in the long-term by mine dewatering is not appropriate habitat for the southwestern willow flycatcher.

The development of the Proposed Action could both directly and indirectly impact nesting loggerhead shrikes that may occupy the mine area. Habitat loss would be primarily associated with removal of low shrubs that may provide nesting sites. This loss of woody perennials would result in both the short-term impacts to breeding birds and their annual productivity, in addition to the long-term effects from loss of nesting habitat (40 to 60 years).

No direct impacts to the common black hawk would occur from the Proposed Action. Although this species has been documented along Percha Creek and may use the area for nesting, the groundwater analysis for the EIS indicated that the potential long-term effects in and near Percha Creek would not likely affect the riparian vegetation supported by this drainage.

Although the ferruginous hawk occupies the region of the proposed Copper Flat Project, no occupied nest sties have been documented in the Proposed Action area. However, if mine development activities were to occur within 0.50 mile of an occupied nest site, disturbances may cause nest abandonment, resulting in the short-term loss of the breeding pair's productivity and the long-term loss of nesting habitat for the species. Potential disturbance of breeding birds is particularly important during the early breeding period, during courtship and incubation, when the birds are most likely to abandon their nest. Secondary impacts to ferruginous hawks would include the loss of foraging habitat in the mine area. However, no high density, small mammal populations (e.g., prairie dog colonies) are known to occur in the mine area that would attract large numbers of foraging raptors, such as the ferruginous hawk.

No impacts to the northern goshawk would occur from implementation of the Proposed Action. The habitats surrounding the mine area are not appropriate for this forest-dwelling species.

Impacts to the Baird's sparrow would be limited to removal of desert grassland habitat that birds may use for foraging during migration. However, no Baird's sparrows have been documented in the project area, and the loss of this habitat would not be significant to this species, based on relative habitat quality and available foraging habitat.

Reptiles

The Texas horned lizard is known to occur in and near the Proposed Action area. Mine development and operation could result in direct mortalities to individuals occurring in the mine expansion area. Nests would be lost, if directly affected by project development. Implementation of the Proposed Action would result in the short-term loss of habitat for this species (life of the project). The lizards would likely reinhabit the mine area upon closure and final reclamation; therefore, long-term impacts to this species following mine closure are not anticipated, potential long-term effects could result, however, if invertebrate prey populations, particularly harvester ant populations, do not recover following mine reclamation.

Fish

No impacts to the long-fin dace, confirmed in Perch Creek, would be expected from the Proposed Action. As discussed above, no short- or long-term effects to the channel flow or the associated riparian vegetation have been identified by the hydrological analysis. Because it is currently believed that the long-fin dace has been introduced into Percha Creek, this species was not addressed in the Biological Assessment prepared for this project.

Plants

No impacts to the grama grass cactus are anticipated from the proposed Copper Flat Project. No suitable habitat has been identified within the Proposed Action area, and no individuals were observed within potential habitat located at higher elevations along the southern slope of Animas Peak. It is not likely that this species would occur within the area of influence for the Proposed Action.

4.1.6.2 Mine Closure/Reclamation

Impacts to special status plant and animal species are not anticipated during mine closure and reclamation activities.

4.1.7 Noise

The potential for noise from mining operations within the mine area was reviewed based on the noise levels commonly associated with noise-emitting operations and the proximity of sensitive receptors. The influence of land features on noise levels off-site was considered. Because measured noise data expected to result from the Proposed Project and noise modeling in the area do not exist, the noise levels and impacts were estimated based on a review of existing literature and existing noise analyses for similar projects.

4.1.7.1 Mine Development/Operation

Noise levels associated with construction and operation would be temporary and would vary widely during the day. Activities that may generate noise include construction/erection of buildings, the operation of heavy mobile equipment, blasting, ore crushing, and the movement of traffic to and from the project site. Noise levels associated with construction are expected to be less than the noise levels during active mining operations and are not expected to adversely effect residents located closest to the Copper Flat Mine.

Most noise-generating activities at the mine site are not expected to be perceptible by noise-sensitive receptors (residences) given their distance from the Copper Flat Mine and the presence of significant topographical barriers that serve to shield them from distant noise sources such as the Proposed Action. Routine blasting would occur in the pit area as part of mining operations; however, blasting would be limited to daylight hours, as described in Section 2.2.3, Mining Operation. Blasting would occur below ground level and noise from blasting activities would largely be attenuated by the surrounding terrain. Noise from blasting may occasionally be perceptible by residents of Hillsboro, located 5 to 7 miles distant, when atmospheric conditions such as lack of wind and/or low-level inversions are conducive to carrying or reflecting soundwaves.

According to the New Mexico Department of Energy, Minerals, and Natural Resources (Mining and Minerals Division), there are currently no State noise regulations pertaining to hard rock mining operations. As such, mining noise standards are currently regulated by the Federal Mine Safety and Health Administration and Occupational Safety and Health Administration (OSHA) noise quality standards.

Vehicular traffic and crushing operations are expected to dominate mining-related noise levels. Vehicular traffic would include employees commuting to and from the site, haul trucks, and vendor vehicles. Additional vehicular traffic along Highway 152 is expected to result from the estimated 170 employees who would commute to the site during project operations. Concentrate haul trucks and vendor truck traffic are also expected to add to existing noise levels along State Highway 152. An average construction workforce of 130 workers per day would add to traffic for approximately 12 to 18 months prior to mine operation. As described in Section 4.1.10, Transportation, the Proposed Action would generate an average of 150 vehicle round trips per day on Highway 152 near the Copper Flat Mine during operations. Major employee shift changes, during which the majority of these trips would take place, would occur during the hours of 12 a.m., 8 a.m., and 4 p.m. on weekdays when a maximum of 110 vehicles would arrive/depart the mine immediately prior to and after these periods. Minor shift changes (no more than 30 vehicles total) would occur around 6 a.m. and 5 p.m. On weekends, traffic generation associated with mill, crusher, and maintenance shop operations would be limited to no more than a total of 60 vehicle trips around the hours of 12 a.m., 8 a.m., and 4 p.m. It is expected that a majority of all employee-related trips on Highway 152 would occur via Interstate 25 (I-25), with few employees commuting from the Hillsboro area and communities farther to the west.

Sensitive receptors located along roadways that would experience increased traffic noise as a result of the Proposed Action include the town of Hillsboro and two residences located within the Percha Creek drainage east of the Copper Flat Mine (a distance of approximately 2 to 4 miles). Concentrate haul trucks transporting ore would not travel west of the Copper Flat Mine on Highway 52 through Hillsboro. Thus, project-related increases in traffic are not expected to result in a perceptible increase in ambient noise levels for residents of Hillsboro.

Project-related increases in noise levels associated with vehicular traffic would likely be perceptible at the two residences located along Highway 152 east of the Copper Flat Mine. These structures are located within 200 feet of the roadway. Estimated noise levels (based on commonly reported literature values) for heavy freeway traffic at 60 mph, measured at a distance of 300 feet, are between 60 and 65 dBA. Noise levels tend to decrease as average speeds decrease. A noise level adjustment of 5 to 10 dBA is appropriate since travel speeds on Highway 152 would be less than 60 miles per hour (mph) and since anticipated traffic volumes during shift changes are considered light to moderate. This results in an estimated maximum level of 55 dBA at 300 feet from the roadway. Generally, noise levels below 70 dBA are considered protective of human health and welfare. However, noise levels in excess of 55 dBA could cause annoyance and result in complaints depending on the sensitivity of the exposed population. Since any increase in project-related traffic would occur during relatively brief intervals each day, the resultant noise should not adversely affect these, or other sensitive receptors, located along Highway 152. Residents near State Highway 152 and in Hillsboro could experience a slight increase in traffic-related noise during daytime commuting hours.

Project-related traffic is not expected to increase ambient noise levels for sensitive receptors located along I-25 and/or State Highway 26. The Proposed Action would not add significantly to existing traffic volumes on Interstate 25; truck trips associated with the hauling of ore concentrate along Highway 26 (8 per day) would also be insignificant when compared to existing traffic volumes along this route.

Crusher operations that would be located in the vicinity of the East Waste Rock Disposal area were assumed to generate noise levels at the primary crusher of approximately 96 dBA at 15 feet. Since noise levels attenuate at 6 dBA with each doubling of distance (ENSR 1992), dBA levels from the crusher at the nearest sensitive receptors, the Clark and Coalson Ranches located 3 miles to the southeast, would be approximately 35 dBA. This level is at or below ambient levels and does not account for terrain variables, which could serve to further block noise generated by crusher operations.

4.1.7.2 Mine Closure/Reclamation

Noise levels from closure activities would be short-term in nature and have little, if any, effect on the nearest sensitive receptors. Upon completion of closure activities, noise impacts would be expected to return to near baseline conditions.

4.1.8 Air Quality

Air quality in the study area would be affected by both construction and operation of the facility. Air emission sources include construction activities, mining and milling activities, and vehicle operation. Air quality effects from construction may result in a temporary elevation of local particulate matter levels. Process emissions from the facility are predicted to be below the 250 tons per year threshold requiring a PSD permit (Biggs 1991). Process emissions include those directly coming from identifiable sources like stacks, crushers, mills, silos, or material transfer points.

Other emissions come from roads, stockpiles, and other disturbed areas. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream (e.g., stack, chimney, or vent). The principal sources of fugitive dust would be related to construction activities, including land clearing, earth moving, scraping, hauling, and materials storage and handling; drilling and blasting; truck loading operations; wind erosion from stockpiles; and ore handling operations. In addition, other fugitive emissions impacts would be caused by mud/dirt carryout onto paved surfaces. The additional surface loading would cause an increase in fugitive emissions during the lifetime of the construction project.

4.1.8.1 Mine Development/Operation

Construction activities that may affect air quality include soil stripping, blasting and construction of the tailings impoundment facility concentrator, and other facilities. During construction, vehicle exhaust emissions would be generated but are not expected to affect regional air quality. Particulate emission levels from construction activities would vary, and impacts would depend on the construction location and the daily wind and weather. While environmental protection measures, such as road watering, would reduce the amount of emissions from construction activities, some level of fugitive dust emissions would be unavoidable due to the nature of this activity. Construction of the Copper Flat Project can be expected to cause locally elevated levels of particulate matter, particularly during the ground clearing and earthwork phases. These activities would require a surface disturbance permit from NMED, which would require that watering or other measures be taken to limit fugitive dust emissions. Although some impacts on air quality would inevitably occur, they would be transitory and temporary, limited in duration, and controlled through Best Management Practices required by NMED.

Air quality impacts due to emissions from mining operations would occur throughout the operational phase of the project. The primary pollutant would be fugitive dust particulates generated by the crushers, screens, conveyors, material handling and storage, and other processes. Other pollutants would include NO_x, CO, and SO_2 from exhaust emissions from electrical generators, vehicles, and other mobile equipment used on-site. Emissions and impacts would be minimal from these sources.

Certain project facilities would produce odors that are characteristic of the reagents that are being used. The concentrator facilities would be expected to produce odors; however, the reagents associated with the concentrator facilities would be stored in closed tanks and used within closed buildings. Odors are not expected outside these buildings.

The tailings impoundment would be kept moist until reclamation to control dust and minimize emissions at committed levels. Particulate and vehicle exhaust emissions would result from mining activities (blasting and hauling) and processing activities (crushing and stockpiling). Dust generation from new soil stockpiles would be controlled by temporarily re-vegetating the piles and would not be expected to substantially impact air quality.

The major particulate-emitting actions associated with the proposed Project include vehicle use of the haul roads, ore crushing (mill) operations, and material handling and storage. Table 4-4 provides a summary of annual process and fugitive emissions expected from the Proposed Action.

Air Quality Modeling

The air quality modeling of the Copper Flat site consisted of 5 model runs using computer models approved for regulatory purposes for flat (ISCST) and complex (COMPLEX1) terrain. Both models predict maximum possible impacts of particulate matter at receptors located on a user-specified grid. Meteorological data used as input to the models came from Truth or Consequences (1964) and Bernalillo (1981), New Mexico. The model runs used emission estimates for total suspended particulates (TSP) because the results would

Table 4-4

Summary of Annual Emissions Copper Flat Mine (Units in tons)

Source Category[1]	TSP	PM-10	NO_x	CO	SO_2	VOCs
Process[2]						
Uncontrolled	1,527	168	<1	<1	0	0
Controlled	76	8	<1	<1	0	0
Mobile[3]	9	9	128	60	15	6
Fugitive						
Uncontrolled	3,302	367	43	168	5	0
Controlled	305	140	43	168	5	0
Total						
Uncontrolled	4,838	544	171	228	20	6
Controlled	381	148	43	168	5	0

Source: Biggs 1991.

[1]Uncontrolled sources are those in which no measures have been taken to reduce emissions. Controlled sources are those which employ measures such as enclosures or mechanical devices to mitigate and reduce emissions from these sources.

[2]Includes crushing, screening, stack emissions, and other activities associated with mining operations.

[3]Mobile sources would be controlled by the pollution control devices installed by the manufacturer.

[4]Fugitive emissions include haul road dust.

provide a conservative estimate of the impacts from the smaller PM_{10} particles that are a subset of TSP. The predicted impacts were then compared to both the TSP and PM_{10} long- and short-term standards. Both TSP and PM_{10} impacts were within ambient air quality standards (see Table 4-5). Other pollutants such as NO_2, SO_2, and CO were not modeled since the estimated emission levels and resultant impacts are far less and therefore insignificant compared to emissions of particulate matter. The highest 24-hour and annual impacts were predicted by the model to occur at the property boundary. The maximum value for the 24-hour concentration of TSP was 98 $\mu g/m^3$ and the highest annual concentration was 18 $\mu g/m^3$ (Biggs 1991). The nearest Class I area is more than 30 kilometers west of the mine and the model estimated that impacts generally fall below 1 $\mu g/m^3$ at less than about 5 to 10 kilometers from the source. Therefore, there would be no significant impact from mining activities on any Class I area.

4.1.8.2 Mine Closure/Reclamation

Reclamation and revegetation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate emission levels would return to what is typical for a dry, desert environment. Equipment use and vehicular traffic would essentially cease following mine closure, thereby reducing emission levels. Once reclamation was successfully completed, pollutant concentrations would be expected to return to background levels.

4.1.9 Social and Economic Values

This section describes potential impacts to population; economy and employment; housing; and community facilities and services, which include water supply, wastewater treatment, solid waste disposal, schools, fire protection, law enforcement, wildlife law enforcement, health care, social services, and public finance.

The following assumptions were used to conduct the impact assessment.

- The required peak construction workforce for the Proposed Action is assumed to number 130 persons (Parshley 1995b). It is further assumed that 70 percent of these new positions would be filled by workers hired from the current labor force (SCEDO and GEC 1993). The remaining 30 percent would be in-migrants.

- It is assumed that local workers would commute daily from their residences to the mine site. This analysis assumes that "local worker" would include those residing within a 75-mile radius of the proposed mine site. This is consistent with the 1982 characteristics of employment at the Copper Flat Mine. In general, "local workers" may reside in Sierra, Dona Ana, Socorro, and Grant Counties (SCEDO and GEC 1993).

- Indirect employment is calculated using a construction multiplier of 2.21 as provided in *Regional Multipliers*, a publication by the U.S. Department of Commerce (1992). This multiplier calculates indirect impacts statewide. Recent BLM analyses have used a multiplier of 1.2 to estimate indirect employment in areas local to mines. (BLM 1994a).

Table 4-5

Air Quality Modeling Results
Copper Flat Mine

Pollutant	Averaging Time	Background Concentration (μg/m^3)	Modeled Addition (μg/m^3)	Total Predicted Impact (μg/m^3)	Ambient Air Quality Standard (μg/m^3)
TSP	Annual	20	18	38	60
TSP	24-hour	40	98	138	150
PM-10	Annual	20	8	28	50
PM-10	24-hour	40	45	85	150

Source: Biggs 1991.

- It is assumed that 70 percent of the indirect or secondary labor force would be second persons in a direct labor household or current residences of the area. The remaining 30 percent would be in-migrants.

- The construction work force of 130 persons is assumed to consist of 80 percent single (including married without family present) and 20 percent married with families present. The population and housing estimates are based on 1 person per single household and 3.5 persons per married household.

- The operations work force of 170 persons (Parshley 1995b) is assumed to be 70 percent local. The remaining 30 percent would be in-migrants requiring housing in the local area.

- The operations work force is assumed to be 25 percent single workers and 75 percent married workers with families. The population estimates are based on 1 person per single household and 3.5 persons per married household.

- Indirect employment is calculated using a mining multiplier of 2.58 as provided in *Regional Multipliers*, a publication by the U.S. Department of Commerce (1992). Local indirect impacts are estimated using a multiplier of 1.74. This multiplier was developed by Dobra (1988) and is used extensively in other mining EISs.

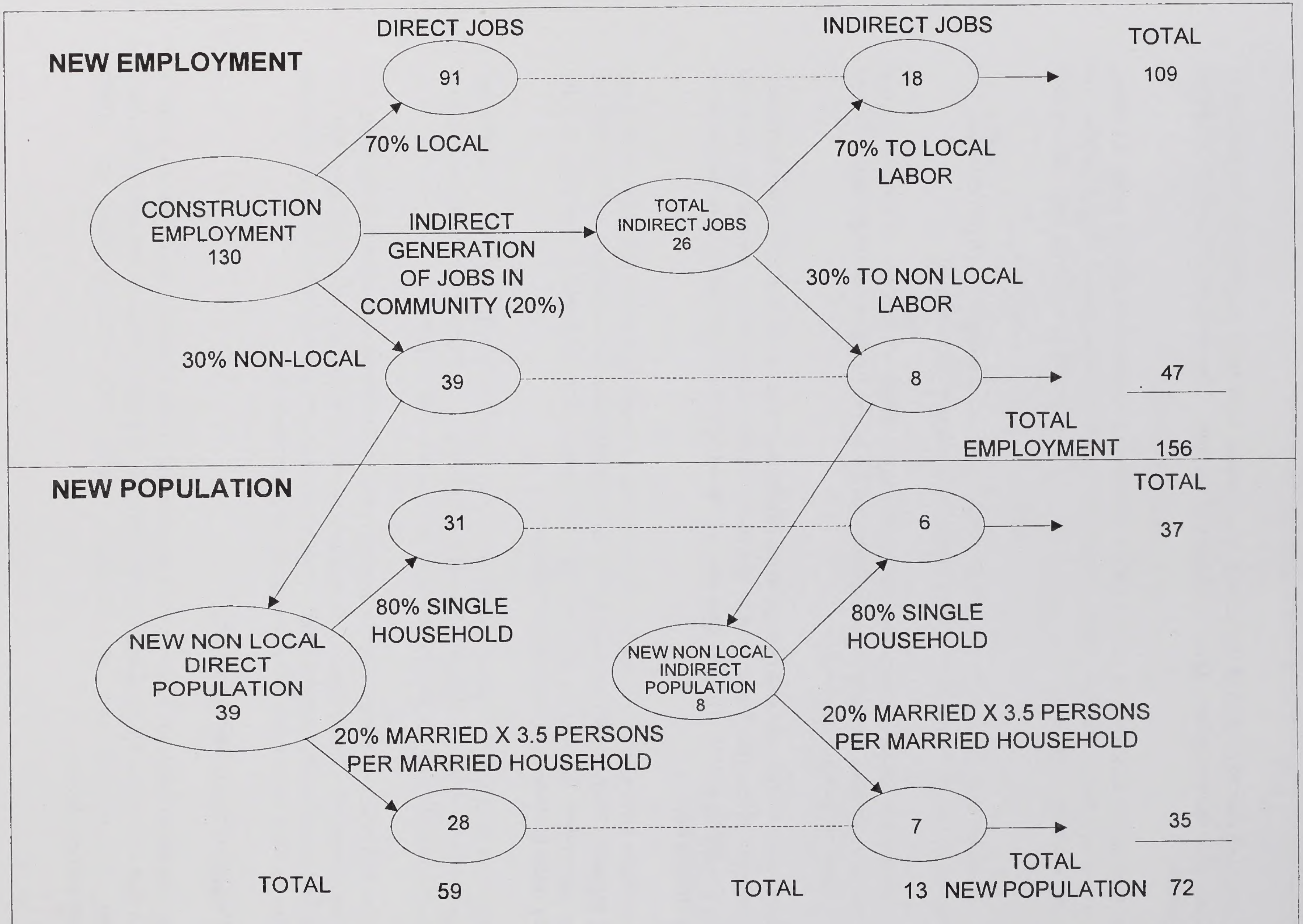
These assumptions and the following impact scenario provides a summary of effects that could be expected to occur in the area. These projections are based on the best information available as of January 1995 and from other assumptions noted in the analysis. Future employment and phasing of other projects in the county may result in changes to the impacts presented.

Construction of the Copper Flat Project is anticipated to take approximately 12 to 18 months. It is estimated that there would be 4 to 6 months of overlap between operations and construction. According to the project proponents, the operations life of the project would be approximately 10 years.

The Proposed Action was evaluated for issues relating to the social, cultural, and economic well-being, and health of minorities and low income groups. Such issues are termed environmental justice issues, and none were identified for the Copper Flat Mine Project. Social and economic impacts of the Proposed Action are not expected to affect minority or low income groups disproportionately.

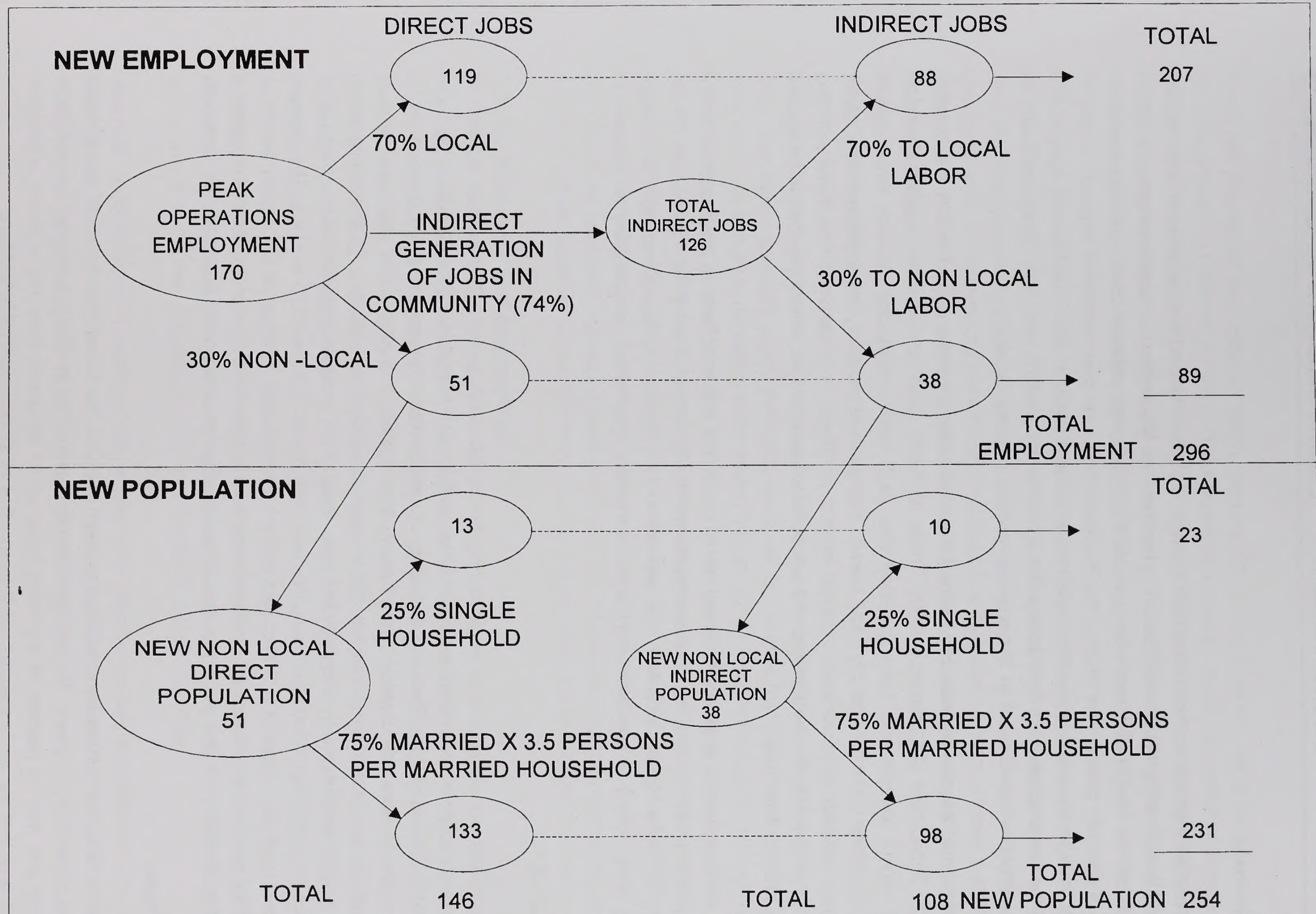
4.1.9.1 Population and Demographics

Anticipated population increases resulting from development of the Proposed Action are presented in Figures 4-4 and 4-5. These figures present employment and population impacts related to construction employment (130 persons) and new operations workers (170), including direct and indirect employment-related effects.



EMPLOYMENT AND POPULATION CONSTRUCTION PHASE COPPER FLAT

Figure 4-4



EMPLOYMENT AND POPULATION OPERATIONS PHASE COPPER FLAT

Figure 4-5

Construction Phase

Construction of the Proposed Action is scheduled to begin in 1996 and would require up to 12 to 18 months to complete. Alta estimates that it would require a maximum of 120 workers to complete construction. It is anticipated that the construction work force would fluctuate, given different tasks requiring short-term employment of specialty crews. The effect of the Proposed Action on area population depends largely on the number of in-migrating workers and the characteristics of their families. Alta estimates that it would hire 70 percent of the construction work force from within a 75-mile radius of the mine site. Figure 4-4 illustrates that these assumptions would result in 39 non-local workers entering the region.

About 157 jobs would be created indirectly by the 130 construction positions using the 2.21 construction multiplier (U.S. Department of Commerce 1992) These positions, however, would be created statewide. Recent BLM impact assessments have assumed that each new construction position would create 0.2 additional positions in the host county (BLM 1994a). Using this assumption, construction at the Copper Flat Mine would generate approximately 26 local indirect positions. It is assumed that these indirectly created jobs would result in the in-migration of 8 additional persons. Most indirect jobs would be created in the service and trade sectors.

The average increase in area population created by the direct and indirect effects of the Proposed Action construction phase, including families, would be approximately 72 persons (Figure 4-4). This would amount to an increase in Sierra County population of approximately 1 percent. Since the construction phase consists of a finite period of approximately 12 to 18 months, this impact to population is considered temporary.

Transition Period

Operational activities are scheduled to begin during the construction period. The gradual addition of operations-related people would cause the population to peak for a short period around the 18th month from the start of the Proposed Action. The peak estimates of construction workers during this peak would be approximately 110 workers, 33 of which would come from outside the area. The peak estimates of operations workers would add an additional 100 workers to existing operations. Of these operations workers, 30 persons would come from outside the area. Peak direct nonlocal employment for construction and new nonlocal operations-related jobs during this same time frame could reach 63 workers. The resultant short-term peak total new population (direct and indirect employment) increase in the county would be 72 people. This peak would endure for approximately 4 to 6 months, then decline, as construction is completed. Transition-period new population would temporarily increase county population by 1 percent.

Operations Phase

Operations of the Proposed Action are scheduled to begin in 1997. The operations life has been estimated by Alta to be approximately 10 years. Alta estimates that operation of the project would require a work force of 170 persons and that 70 percent of the work force could be drawn from the regional population. Figure 4-5 indicates that the project would result in an influx of 51 non-local mine workers.

About 269 jobs would be created indirectly from the 170 mining positions using the 2.58 mining multiplier (U.S. Department of Commerce 1992). These positions, however, would be created statewide. Rural areas around mine locales generally experience an increase of 0.74 workers for every new mine worker (Dobra 1988). Making the same assumption for Sierra County, indirect jobs resulting from the Proposed Action would number 126, of which 30 percent, or 38 persons, would be assumed to be from non-local origins.

The average population increase created by the Proposed Action operations phase, including families would be approximately 254 persons (Figure 4-5). This would increase Sierra County population by 2.4 percent over the 1995 population estimate. New residents are expected to locate largely in Hillsboro, Truth or Consequences, or Williamsburg, New Mexico; however, it is likely that some may locate outside the county. The impact to Truth or Consequences would at most cause an increase in population of nearly 4 percent over the 1990 population count.

Post Operations Phase

Project mining operations are currently estimated to last approximately 10 years. Assuming the mine life is not extended, operations personnel would gradually be released from their employment duties. At that time, if no new activity is occurring in the mining industry or a related field, a portion of persons directly or indirectly employed by the Proposed Action could be expected to leave the area. This would cause downward pressure on the area population. Phased closure of the mine could enhance the absorption capacity of the local area by giving workers time to seek other work or funding from social aid programs. This would minimize sudden significant changes in population. The ultimate impact of mine closure would depend on the economic conditions prevailing in the area. Although unemployment levels would increase initially, a robust economy would, in theory, provide opportunities for unemployed workers.

4.1.9.2 Economy and Employment

The principal economic effect of the Proposed Action would be an increase in mining employment in Sierra County, with secondary growth in the services and retail sectors. It is anticipated that most of the secondary impact would occur in Hillsboro, Truth or Consequences, and several other communities near Truth or Consequences due to their proximity to the project. Job creation in Sierra County would stimulate the economy to some extent, leading to greater incomes, greater expenditures, and a decrease in unemployment.

It is likely that several new businesses and services would start in Hillsboro to provide services not currently available. Other businesses would likely expand their operations to meet the additional demand for goods and services by the new population. It is not possible to qualify this impact.

Alta is an equal opportunity employer with women and minority workers employed at other projects. It is unlikely that the Proposed Action would affect minority or female employment in the county other than increasing employment opportunities for these groups.

Unemployment in Sierra County was 5.9 percent in 1993, representing approximately 196 unemployed workers. Employment impacts of the Proposed Action are summarized in Figures 4-4 and 4-5. It is likely that the Proposed Action would result in the employment of previously unemployed persons. To the extent that necessary skills are available locally, the Proposed Action would result in a decrease in unemployment.

Operation of the Proposed Action could benefit the economies of Sierra County and the State of New Mexico in various ways, including: the purchase of goods and services; investment in further explorations by the company; and hiring of employees for construction, as well as operation and maintenance phases of the project. As these expenditures are re-spent throughout New Mexico's economy, additional secondary and positive impacts would be added to the initial impacts, implying that the total economic impact of the proposed facility would be greater than the initial expenditure.

Construction Phase

The 130 construction positions required during this phase would increase construction sector employment in Sierra County by 49 percent over the 1993 sector employment figure (see Section 3.9.2, Economy and Employment). In addition, indirect employment would increase retail and service sector employment in the County by 2.8 percent over the 1993 sector employment levels. A total of 101 direct and indirect jobs would be assumed to be filled by local workers. A portion of these workers would transfer from other jobs and a portion would have been previously unemployed. The County unemployment rate would likely be affected although this is difficult to quantify without extensive information on skill needs and skill availability. At best the project could decrease the unemployment rate by 2 points to 3.2 percent. Impacts of this kind are temporary and expected to last approximately 18 to 24 months after which construction jobs would be terminated.

Alta has estimated that its monthly payroll during the construction phase would be $300,000, totaling $5,400,000 for the 18-month period. A portion of these expenditures would be re-spent both locally and outside the area. The income multiplier describes how much more spending is generated by each dollar of income initially paid out by the mine. Applying an income multiplier of 1.96 (U.S. Department of Commerce 1992), the total income effect of the expected $5,400,000 payroll would be increased to a total of $10,584,000 in income. Of this, $5,400,000 shows the direct project impact and $5,184,000 represents the indirect impact of re-spending associated with the initial payroll.

The effect of direct and indirect payroll expenditures on Sierra County and the remainder of New Mexico's economy is dependent on spending and saving patterns of mine workers and their families. It is not possible to precisely quantify the local impact of increased payroll expenditures, except to say that local purchases would increase. If it is assumed that disposable income amounts to 70 percent of gross income (30 percent income tax rate), 130 construction workers would have $3,780,000 to spend on housing, food, clothing, entertainment, other miscellaneous items, and savings over the 18- to 24-month construction phase.

Transition Period

As stated previously, there would be some overlap of construction and operations activities at the minesite. In terms of the effect on the local economy and employment, this period would not be noticeably different from the operations and construction phases. The unemployment rate should have decreased in the construction phase and would continue to be dampened by activities during the transition period. The mine would pay workers who would in turn spend their income. The impact of the transition period is a continuation of enhanced expenditures and economic activity, although the magnitude of this effect would decrease as the construction phase is completed and only operations personnel remain.

Operations Phase

The 170-person operations work force would increase mining sector employment in Sierra County by over 700 percent from 28 to 198 persons (see Section 3.9.2, Economy and Employment). Indirect positions created locally would increase employment in the retail and services industry by approximately 13.5 percent over 1993 employment levels in these sectors. It is assumed that a total of 207 direct and indirect jobs would be filled by local workers. A portion of these jobs would go to workers who were previously employed by the construction phase of the Proposed Action; a portion of the jobs would also go to workers transferring from other jobs, and a portion could go to persons previously unemployed. The region's unemployment rate could be reduced, however quantification is not possible due to the uncertainty of future economic conditions and current skill level of the available labor force. Employment growth created by the Proposed Action would stimulate the economy by improving employment opportunities, and by increasing total county income and expenditures.

Alta has estimated its monthly payroll during the operation phase to be $483,333 totaling $5,800,000 annually. Applying an income multiplier of 1.96 (U.S. Department of Commerce 1992), the total income effect of the $5,800,000 in payroll would be increased to a total of $11,368,000. Of this, the $5,800,000 shows the direct impact and $5,568,000 the impact of re-spending associated with the initial payroll expenditure.

The allocation of the total income effects to Sierra County and to the remainder of New Mexico's economy is dependent on spending and saving patterns of mine workers and their families. It is not possible to precisely quantify the local impact of increased payroll expenditures, except to say that local purchases would increase. If it is assumed that disposable income amounts to 70 percent of gross income (30 percent income tax rate), 170 workers would have $4,060,000 annually to spend on housing, food, clothing, entertainment, miscellaneous items, and savings. A significant amount of these expenditure should be captured by local businesses.

Post Operations Phase

Mine closure may result from the planned exhaustion of extractable resources or may be caused by outside conditions such as world copper prices. In the case of resource exhaustion (anticipated to occur after 10 years of operation), the mine closure would be fully anticipated. Typical closure procedure involves a phase-down of production activity and, hence, employment. During the mine closure phase and assuming that no additional mines open or expand in the area, mining sector employment as well as employment in the services and retail sectors would decline. This would have a negative impact by increasing unemployment and decreasing total income in the region unless alternative employment opportunities are available. The ultimate impact would be dependent on prevailing economic conditions at the time of mine closure.

Mine closure due to exogenous economic conditions, such as changes in the world price for copper, is an inherent risk in resource-based operations. Such closures tend to be unexpected (due to the uncertainty of economic conditions) and occur fairly rapidly. Changing economic conditions could cause a sudden and complete mine closure. This scenario did occur with the 1982 closure of the Copper Flat Mine. A sudden closure would have negative effects on the community in terms of a rapid increase in the unemployed labor force and an associated decline in regional income and economic activity. However, since 1982, both the Federal government through its Plant Closure legislation and the State government through services provided by the Department of Labor are now able to assist any community severely impacted by mine closures. Services that would be provided include economic assessment, retraining, job search programs, and other social support services (Chance 1995). This assistance coupled with the more diversified regional economy should ensure that negative impacts from sudden mine closures are temporary.

4.1.9.3 Housing

Construction Phase

The construction population projections for the Proposed Action, over the 12-month to 18-month construction period, indicate an incoming population of 47 persons. These in-migrants could create an average demand for about 47 housing units, (37 single households and 10 married households) depending on the number of local workers available to fill construction jobs (Table 4-6). Time spent on the job site by individual construction workers would range from a few weeks to the full period. Temporary construction workers typically would not purchase homes. Consequently, it is estimated that the housing need during construction would be for rentals and transient-type housing, such as RV spaces, motel rooms, or perhaps mobile home spaces or mobile home rentals. This scenario, however, does place pressure on the local hotel/motel industry to handle much of the transient housing. Construction during summer months may displace tourists from hotel/motel units; however, continual occupancy would increase hotel/motel revenues. However, given that there are over 1,124 apartments, hotel/motel units, and RV spaces in the study area (SCEDO and GEC 1993), the increased demand for temporary housing would result in a demand for 4.2 percent of the available rental units.

Housing costs should not be a problem. Construction worker wages in New Mexico average about $1,582 per month (New Mexico Department of Labor 1994). Assuming that 25 percent of a worker's wages would be spent for housing, the average worker could afford a gross housing cost of $396 per month. This would be a reasonably competitive amount in the local rental and temporary housing markets (see Section 3.9.3, Housing).

Table 4-6

Housing Demand from In-Migrant Households

Household Type	CONSTRUCTION Direct Labor-Related Households	CONSTRUCTION Indirect Labor-Related Households	CONSTRUCTION Total Households	OPERATION Direct Labor-Related Households	OPERATION Indirect Labor-Related Households	OPERATION Total Households
Single-Status Workers	31	6	37	13	10	23
Married-Status Workers	8	2	10	38	28	66
Total	39	8	47	51	38	89

Transition Period

As stated previously, concurrent construction and operations activities would occur during the construction phase. During this period, construction worker numbers would begin to decline and demand for temporary housing would decrease. As operations begin, in-migrant workers would enter the area creating demand for apartment and house rentals as well as for housing sales. The transition period may see some originally non-local workers leaving the area. This vacancy would, in part, be offset by incoming operations workers. Given the availability of rental units and units for sale, the transition period should not overly strain the market.

Operations Phase

The Proposed Action could generate demand for an estimated 89 direct labor housing units during its 10-year active mining life (23 single households and 66 married households) (Table 4-6). Similar to the construction period, the actual demand would depend on how many workers are available locally, how many would move into the area for work, and how many single workers would choose to share housing.

After the construction period, some construction workers would likely leave the area. As mine operations personnel are hired, there would be a transference of housing from construction workers to operations workers. Permanent housing units, purchased or rented by construction personnel during the construction phase, would either again become available as construction personnel leave the area and sell their homes, or the units would become part of the operations phase housing inventory, if the construction worker made the transition to the operations work force.

Unlike construction workers, most mine and plant operators are expected to prefer permanent housing over transient housing. Most of the direct labor would be expected to prefer single-family homes, multi-family dwellings, or mobile homes with permanent connections. Most of the remainder would seek available rentals. Few, if any, are expected to opt for RV or motel-type accommodations except, perhaps, on a temporary basis.

Housing stock is limited in the Hillsboro area as well as other smaller unincorporated communities near the mine site. Demand for 89 housing units would not likely generate much new construction in these areas. A more likely scenario is that housing for project-generated demand would be dispersed and largely supplied by the municipality of Truth or Consequences.

Given the availability of housing units in the area in general and in Truth or Consequences, demand for 89 households could be sufficiently met by the local housing market with some strain in the local rental market given the tight rental market for 2-bedroom and larger apartments. It is likely that some demand for units would be supplied by markets outside of Sierra County.

Housing costs for operations workers should not cause a problem given current housing costs. Average mine worker wages in New Mexico are approximately $2,762 per month (New Mexico Department of Labor 1994). Assuming 25 percent would be devoted to housing, the average worker could afford $691 per month in gross housing costs. This would be competitive in the regional housing market. However, given that demand for housing would increase, it would be likely that housing and rental prices would increase to capture higher profit potential. The extent to which this occurs depends on the intensity of existing demand and the availability of housing supply. Such an increase should not be a detriment to the mine workers (where wages are above average), but may adversely affect persons in other employment sectors or those not in the labor force (e.g., retired persons). It is anticipated that rental rates would increase due to the high demand currently exhibited in the local area, but that the sales market would not be significantly affected.

Post Operations

With a phased closure of the mine, and assuming that no additional mines would open, the region may see an increase in the vacancy rates of all types of housing. This decrease in quantity of housing demanded could drive prices down incurring losses to persons who purchased homes when prices were higher and decreasing income to landlords. Decreases in housing prices would drive down income thereby adversely impacting the economy.

4.1.9.4 Community Facilities and Services

Water Supply

The mine operator would provide potable water to the site via private wells. Water production, storage, and treatment capacities in Sierra County as a whole are in excess of current demand plus projected new demand generated by the Proposed Action's personnel and families (Hoskinson 1995). There are areas, however, with limited excess capacity. Hillsboro, as described in Chapter 3.0, can only accommodate 20 to 30 new water meters. This limited capacity and the unlikely event of new housing construction generated by the Proposed Action would limit use of Hillsboro water systems.

Wastewater Treatment

The current municipal wastewater treatment system in Truth or Consequences has sufficient capacities to accommodate project-related population increases (Hoskinson 1995). All other areas in the County are served by private septic systems.

Solid Waste Disposal

Alta is currently planning to handle the mine-generated solid waste stream in a state-approved, on-site solid waste landfill for the life of the mine or in a local off-site county landfill. Wastes generated by the work force living in Truth or Consequences would be directed toward the City-operated landfill. The present county sanitary landfill has the capacity to accommodate anticipated project-related growth for the next 10 years (Millard 1994).

Schools

Estimated student enrollment generated upon implementation of the Proposed Action was calculated by estimating married households and by assuming 1.5 children per married household. Of these children, assumptions were made as to approximate age distribution and, therefore, which schools may be impacted by the additional students. These assumptions are identified in Figure 4-6, School Enrollment Projections.

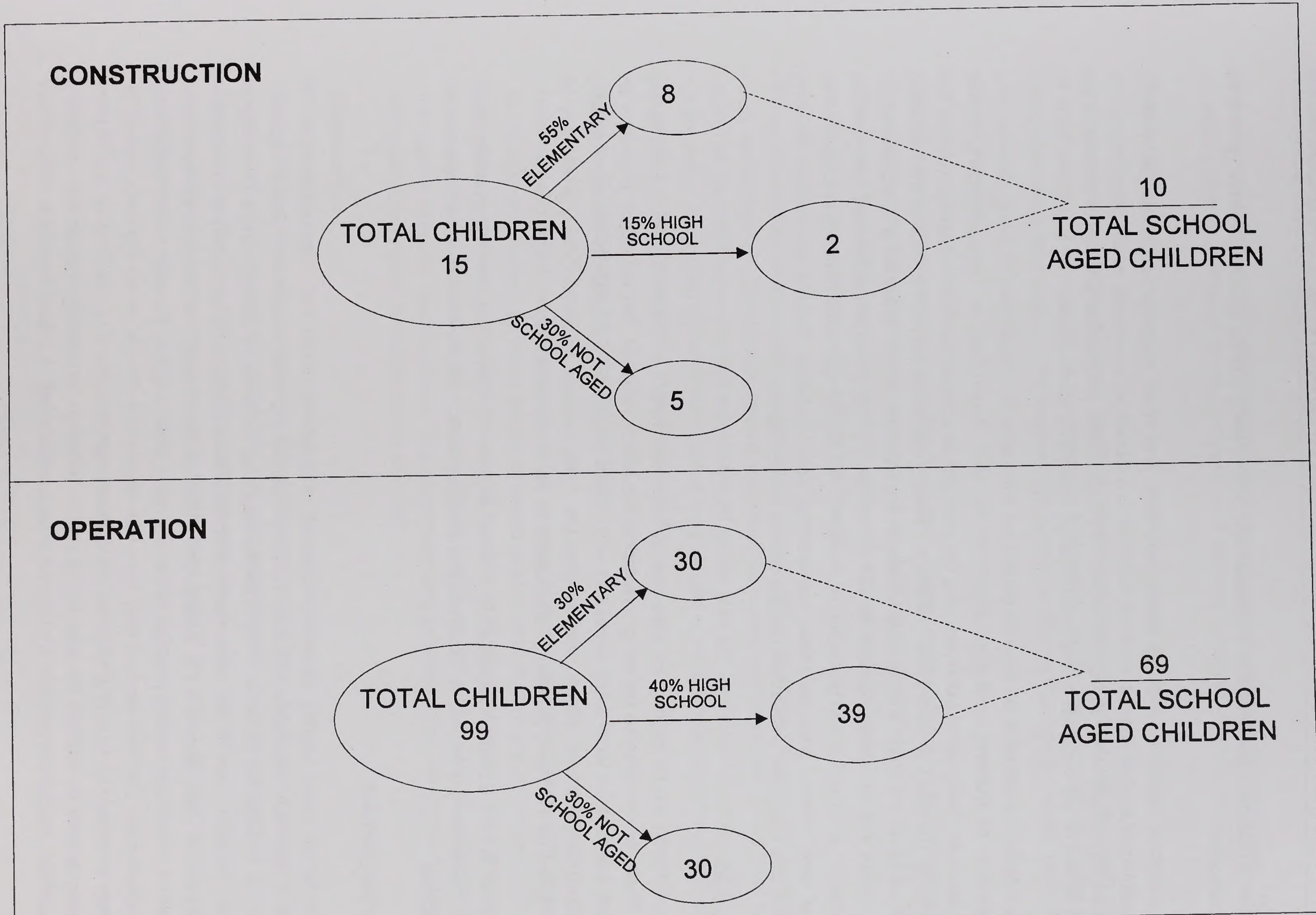
About eight married households would be expected to immigrate to the area as a result of direct construction employment at the Copper Flat Mine; two married household would immigrate as a result of secondary employment. Based on these figures, it is estimated that there would be a total of 15 children entering the area. Of these, it is estimated that 10 children would be of school age. Given the temporary nature of this phase and given current capacity and planned expansion, 10 students could be absorbed by the Truth or Consequences Municipal School District with minimal disruption.

About 38 married households are expected to immigrate to the area as a result of direct project operations employment and 28 married households would immigrate as a result of indirect employment. Based on these numbers, it is estimated that 99 children would enter the region. Of these, 69 children are expected to be of school age (see Figure 4-6). It is further estimated that 39 of the children would be of middle school and high school age and 30 would be of elementary age. This would increase peak enrollment by 4 percent over the 1993-94 enrollment levels and increase expenditures by approximately $238,878 (given a per child expenditure of $3,462). Given existing capacity and planned expansion in the Truth or Consequences School District, these new students could be accommodated by the system, however they could contribute to the current strain on school capacities (see Section 3.9.4.3, Schools). The increase in population and employment and operations at the mine site would result in an increasing tax base and increased operation revenue for the school district to offset the increased expenditures. State transfers also offset increasing expenditures.

The impact of mine closure on schools would depend on the prevailing economic conditions in the County at that time. Mine closure would decrease the County tax base potentially decreasing school district operating revenue. The impact on the school district would depend on the prevailing economic conditions in the region at the time of mine closure.

Fire Protection

The Proposed Action would generate only minor increases in the need for fire protection services in developed areas of Sierra County. Fire danger would increase somewhat in the vicinity of the proposed project area because of increased activity; however, the manpower, equipment, and water source on-site would notably increase the opportunity to suppress wildland fires in the area before they became large and difficult to control. Thus, the increased risk would be offset by the fire suppression abilities of the mine personnel. Alta would prepare a Fire Suppression Plan to supplement the Plan of Operation. A fire truck would be located at the site for use in fighting fires on the property. Alta would train an in-house fire brigade in the proper use of this equipment. In addition, the County Fire Protection Officer is expected to provide



SCHOOL ENROLLMENT PROJECTIONS
(DERIVED FROM 3.5 PERSONS PER MARRIED HOUSEHOLD)
COPPER FLAT

FIGURE 4-6

advice on how to maximize the benefit of equipment and also provide training assistance in fire fighting for the project personnel.

Potentially hazardous materials, such as diesel, kerosene, and other petroleum products; solvents for degreasing machinery and equipment; process reagents; and laboratory chemicals, would pass through the area. Alta would ensure that the Hillsboro Volunteer Fire Department and the Sierra County Fire District are aware of the nature of the materials transported through town on a routine basis.

The Proposed Action would have no adverse impact on spill response capabilities in Sierra County. Alta would specify that its trucking contractor adhere to the U.S. Department of Transportation's current regulations, which are designed to aid in reducing the potential for accidents and in mitigating releases that may occur during transport of hazardous materials. These rules require that the truck drivers bringing hazardous materials to the study area receive training in the following areas: methods and procedures for avoiding accidents; pre-trip safety inspections; use of vehicle, including dangers associated with weather or road conditions; and loading and unloading of materials. Additional specialized training is also required for drivers of tank trucks, such as those transporting acid, including training on vehicle handling characteristics, and retest and inspection requirements for cargo tanks.

Law Enforcement

The Proposed Action would slightly increase law enforcement needs in Sierra County by increasing population. There are no precise means of predicting this effect; however, the net effect should be an increase in law enforcement work loads compared with current levels. On a population basis, the existing ratio of approximately 2 patrol officers and deputies per 1,000 persons in Sierra County would not be noticeably reduced by incoming population attributable to the Proposed Action.

The local judicial system would be impacted to a minor degree. The projected rise in population would increase work loads from current levels; however, this increase would not interfere with the efficiency of the courts' operations.

Wildlife Law Enforcement

The Proposed Action would slightly increase wildlife law enforcement needs and responsibilities for the NMDGF. With a maximum population increase of 254 new people (operations estimate), greater impact to wildlife resources is expected to occur. The potential exists for increased poaching, due to the influx of transient construction workers, limited personnel to enforce wildlife laws, and the generally easy access to big game populations (see Section 4.1.5, Wildlife and Fisheries Resources). Although construction and operation workers are not necessarily predisposed to poaching, poaching may increase over present levels because: 1) construction transient workers may have little attachment or concern for the resources in the County; 2) there is limited numbers of wildlife law enforcement agents stationed in the County; and 3) there is generally easy access throughout the year to big game. Although anticipated impacts from poaching cannot be quantified, the current problem is expected to be compounded. A greater interest in consumptive and non-consumptive use of wildlife and fisheries resources would be expected in the area. This would lead to greater responsibilities for game, nongame, and fisheries law enforcement programs.

Health Care

Project-related population increases would increase demands on the Sierra County health care system to a small degree. The capacity of the system is sufficient to handle the increase. A higher usage rate of hospital facilities may help provide incentive for doctors to stay in the area for longer periods.

Social Services

The Proposed Action would have small and offsetting effects on the local social services system. Increased population would increase demand slightly for such services as counseling and day care. However, new jobs created by the Proposed Action would reduce unemployment and increase financial opportunity, which could reduce the need for public welfare assistance.

Those construction workers who are hired from outside the area would be expected to leave the area as their work is finished. This should prevent any impact from construction operations on local social services. Some of the construction workers who are hired locally may get permanent employment in the operation of the mine. Remaining construction workers may require some financial assistance until new jobs could be located. This impact would likely be negligible.

4.1.9.5 Government and Public Finance

The Proposed Action would contribute a net revenue increase to Sierra County throughout its projected 10- to 13-year life span. Revenue increases would result primarily from greater property tax, minerals tax, and sales tax revenues. Property taxes would be paid on all improvements to the mine site. In addition, taxes would be assessed on all minerals severed from the land at a rate of approximately $3.50 per 100 pounds of market quality copper. The mine would also generate sales and use tax revenue for the State and local governments, including Sierra County.

Construction

During the first few years of operation, the principal revenue change for Sierra County would result from an increase in sales and use tax revenues. Alta has estimated monthly expenditures of $75,000 during the 18-month construction phase. Using an average sales tax rate of 6 percent, sales tax revenue for the region would total $4,500 per month for a construction phase total of $81,000 to be shared by State, county, and municipalities.

Operations

The primary long-term revenue change would come from the minerals tax and the property tax generated by increased assessed valuation attributable to the mine improvements, processing facilities, and other support facilities.

Preliminary studies indicate that Alta would pay an average annual minerals tax in the neighborhood of $840,000 for 10 years of operation. This would amount to a tax obligation of $8.4 million. Receipt of the property tax on mine structures would lag 1 year behind installation of improvements because of conventional assessment and collection practices.

In addition to project construction activities, other commercial and residential activity would be occurring in surrounding areas. These developments would contribute to the tax base and add property tax and sales tax revenues to Sierra County's treasuries.

The Proposed Action would generate an approximate annual payroll of $5,800,000 during the operational period of the mine. As stated previously, a total of $4,060,000 in new annual local spending for goods and services would occur from the project payroll. Applying an income multiplier of 1.96 (U.S. Department of Commerce 1992), the total income impact after respending would be $7,957,600. Sales and use tax would be generated for the county, city, and State by a portion of this spending and could be as high as $465,519 (sales tax rate of 5.85 percent).

Post Operations

The socioeconomic impacts from closure, reclamation, and abandonment of the Proposed Action would be the loss of the approximately 170 jobs associated with the mine operation.

When mine operations cease, tax revenues would no longer be accrued from this mine, including minerals tax revenues, property tax revenues for Sierra County, and the sales and use tax revenues related to the operation of the mine. The salaries from these jobs, and their multiplier effect in the local communities, would also be lost. The workers would likely attempt to acquire work at other mines in the area, depending on the available jobs at that time. If jobs were unavailable, the unemployed workers would either remain in the area, continuing their demands on community services, or would relocate to another area for employment. If workers left the area at a time when there was a net loss in population in the communities, there could be underutilized infrastructure (schools, housing, etc.) in the communities, resulting in an inefficient use of resources.

The Sierra County economy has experienced periods of economic hardship in the past. Efforts taken by Alta to phase out operations over several years would minimize impacts by allowing the affected population to adequately adjust and plan for their future.

4.1.10 Transportation

4.1.10.1 Mine Development/Operation

Traffic Service Level

Additional vehicular traffic along Highway 152 during the 12- to 18-month project construction period is expected to result from the estimated construction work force of 130 persons each day. Assuming that construction workers are not housed on site, and that they do not share rides, the workforce alone would add approximately 130 private vehicles to the daily traffic volume of Highway 152. Construction-related equipment, supplies, raw materials deliveries, and visitors could add an estimated 15 to 20 vehicle trips per day to the total. This would result in the addition of an approximate total of 150 daily trips to the existing traffic volume of State Highway 152, 7 days per week, during the construction period. This represents an increase in the average daily traffic volume of this portion of Highway 152 of approximately 28 percent. This additional traffic could lead to congested periods on Highway 152 during the morning and evening commute and could slow travel speeds when loaded transport trucks are involved.

During mine operations, Alta projects an estimated 170 employees would commute to work at the Copper Flat Mine during weekdays. On weekends, a total of approximately 90 employees would commute to the mine. There is no plan, at present, for a company-operated employee transportation system although Alta will encourage employee carpooling and alternative transportation.

Section 2.2.8, Project Workforce and Schedule, describes the hours of employees shifts estimated per mine operation. This section indicates that the shift change with the largest number of employees arriving/departing the mine at approximately the same time would occur at 4 p.m. on weekdays. At this time, the estimated number of mine, mill, crusher, office and maintenance operations employees requiring ingress/egress to the Copper Flat Mine is estimated at approximately 110. Assuming that workers do not share rides, this translates into approximately 110 private vehicles using Highway 152 during the 4 p.m. shift change. Section 2.2.8, Project Workforce and Schedule, indicates two other periods when shift changes for mine operations coincide: 12 a.m. and 8 a.m. Using the same assumption for the commuting habits of employees, during shift change periods approximately 85 and 90 private vehicle trips, would be added to traffic volumes on Highway 152 at 12 a.m. and 8 a.m., respectively. The remainder of shift change periods (i.e., 6 a.m. and 5 p.m.) would not add more than a total of 30 private vehicles trips to highway traffic. Existing traffic levels on Highway 152 are low enough that entering traffic would be essentially unrestricted during these times and levels of service should not be affected.

Average daily truck traffic to and from the mine is estimated at 18 to 23 vehicles. This would include eight trucks transporting concentrate from the mine to the smelter and 10 to 15 vendor and equipment service supplier delivery trucks (a description of the transportation routes for hauling ore concentrate to the smelters is contained in Chapter 2). An additional 15 to 20 trips per day have been estimated for visitors and sales representatives, resulting in a total of approximately 210 employee, vendor, and haul vehicle round trips to the Copper Flat Mine on any one day. This would represent an increase of approximately 58 percent in the average daily traffic volume of this portion of Highway 152. The interstate and State highway systems have been designed to accommodate this type of traffic. No significant impact to highway transportation systems would be anticipated as a result of the Proposed Action, although the State Highways and Transportation Department would make a final assessment of Project-related traffic impacts upon their review of Alta's Traffic Impact Study. The State Highways and Transportation Department would determine whether the construction of acceleration/deceleration lanes would be required on Highway 152 as a result of project-related increases in traffic and safety issues.

Assuming a 10-year period of mine operation and truck hauling, approximately 9 additional highway accidents along haul routes related to mine tractor-trailer traffic activities would occur during the life of the project. This estimate is based on a statistical average accident rate for tractor-trailers in New Mexico (NMSHTD 1995; Defoya 1995). Deaths resulting from tractor-trailer crashers occur at a rate or approximately 1 per every 200 accidents. Based on this rate, the 9 project-related accidents would be expected to result in <0.2 fatalities.

Transport of Process Materials, Products, and Hazardous Wastes

The possibility of an accident resulting in the release of a process material, product, or hazardous material is small for trucks hauling concentrate between the mine site and the smelters. Trucks would be used to transport a variety of nonhazardous materials as well as hazardous materials and wastes. Approximately 10 to 20 trucks per day would supply the mine with fuel and other materials and supplies. The mine is expected to generate only small quantities of hazardous wastes. These would be stored on-site until a sufficient quantity has been accumulated to warrant pickup by a licensed hauler. It is assumed that one pickup per month would be required. Diesel fuel was assumed to be delivered on-site 4 times a week from El Paso, Texas, a distance of 125 miles.

The probability of a truck accident resulting in the release of hazardous material (such as diesel fuel) has been calculated from a national statistic that shows a rate for such events of 0.28 releases per million vehicle miles traveled (Abkowitz et al. 1984). The potential for releases of diesel fuel from tanker truck deliveries over the 10-year life of the project are calculated in the following:

Diesel Fuel: 208 diesel truck deliveries per year over 10 years (2,080) x 125 miles =
260,000-mile haul distance over 10 years x
0.00000028 accidents per mile =
≈.073 releases in 10 years

The probability of a release occurring from other vendor trucks, including reagent suppliers, assuming 10 deliveries per day from El Paso 5 days per week, would also be <.1 releases in 10 years.

A release into a wetland or riparian area would be even less likely since few wetland or riparian areas would be crossed. Assuming pickup of hazardous waste once per month, an even smaller chance for release of hazardous waste along the haul route would be anticipated during the life of the project.

While the release of a hazardous material or waste into a sensitive area (such as stream, wetland, or populated area) is judged to be very unlikely, the probability is not zero. Depending on the material released, the amount released, and the location of the release, an accident resulting in a release could cause significant impacts to soil, water, biological, and human resources.

Process materials, products, and hazardous wastes would be transported by independent companies contracted by Alta. All hazardous materials would be transported in compliance with 49 CFR and U.S. Department of Transportation Federal Motor Carrier Safety Regulations. In the event of a release, the transportation company would be responsible for response and cleanup. Local and regional law enforcement and fire protection agencies may also be involved to initially secure the site and protect public safety. As discussed in Section 2.2.11, Transportation, Alta would specify that the contract haulers maintain certain safety standards.

4.1.10.2 Mine Closure/Reclamation

Mine closure and reclamation activities at the Copper Flat Mine would be estimated to employ a maximum of approximately 35 persons during the 3- to 4-year reclamation period. Level of service on Highway 152 would not be adversely affected by this number of private vehicles accessing the highway at any one time. Truck traffic accessing the mine is expected to be minimal and would be generally limited to the hauling of fuel for heavy equipment.

4.1.11 Land Use

The Proposed Action could affect land use both directly and indirectly. Direct effects may include the termination or modification of existing land uses and/or rights-of-way in the study area. Indirect impacts may result in altered land use patterns or access to use areas adjacent to or within proximity to the Proposed Action. Indirect effects would also result if the Proposed Action stimulated or encouraged the development of land uses not presently anticipated, or conversely, precluded other planned or proposed uses.

The following criteria were considered in determining impacts of the Proposed Action on land use: 1) termination of an existing land use or creation of land use incompatibility; 2) proximity to "sensitive" areas; 3) termination or modification of existing public access opportunities; and 4) potential conflicts with existing land use plans (e.g., BLM RMP, Sierra County ordinances). Direct impacts would primarily affect public access patterns, grazing allotments, wildlife habitat, recreational opportunities, and land ownership. Impacts to wildlife habitat and recreation resources are discussed in Section 4.1.5 (Wildlife and Fisheries Resources) and Section 4.1.12 (Recreation), respectively.

4.1.11.1 Mine Development/Operation

Land Use

The Proposed Action would result in expansion into areas already affected by previous mining activities. As currently planned, the total disturbance to lands from the Proposed Action would be approximately 537 acres on public land and 566 acres on private land, resulting in a total project disturbance of approximately 1,103 acres (see Table 2-1). This would represent an increase in the amount of disturbed land (both public and private) at the Copper Flat Mine of approximately 414 acres. In addition to private lands controlled by Alta, the expansion of existing waste rock disposal areas and the tailings impoundment facility would require use of public lands administered by the BLM. Mining activities on private lands would not require any special use permit from Sierra County. It is not known at this time whether Alta intends to submit an application for a mining patent of public lands affected by the Proposed Action. If a mining patent were issued to Alta, ownership of these parcels would be transferred to Alta with accompanying surface and/or subsurface development rights. Congress has ordered a temporary freeze on the approval of all public land patents while it considers legislation that may permanently halt the issuance of Federal land patents.

The proposed development generally would preclude any public use of the affected lands for the life of the mine. For both safety and security reasons, public access to the active mining and processing areas would be precluded to the maximum extent permitted by law during the life of the Proposed Action.

Land uses in the vicinity of the Proposed Action would not likely change or be affected during the life of this project. Access to existing uses, such as the neighboring Placer mine, grazing, and recreational use, would continue without major interruption. The Proposed Action could contribute to the demand for additional residential and commercial development in Hillsboro (see Section 4.1.9.3, Housing).

Livestock grazing would continue to be excluded from the mine area during the life of mining at Copper Flat by fencing and cattleguards. No existing range improvements would be lost as a result of the Proposed Action. Access to portions of the grazing allotment both west and north of the mine would be maintained by allowing the permittee to pass through the mine area when necessary.

Lands managed by the State of New Mexico, in the vicinity of the Proposed Action, are not anticipated to be adversely affected. However, it is possible that use of the production well field could result in a drawdown of 10 to 12 feet for wells on State Trust Land sections adjacent to the well field (see Section 4.1.2.1.2, Potential Impacts to the Palomas Basin and the Rio Grande) during the life of the Proposed Action.

Rights-of-Way

As described in Section 3.11.2, Rights-of-Way, all rights-of-way (ROW) necessary to support operations at the Copper Flat Mine are in place and current with the exception for the water pipeline ROW and an amendment for the rebuilding of short segments of transmission line to the substation near I-25. The water pipeline from the production wells is currently owned by BLM and would be leased to Alta. At present, a ROW for telephone communications to the Copper Flat Mine has not been granted. It is possible that the Proposed Action would be served by radio phone. On public lands, use of radio phones may require establishment of ROWs for the placement of solar-powered utility poles (Kelley 1995).

Relevant Plans and Policies

The Proposed Action is consistent with established plans and ordinances of Sierra County. Redevelopment of the Copper Flat Mine has been supported by a resolution adopted by the Sierra County Commission. The Proposed Action also is consistent with plans and policies of the BLM which recognize that the Copper Flat Mine could become a producing mine again in the future.

4.1.11.2 Mine Closure/Reclamation

The closure, abandonment, and reclamation of the Proposed Action would return public lands to their premining land use as rangeland, wildlife habitat, and dispersed recreation. Some private lands would remain available for industrial use. Except for the mine pit, all other areas would be revegetated and public access would be established.

The required reclamation of the proposed project area would include the reseeding of all disturbed acreage except for the pit. Reseeding would increase vegetative cover and make the area suitable for livestock grazing. Livestock grazing may be resumed after re-established vegetation is capable of supporting grazing as determined by the State.

4.1.12 Recreation

4.1.12.1 Mine Development/Operation

No parks, concentrated recreational use areas, BLM Wilderness Study Areas (WSAs), designated wilderness areas, or protected natural areas would be directly impacted by the proposed project. Development of the proposed project would reduce opportunities for dispersed recreationists during the operation and reclamation activities. Recreational activities, such as hunting and hobby rock collecting, would be prohibited within the mine site during the life of the Proposed Action. Use of the mine site would continue to be restricted to off-highway vehicles. Overall, the displacement of dispersed recreationists would be a minimal adverse impact since existing recreational use in the project area is relatively light, and the Caballo Resource Area has abundant public, open-space lands available for dispersed recreational opportunities. Public access would not be restricted on public roads near the mine site. Although no specific recreational use data for public lands directly affected by the proposed project are available, the number of dispersed recreationists affected is expected to be minimal, and their displacement would not create overuse of other areas or degradation of the resource. Adverse impacts to big and small game populations are not anticipated as a result of the Proposed Action (see Section 4.1.5, Wildlife and Fisheries Resources). Consequently, impacts to hunting opportunities are not expected.

The Proposed Action would be consistent with the management objectives for the Lake Valley Back Country Byway, which recognize the opportunities available at the Copper Flat Mine for interpretative education about the area's ongoing and historical mining operations. Some byway travelers could therefore consider the presence of an active mine an enhancement of their recreational touring experience. However, the presence of the active mine and associated traffic could also serve to detract from a quality touring experience for some travelers.

Developed recreational facilities within the region are not expected to be adversely impacted by an influx in Proposed Action-related construction and operations work forces. The Forest Service's Iron Creek campground, located nearby in the Gila National Forest, could experience increased demand as a result of transient workers during the construction period. Other developed facilities such as Elephant Butte Lake State Park, Caballo Lake State Park, Percha Dam State Park, and those located in Truth or Consequences would be able to absorb any extra demand placed on them as a result of the anticipated new residents to the area. The influx of new mine-related residents to the Hillsboro and Kingston area could, however, increase demand for developed recreational facilities in these communities. At present, the only developed recreational facility in Hillsboro is a single tennis court. Given that many of these new workers would have families, a demand for local parks, playgrounds or other facilities could develop.

4.1.12.2 Mine Closure/Reclamation

The closure, abandonment, and reclamation of the Proposed Action, including the waste rock disposal area, tailings impoundment facility, and ancillary facilities, would return public lands to their premining land use as rangeland, wildlife habitat, and dispersed recreation. Except for the mine pit, all other facilities would be revegetated and made available for public access.

4.1.13 Visual Resources

Visual impacts have been assessed in accordance with standard BLM visual resource management (VRM) contrast rating principles (BLM 1986b). The contrast rating process is used to systematically identify the nature and degree of visible modification to the landscape that would occur as a result of a Proposed Action. The degree of contrast is then compared to visual resource management guidelines for the area to determine the level of impact or compatibility.

The extent to which the Proposed Action would affect the visual quality depends upon the amount of visual contrast created between the proposed facilities and the existing landscape elements (form, line, color, and texture) and features (land and water surface, vegetation, and structures). The degree of contrast is rated on a standardized Visual Contrast Rating Worksheet for each element and feature (see Appendix C). Management actions that exceed visual management objectives may be required to reduce their overall contrast. Assessing the Proposed Action's contrast in this manner indicates the severity of potential impacts and guides the development of mitigation measures so the VRM objectives would be met.

4.1.13.1 Mine Development/Operation

The Proposed Action would be located within an extensively previously disturbed mine area. The Proposed Action would increase the physical extent of visual contrast with the natural environment; however, many elements of the Proposed Action would not be visible to the general public.

Since much of the Copper Flat Mine is located in a low-lying area between Animas and Black peaks, major mining elements that would be obstructed from public view include: the pit area; the plant area (including most of the buildings); the North and West Waste Rock Disposal areas; the south lean ore stockpile; and most of the tailings impoundment. Major mining elements that would be visible to the general public include the East Waste Rock Disposal area, primary crusher, and the tailings impoundment dam.

The East Waste Rock Disposal area presently reaches an elevation of approximately 5,560 feet above sea level (asl) and covers an area of 16 acres. By the end of the life of the Proposed Action, the East Waste Rock Disposal area would be 80 feet higher than present and would cover an area of approximately 130 acres. The primary crusher would be located on top of the East Waste Rock Disposal area. This structure would be sited near the haul road on the west end of the disposal area.

The existing tailings dam is 50 feet high and approximately 6,600 feet in length. It would be raised over the life of the Proposed Action though five additional 30-foot raises resulting in a total dam height of 200 feet. The front face of each raise would be vegetated after its construction.

Two existing decant towers located within the tailing impoundment (see Figure 2-3) would remain as part of the Proposed Action and would be visible in close range views along Highway 152. Two water tanks (freshwater storage and process water storage), located on the southern flank of Animas Peak, would also be visible from the highway.

The following discussion describes in more detail those components of the Proposed Action that would result in changes to the visual landscape as viewed from the two key observation points (KOPs) described in Visual Resources, Chapter 3.0, Section 3.13. Visual Contrast Rating Worksheets for each of these KOPs can be found in Appendix C.

The only project elements that would be readily visible during day-light hours in long-range views to the west from KOP 1, located 10.5 miles to the northeast near I-25, would be the expanded East Waste Rock Disposal area and the tailings impoundment dam. From this viewing distance, only a slight increase in scale of these man-made land forms would be evident. Modification to line, color, and texture elements of the characteristic landscape are not expected to be noticeable from this viewpoint. Night lighting at the mine could, however, be visible from this KOP.

Changes to the characteristic landscape as a result of the Proposed Action would be noticeable in views from KOP 2, which is located less than one mile to the east at the interpretive Kiosk. The increase in the height and size of the East Waste Rock Disposal area and the tailings impoundment dam would result in strong contrasts with existing land forms. The height of these features would exacerbate the presence of strong man-made horizontal lines. The primary crusher would be visible on top of the disposal area, as would the water storage tank further up Animas Peak. Modifications to the waste rock disposal area and the tailings impoundment dam would increase color and textural contrasts with the existing landscape. These contrasts, however, would be fairly weak, since the slopes of the East Waste Rock Disposal area and the tailings impoundment dam currently contain varying lightly colored hues as a result of the varied origin of the material in these slopes. Night lighting at the Copper Flat Mine would likely illuminate the lower slopes of Animas Peak and attract the attention of passing motorists.

Reactivation of Project-related utilities (powerlines, water supply wells, and pipeline) would not result in new visual contracts as these facilities are currently in place and would not require major alteration.

It is possible that, on occasion, dust plumes originating from the mine area would be visible from distances of several miles. Dust could be generated as a result of blasting in the pit area, vehicular traffic on haul roads, and by the dumping of waste rock. The creation of large dust plumes would be minimized by wetting blast areas and dirt roads as prescribed by MSHA and State Mining Inspectors Office regulations. This requirement is considered adequate to avoid significant impairment of the visual resource.

The Proposed Action would be consistent with the management objectives for which the Lake Valley Back Country Byway (State Highway 152) was designated (see Section 4.1.12.1, Mine Development/Operation).

Overall, the Proposed Action would exacerbate man-made forms, lines, textures, and colors that presently exist at the Copper Flat Mine. The proposed increase in height of the tailings dam would introduce a new landform with strong lines. The scale of existing landform modification would increase with the increase in size of the East Waste Rock Disposal area and the gradual completion of the tailings facility. The East Waste Rock Disposal area would be located adjacent to existing disturbances and would draw additional visual attention in close range views. The tailings impoundment facility would attract attention, but it is also an extension of an already disturbed viewshed. Thus, the Proposed Action would be consistent with the objectives of VRM Class III areas (as viewed from both KOPs) where visual modifications are permitted to attract attention, but not to dominate the view. Impacts would be partially mitigated as reclamation and revegetation progress during and after the period of active mining.

4.1.13.2 Mine Closure/Reclamation

After successful reclamation, the visual contrast of the Proposed Action would be reduced. Color and texture would blend more with the natural landscape. Revegetation of the faces of waste rock disposal areas and the tailings impoundment dam would reduce visual contrasts with surrounding vegetation. Natural vegetation over the long term would begin to blend with the color and texture of the existing natural landscape. Growth of the grasses and shrubs, and the recontouring of the tailings and waste rock facilities would create less visual contrast in the landscape. The scale of visual disturbance of existing modified pyramidal landforms contrasted with rounded natural landforms, however, would remain dominant.

4.1.14 Cultural Resources

Direct physical impacts to cultural resources could occur during ground-disturbing activities associated with expansion and construction of the mine pit, waste rock disposal areas, the tailings impoundment, and access road. Indirect impacts could result from increased erosion or improved access, and increased human activity in the area, which make sites more vulnerable to accidental or deliberate disturbance and illegal collecting. Physical alteration of a cultural property diminishes the integrity of the resource with respect to its cultural setting. Any adverse impact to a cultural resource that is eligible for inclusion on the NRHP or is protected under Federal or State statutes is considered a significant impact. The significance of a cultural resource is an assessment of its importance to the citizens of the United States and indicates that a site has attributes that qualify it for inclusion on the NRHP or protection under other Federal or State statutes (see Section 3.14, Cultural Resources, for a discussion on NRHP eligibility criteria and Federal and State cultural protection statutes).

An undertaking is regarded as having an effect on a cultural property if it alters any of the characteristics that may qualify the property for inclusion on the NRHP or otherwise affects a property's legally protected status. An adverse effect is one that diminishes the integrity of any of these characteristics. Adverse effects can only be incurred by sites that have been identified as significant cultural resources eligible for inclusion on the NRHP or sites that are protected under Federal and State statutes. An undertaking is always considered to have no adverse effect or no effect if all sites in the area have been shown to be not significant or the impacts to the qualities that make the sites significant are mitigated as defined in 36 CFR 800.9(c)1. Therefore, discussions of project impacts are limited to sites within the proposed mine area deemed to be significant or eligible for inclusion on the NRHP or sites that have Federal and/or State protection under other statutes.

4.1.14.1 Mine Development/Operation

Ground-disturbing activities could result in direct impacts to prehistoric, proto-historic, and historic cultural resources in the form of vertical and horizontal displacement of soils containing cultural materials and in the loss of integrity of the cultural deposits, loss of information, and alteration of site setting. Additionally, construction could result in direct impacts to cultural resources by altering site settings and isolating the resource from access and further study.

Increases in the number of people in the area and improved access could impact sites located outside of the direct impact area by making the sites more susceptible to vandalism and casual collecting. Subtle changes in topography due to mine construction and waste rock disposal could also result in indirect impacts to cultural resources due to alteration of the amount or patterns of erosion.

Avoidance of impacts is the primary mitigation for cultural resources. When disturbance of NRHP-eligible or other Federal and state-protected sites is unavoidable, impacts will be mitigated according to a site-specific treatment plan that will be formulated in consultation among Alta, the BLM, the State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation (ACHP). This plan could include avoidance/protection, recording/documentation, collection, partial or complete excavation, and treatment or maintenance.

If previously undocumented sites or subsurface components of documented sites are discovered within the Proposed Project area, construction would be halted until the resources are examined by professional archaeologists. If the resources are eligible for the NRHP or protected under State and Federal statues, impacts would be mitigated through an appropriate data recovery program agreed upon by Alta, the BLM, the SHPO, and the ACHP.

Reports detailing the results of the intensive archaeological evaluations conducted as part of this project are on file at the BLM office in Las Cruces, New Mexico. Only brief summaries and general location descriptions are provided in the EIS to protect the confidentiality of the sites.

At least 21 known sites eligible or potentially eligible for the NRHP (pending SHPO concurrence) have been identified within the proposed Project area. These include 7 sites that are eligible to the NRHP and 14 sites with NRHP potential (see Table 3-17). Five potential grave sites protected under Federal and State statues governing burials were also identified within the proposed Project area. Of the 21 NRHP-eligible and potentially eligible sites, 12 sites could be directly impacted by the proposed Project (MA 558-7, 9523-1, 9523-2, 9523-3, 9523-4, 9523-5, 9523-6, 9523-7, 9523-9, 9523-10, 9523-11, 9523-14) and 9 sites would be avoided. Of the five potential grave sites located in the proposed Project area, two would be directly impacted (9523-15, 9523-16) and 3 sites would be avoided (MA 558-4, MA 558-13, MA 558-14). The 12 sites and 2 graves that could be directly impacted by construction and operation would be mitigated under conditions agreed to by Alta, the BLM, the SHPO, and the ACHP.

The 12 directly impacted sites include 6 sites located in the tailings impoundment area, 1 site located in the West Waste Rock Disposal area, 1 site located near the pit, 2 sites located in the North Waste Rock Disposal area, and 2 sites potentially impacted by access road work. Two potential grave sites are located in the tailings impoundment.

The 9 sites with NRHP potential (9523-8, 9523-12, 9523-13, MA 558-2, MA 558-3, MA 558-6, MA 558-8, MA 558-9, MA 558-11) and 3 grave sites (MA 558-4, MA 558-13, MA 558-14) that would not be directly impacted by the proposed Project could still experience indirect impacts associated with construction and operation of the project. These may include increased potential for vandalism and illegal collecting, and potential effects from erosion, particularly in those sites, such as MA 558-6, MA 558-11, MA 558-14, 9523-12, and 9523-13, which are located directly adjacent to areas that will be disturbed during the project.

4.1.14.2 Mine Closure/Reclamation

Previously identified cultural sites would be mitigated prior to commencement of mine closure and reclamation. Ground-disturbing activities associated with mine waste rock disposal reclamation could result in direct impacts to previously unidentified prehistoric, proto-historic, and historic cultural resources in the form of vertical and horizontal displacement of soils containing cultural materials and in the loss of integrity of the cultural deposits, loss of information, and alteration of site setting.

Subtle changes in topography due to mine reclamation could result in indirect impacts to cultural resources due to alteration of the amount or patterns of erosion.

4.1.14.3 Ethnography

On July 12, 1994, notification letters requesting comments on the Proposed Project were sent to the Tribal Chairs of the Mescalero Apaches in Mescalero, New Mexico; the San Carlos Apaches in San Carlos, Arizona; the Jicarilla Apaches in Dulce, New Mexico, the Piro-Manso-Tiwa in Las Cruces, New Mexico; and the Tribal Governor of Isleta del Sur Pueblo in El Paso, Texas. As of the date of this PDEIS, no comments had been received.

4.1.15 Paleontology

Invertebrate and paleobotanical fossils occur in formations found the vicinity of the Proposed Action. None of the formations however, occur within the boundaries of the Proposed Action, and none of the fossils appear to be unique or site-specific to the area. Therefore, no impacts to significant or critical fossil resources requiring protection are anticipated. Because fossils are usually buried, their locations cannot be confirmed until excavation occurs. If significant fossiliferous deposits, specifically Tertiary vertebrate fossil deposits, are located during construction, operation, or reclamation, measures would need to be taken to identify and preserve the fossils. Potential direct impacts to paleontological resources from the Proposed Action would be limited to areas of disturbance; potential indirect impacts could result from increased accessibility to fossil beds from improved transportation routes. Waste rock disposal areas would not destroy any known fossil beds but would potentially restrict access and limit future study.

4.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, impacts from the Proposed Action to the following resources, as described in the previous section, would not occur:

- Geology and Minerals;
- Transportation;
- Land Use;
- Recreation;
- Visual Resources;
- Cultural Resources;
- Paleontological Resources; and
- Noise.

Potential improvements to environmental conditions associated with the Proposed Action would not occur. These issues are discussed below.

A comparison of the No Action Alternative to the Proposed Action is found in Table 2-4.

4.2.1 Water Quantity and Quality

Groundwater quantity and quality in the Mining District would not change from present conditions. No pumping and resultant drawdown would occur. The groundwater quality would not degrade with time under the No Action Alternative. Wells and springs that currently exhibit good water quality should continue to be sources of good water. Percha and Las Animas Creeks would not be affected in quantity of flow or water quality under the No Action Alternative.

None of the stormwater and surface water diversion and detention facilities associated with the Proposed Action would be constructed under the No Action Alternative. Heavy precipitation runoff would continue to carry waste rock, soil, and water affected by oxidizing sulfides to Greyback Wash.

No mining facilities would be constructed; no additions to the tailings impoundment would be built; no waste rock would be generated; and no other mining related surface disturbances would be generated.

4.2.2 Vegetation, Grazing, and Wildlife

Under the No Action Alternative, 414 acres of new disturbance to vegetation, range resources, wildlife habitat would not occur. In addition, 690 acres of previously disturbed land would not be newly reclaimed, as described for the Proposed Action. The 690 acres of disturbed land would continue to naturally revegetate over an extended period of time.

4.2.3 Social and Economic Values

Under the No Action Alternative, the impacts described in Section 4.1.9, Social and Economic Values, would not occur. There would be no increase in population due to in-migrating construction workers or operations workers. Furthermore, employment opportunities would not be enhanced by mine construction or operation. The No Action Alternative would not lead to the increased usage of community facilities such as schools, water and wastewater systems, or protection and medical services. Likewise, no tax revenue attributable to property taxes, minerals taxes, or sales tax generated by the Proposed Action would occur.

4.2.4 Soils and Air Quality

Disturbance to 414 acres of native soils would not occur under the No Action Alternative. Native soils would not be salvaged for reclamation and reclamation materials would not be applied to the 690 acres of previously disturbed land that would be newly reclaimed under the Proposed Action (pit and diversion structures would not be reclaimed under any alternative). Erosion would continue at levels comparable to existing conditions at the mine site.

Air quality impacts from dust emissions would continue at levels comparable to current conditions.

4.3 REDUCED STRIPPING RATIO ALTERNATIVE

Impacts to the following resources from a reduced stripping ratio would be the same as those described under the Proposed Action:

- Geology and Minerals;
- Socioeconomics;
- Transportation;
- Noise;
- Air Quality;
- Land Use, Recreation; and
- Paleontology.

Impacts to other resources have been assessed and quantified where possible, and the results are presented in the following sections and on Table 2-4. Except for specific topics discussed below, impacts for this scenario would be the same as the Proposed Action.

4.3.1 Hydrology

This alternative would reduce the amount of waste rock left on the surface and consolidate it in areas immediately adjacent to the pit. This, in turn, would reduce the potential for seepage from waste rock that may contain elevated levels of metals and sulfate and reduce potential impacts to surface and groundwater by directing drainage from the waste rock disposal areas into the pit lake, where the sump action of the lake would prevent impacts to groundwater. The pit lake would also be reduced in size and this would decrease the final extent of the steady-state drawdown in the water table in the mining area. Potential drawdown impacts to the Percha Box area, Warm Springs Canyon, and the Ladder Ranch may all be reduced or eliminated under this alternative; however, the reduction in impacts can not be identified quantitatively without additional hydrologic modeling.

4.3.2 Soils

Direct and indirect impacts to soils would be the same as those described under the Proposed Action, but the total disturbance would decrease by 80 acres; new disturbance would decrease by 77 acres, and previous disturbance to be redisturbed would increase by 4 acres. Prior to construction and mining activities, a total of approximately 1.3 million cubic yards of suitable reclamation material would be available for salvage from 337 previously undisturbed acres.

Reclamation activities would be the same as those described for the Proposed Action, except the total area to be reclaimed would decrease by 80 acres. Salvaged reclamation material would be utilized as the primary plant growth medium on reclaimed areas. Soil would be redisturbed to depths of 6 to 12 inches on all graded areas within the tailings impoundment area, the waste rock disposal areas, and on all other mine areas affected by this alternative, as available. Sufficient reclamation material could be salvaged from the tailings impoundment area to provide a 6-inch cover of growth medium for all project components to be reclaimed. There would be insufficient reclamation material available to provide a 12-inch cover of growth medium for all project components to be reclaimed.

4.3.3 Vegetation

Impacts to vegetation would result from the disturbance or removal of vegetation during mine development and construction. Potential impacts include the loss of vegetation, vegetative productivity, and forage for livestock and wildlife use. Impacts would be the same as those described for the Proposed Action, except new disturbance to vegetated land would decrease by 77 acres.

Reclamation activities would be the same as those described for the Proposed Action, except the total area to be reclaimed would decrease by approximately 80 acres.

4.3.4 Wildlife/Special Status Species

Overall impacts to wildlife and fisheries and the threatened, endangered, and other sensitive species for this alternative would essentially be the same as those described for the Proposed Action. The amount of previously undisturbed native desert grassland that would be lost would be 337 acres, as compared to 414 acres for the Proposed Action. The water analysis also indicated that the amount of groundwater drawdown could be less for this alternative. Both the decrease in habitat disturbance and groundwater effects would benefit the species that occupy the areas potentially affected. These species, however, would still be exposed to the other impacts identified for the Proposed Action, which would include increased habitat fragmentation, displacement, noise, human activity and access, and possibly direct loss of individuals.

4.3.5 Visual Resources

As with the Proposed Action, the only major mining elements that would be visible by the general public under the Reduced Stripping Ratio Alternative would be the East Waste Rock Disposal area and the Tailings Impoundment Dam. However, visual contrasts created by the construction of the waste rock disposal area would be greatly reduced under this alternative. The East Waste Rock Disposal area would cover approximately 35 acres under this alternative, 95 fewer acres than would be covered under the Proposed Action. The total height of the East Waste Rock Disposal area would be 5,600 feet ASL, approximately 40 feet lower than under the Proposed Action. Under the Reduced Stripping Ratio Alterative, design of the tailings impoundment dam would not differ from that of the Proposed Action.

Reclamation of the East Waste Rock Disposal area and the Tailings Impoundment Dam would, as under the Proposed Action, occur concurrently with operations as portions of these facilities became inactive.

When viewed from KOP 1 (an I-25 rest stop located 10.5 miles east-northeast of the Copper Flat Mine), earth disturbance under the Reduced Stripping Ratio Alternative would not differ greatly in appearance from the disturbance that currently exists at this site. Views from KOP 2 (located at the Highway 152 Kiosk less than one mile east of the Copper Flat Mine) would be similar to those described for the Proposed Action except that the East Waste Rock Disposal area would contrast only moderately with natural land forms since it would not be much larger than it is at present. As with the Proposed Action, implementation of this alternative would be consistent with the objectives of VRM Class III areas.

4.3.6 Cultural Resources

Impacts to cultural resources would generally be similar to those described for the Proposed Action. However, it is likely that NRHP-eligible cultural resource site 9523-1 would not be subject to direct impact under this alternative because the pit area will be smaller and the site, located on an access road to the pit, could be avoided. Indirect impacts particularly from erosion, to sites MA 538-14, MA 558-8, and MA 558-9, may be lessened since under this alternative the East Waste Rock Disposal area would be smaller and located further away from these sites.

4.4 CONSOLIDATED WASTE ROCK DUMP ALTERNATIVE

Impacts to the following resources by consolidating waste rock dumps would be the same as those described under the Proposed Action:

- Geology and Minerals;
- Socioeconomics;
- Transportation;
- Noise;
- Air Quality;
- Land Use, Recreation; and
- Paleontology.

Impacts to other resources have been assessed and quantified where possible, and the results are presented in the following sections and on Table 2-4. Except for specific topics discussed below, impacts for this scenario would be the same as the Proposed Action.

4.4.1 Hydrology

This alternative could increase the potential for ARD by placing potentially acid-generating transitional waste rock with unoxidized waste rock in the East Waste Rock Disposal area. If, in spite of reclamation and ARD control efforts, transitional material should oxidize further during percolation of water through the waste rock pile, the resultant acidic seepage could trigger generation of ARD in the unoxidized portion of the waste rock pile and lead to an increase in overall ARD.

The proposed waste rock disposal area closure design would consist of encapsulating the transitional material within the unoxidized material over the transitional material, compacting unoxidized material over the transitional material,and covering the entire pile with 12 inches of reclamation cover material. This design, coupled with the area's low precipitation and high evaporation rate, is expected to prevent the triggering of ARD, however, without additional modeling and testing the potential of this alternative to generate impacts can not be fully determined. Expected seepage from waste rock piles under the Proposed Action is 0.5 to 3 gpm (Section 4.1.2.1.1, Potential Impacts to the Mining District). If it is assumed that seepage rates under the Consolidated Waste Rock Disposal Area Alternative would be similar, and that meteoric water could percolate through the waste rock pile to create the 0.5 to 3 gpm seepage, ARD could occur at a low rate. Under the Proposed Action, all potential ARD drainage was diverted into the pit lake, where it would be prevented from impacting groundwater. Under the Consolidated Waste Rock Disposal Area Alternative, low rates of ARD could directly interact with groundwater and potential water flows in the Greyback Wash drainage.

4.4.2 Soils

Direct and indirect impacts to soils would be the same as those described under the Proposed Action, however the total disturbance would increase by approximately 15 acres; new disturbance would decrease by 2 acres, and previous disturbance to be redisturbed would increase by approximately 16 acres. Prior to construction and mining activities, approximately 1.3 million cubic yards of suitable reclamation material would be available for salvage from 412 previously undisturbed acres.

Reclamation activities would be the same as those described for the Proposed Action, except the total area to be reclaimed would increase by approximately 5 acres. Although no new disturbance would occur in the West and North Waste Rock Disposal areas, approximately 15 acres of previously disturbed land would be reclaimed in each area. Salvaged reclamation material would be utilized as the primary plant growth medium on reclaimed areas. Soil, as available, would be redistributed to depths of 6 to 12 inches on all graded areas within the tailings impoundment area, the waste rock disposal areas, and on all other mine areas affected by this alternative. Sufficient reclamation material could be salvaged from the tailings impoundment area to provide a 6-inch cover of growth medium for all project components to be reclaimed. There would be insufficient reclamation material available to provide a 12-inch cover of growth medium for all project components to be reclaimed.

4.4.3 Vegetation

Impacts to vegetation would result from the disturbance or removal of vegetation during mine development and construction. Potential impacts include the loss of vegetation, vegetative productivity, and forage for livestock and wildlife use. Impacts would be the same as those described for the Proposed Action, except new disturbance to vegetated land would decrease by 2 acres.

Impacts to vegetation, including riparian vegetation, would be the same as those described for the Proposed Action, except the total area to be reclaimed would increase by approximately 5 acres. Although no new disturbance would occur in the West and North Waste Rock Disposal areas, approximately 15 acres of previously disturbed land would be reclaimed in each area.

4.4.4 Wildlife/Special Status Species

As discussed for the Reduced Stripping Ratio Alternative, the general impacts identified for wildlife, fisheries, and sensitive species would parallel those discussed for the Proposed Action. The amount of previously undisturbed native grassland would be approximately 412 acres for this alternative, as compared to 414 acres for the Proposed Action. The consolidation of waste rock material would aid in minimizing habitat effects. However, this alternative could potentially generate acid mine drainage, which could flow into Greyback Wash. Although no important wildlife, fisheries, or sensitive species' resources have been identified for Greyback Wash, the effects of acid mine drainage into this intermittent channel would be an adverse impact to area plant and animal species that may either be directly affected by the acidic water or those species dependent on the vegetation that may be affected. Impacts to riparian areas would be similar to those discussed under the Proposed Action.

4.4.5 Visual Resources

As with the Proposed Action, the only major mining elements that would be visible by the general public under the Consolidated Waste Disposal Alternative would be the East Waste Rock Disposal area and the tailings impoundment dam. Visual contrasts created by the construction of the east disposal area, however, would be greater under this alternative as a result of the larger area that would be covered (approximately 158 acres versus 130 for the Proposed Action) even though its total height would be about 40 feet less. Design of the tailing impoundment dam would not differ under this alternative from that of the Proposed Action. Reclamation of the dam and East Waste Rock Disposal area would occur concurrently with operations as portions of these facilities became inactive.

When viewed for KOP 1, earth disturbance under the Consolidated Waste Disposal Alternative would appear as described for the Proposed Action. Visual contrast viewed from KOP 2 would be incrementally greater than those described for the Proposed Action as a result of the larger waste rock disposal area. Implementation of this alternative would, however, be consistent with VRM Class III objective.

4.4.6 Cultural Resources

Impacts to cultural resources would be generally similar to those described for the Proposed Action. However, NRHP-eligible cultural resource sites 9523-14, 9523-6, and 9523-5 would not be directly impacted by implementation of this alternative because no new disturbance would occur at the West and North Waste Rock Disposal areas. The larger East Waste Rock Disposal area proposed under this alternative could directly impact the MA 558-14 grave site, NRHP-eligible sites 9523-12, MA 558-8, and MA 558-9 that would not be directly affected under the Proposed Action.

4.5 POTENTIAL MITIGATION AND MONITORING

The following potential mitigation and monitoring measures have been developed to reduce adverse impacts. These are in addition to the environmental protection procedures outlined in Section 2.2.14, Summary of Environmental Protection Measures.

4.5.1 Hydrology

Measure H-1: BLM recommends that a monitoring well system be installed to the east and downgradient of the proposed seepage capture system, if such a system is not recommended by the NMED in Alta's Groundwater Discharge Permit.

Effectiveness: Downgradient monitoring would provide a means for determining the effectiveness of the capture system during operation of the tailings facility, and increase the ability to rapidly respond to potential problems and initiate corrective action.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure H-2: BLM recommends that the tailings pumpback wells be kept in operation with return of groundwater to the pit lake until the water quality in the return water is within water quality standards as identified by the NMED for at least 4 consecutive quarters, if not otherwise addressed by NMED in Alta's Groundwater Discharge Permit. The monitor wells recommended for ensuring the adequate operations of the capture and pumpback system during operation of the tailings facility could be used to further determine when the pumpback system could be discontinued after cessation of mining and reclamation of the tailings facility.

Effectiveness: This measure would ensure that return water is within acceptable water quality standards.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure H-3: Water levels in existing private wells would be measured with the permission of the landowner to establish baseline levels to compare future drawdown. If impacts reasonably attributed to actions at the mine are identified the private wells would be deepened sufficiently to support the existing use.

Effectiveness: This measure would minimize direct impacts to current water users.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure H-4: Pit lake water would be analyzed for total dissolved copper.

Effectiveness: This measure would provide information that would confirm if copper levels in pit lake water meet State livestock and wildlife standards for dissolved copper.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

4.5.2 Wildlife Resources

Measure W-1: Removal of native shrubs on previously undisturbed lands in the Proposed Action area would be prohibited between May 1 and July 31 to protect nesting birds, particularly neotropical migrants. As an option to the construction constraint period, breeding bird surveys, as approved by the Authorized Officer, could be conducted during the breeding season and prior to site disturbance to identify if any occupied territories or active nest sites occur within the areas to be disturbed. If nesting birds are not located during the survey, construction can proceed, if nesting birds are found, Alta would coordinate with the Agencies to implement the appropriate protection measures (e.g., avoidance).

Effectiveness: Constraint periods for removal of native shrubs would minimize the loss of resident and migratory birds. Breeding bird surveys would identify any sensitive breeding areas prior to site disturbances.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure W-2: Raptor surveys would be conducted during the breeding season prior to the initiation of mining activities, if mining were to begin between March 1 and August 15. If an occupied breeding territory or active nest site is located, restrictions would be applied to all disturbance activities during the breeding season. Applicable protection measures would be identified by the BLM biologist to protect breeding birds. Depending on the nest location in relation to the planned mining activities, protection measures may include construction constraints within 0.50 mile of the nest during the sensitive early periods of the breeding season (e.g., courtship and incubation).

Effectiveness: Surveys would determine the potential for impacting breeding raptors during nesting, and the appropriate protection measures would prevent disturbance of breeding birds.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure W-3: Alta would develop an employee awareness program for wildlife resource protection and communication of applicable laws. This program information would be distributed to all new employees.

Effectiveness: This measure would reduce the potential for increased harassment and increased illegal shooting of wildlife species, particularly of highly visible species (e.g., mule deer, golden eagles).

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure W-4: An inspection or survey of the existing mine shaft would be conducted prior to the initiation of mining activities to determine if it is occupied by bats. Alta would notify the BLM prior to closing any shafts, adits, or man-made structures on BLM-managed land during mine operation. BLM would determine if additional protection measures are necessary to prevent impacts to bat species that may inhabit these areas.

Effectiveness: These measures would prevent any impacts to bat species that may occupy abandoned underground openings, including use by hibernating and breeding bats.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure W-5: Alta would notify the BLM and the NMDGF regarding any wildlife mortalities that occur within the Proposed Action area. In the event that mortalities exceed thresholds identified by the Agencies, Alta would coordinate with the BLM and NMDGF to develop the appropriate mitigation measures to minimize wildlife mortality.

Effectiveness: This measure would minimize potential wildlife mortalities from project construction and operation (e.g., vehicle-related mortalities, miring within the tailings facility, increased line strikes).

Application: This measure would apply to the Proposed Action and all alternatives except the No Action Alternative.

Measure W-6: Alta would coordinate with the BLM to erect artificial bat roosts within the appropriate habitat types located within the Proposed Action area. These roosts would be designed to support specific sensitive bat species that may be impacted by the Proposed Project (e.g., pale Townsend's big-eared bat).

Effectiveness: This measure would provide additional bat roosts for area bat species to aid in minimizing the effects to bats from habitat loss and mine disturbance.

Application: This measure would apply to the Proposed Action and all alternatives except the No Action Alternative.

4.5.3 Air

Measure A-1: Chemical stabilizers would be used on mine haul and access roads, as necessary.

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: A "drop-out" grate structure and paved apron would be placed on site access roads prior to their intersection with paved roads.

Effectiveness: This measure would minimize carry-out of soil onto paved roads and help to minimize fugitive dust emissions.

Application: This measure would be applied to the Proposed Action and all alternatives, except the No Action Alternative.

4.5.4 Visual

Measure V-1: Outdoor night lighting at the Copper Flat Mine would be shielded and directed downward where possible.

Effectiveness: Proper shielding and directing of outdoor lights would reduce excessive skyward illumination and glare.

Application: This measure would be applied to the Proposed Action and all alternatives, except the No Action Alternative.

4.5.5 Cultural Resources

Measure C-1: Mitigation of indirect impacts could be accomplished by limiting access to archaeological sites on private land, education of Alta employees as to the fragile nature of cultural resources, and an Alta strict management policy regarding casual collecting of artifacts from project lands.

Effectiveness: This measure would reduce but not eliminate indirect impacts to cultural resources on both public and private land.

Application: This measure would be applied to the Proposed Action and all alternatives, except the No Action Alternative.

Measure C-2: If previously undocumented archaeological sites or subsurface components of documented sites are discovered during construction, Alta would cease activities until the resources are examined by BLM-approved archaeologists. If resources were eligible for the National Register of Historic Places (NRHP), impacts would be mitigated through an appropriate treatment plan or site avoidance.

Effectiveness: This measure would allow for the evaluation of the importance of archaeological resources that may be discovered, and provide adequate time for their preservation or data recovery.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure C-3: Where site avoidance is the proposed mitigation to avoid adverse impacts to NRHP-eligible sites, boundary markers, such as brightly painted posts, would, at the direction of the BLM, be installed to mark the project boundary along the edge of the proposed disturbance area.

Effectiveness: This measure would reduce, but not eliminate inadvertent disturbance of known cultural resources in the project area. Marking of the project boundary could also lead to increased vandalism of the sites if personnel and visitors realize that the project boundary markers indicate that a site is in close proximity.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

Measure C-4: Data recovery would be conducted at NRHP-eligible sites directly impacted by the Proposed Action and would be carried out in accordance with a formal mitigation plan. This plan would be prepared by a professional archeologist, and approved by the BLM, the SHPO, and the Advisory Council prior to project commencement.

Effectiveness: This measure would mitigate adverse effects from direct impacts through data recovery and collection of available site information.

Application: This measure would apply to the Proposed Action and all alternatives, except the No Action Alternative.

4.5.6 Paleontology

Measure P-1: If potentially significant fossils, such as vertebrate fossils, are discovered during mine development, operations, or reclamation, steps would be taken to identify and preserve them. Alta would contact the BLM-authorized officer in the Las Cruces District Office to determine steps necessary for dealing with the fossils.

Effectiveness: This measure would allow for the evaluation of the importance of any fossils that may be discovered and provide adequate time for their preservation or data recovery.

Application: This measure would be applied to the Proposed Action and all alternatives, except the No Action Alternative.

4.6 CUMULATIVE IMPACTS

The following sections discuss the cumulative impacts to the various natural and human resources in the Copper Flat Project area. Impacts to a resource could come from one of two sources, the Proposed Action or an interrelated project (past projects, present projects, or reasonably foreseeable future actions [RFFAs]). These impacts could interact in a cumulative manner to produce cumulative effects. This analysis summarizes the combined impacts of development in the area regardless of the sources or the contribution of the Proposed Action. Each discipline presents the Cumulative Effects Area that has been defined for that resource and the combined effects from the Proposed Action and interrelated projects. If an alternative to the Proposed Action would affect the cumulative effects in an important way, these implications are discussed.

Work at Copper Flat is expected to begin in 1995 and extend approximately 15 years, including the reclamation period. Thus , the cumulative impact analysis has been restricted to the 15-year period between 1996 and 2010. In order to be considered in the analysis, impacts from RFFAs must be expected within this time frame. As a result of the EIS analysis, no major RFFAs were identified within the 15-year project time frame or in the geographic areas identified for the various resources. For this reason, the cumulative impact analysis focuses on past and present activities identified in the area and how these correlate with the Proposed Action. These actions or activities included: 1) past and present mining development and operations, 2) present oil and gas exploration and development, and 3) past and present livestock grazing.

The predominant past and present mining activities include past mining operations at the location of the Proposed Project and placer operations currently being conducted to the northeast and south of the proposed mine site. Oil and gas exploration and development occur sporadically, with no permanent structures located within the cumulative effects area. Ongoing livestock grazing occurs in the immediate vicinity of the proposed mine area.

4.6.1 Geology

The cumulative effects study area for geology and minerals encompasses the Greyback, Percha, and Animas watersheds. Past mining operations in the area have removed both gold and copper in the Proposed Project area. Approximately 500 million pounds of copper are estimated to remain in reserve. Approximately 60 million tons of copper-bearing ore would be mined under the Proposed Action between 1997 and 2007. This would yield approximately 480 million pounds of copper. The existing estimated recoverable resource for copper would decrease from the present resource estimate of 500 million pounds of copper to approximately 20 million pounds or less of recoverable copper. Loss of access to mineral resources that could occur by placing waste rock dumps over potential mineral resources would be avoided by condemnation drilling during mine operation. Additional mining operations may be developed in the area as economic ore deposits are discovered, however, no future mining proposals were identified to date.

Placer operations are currently removing alluvial gold from dry washes in the area. Approximately 125,000 ounces of gold have been removed during past placer operations. Approximately 8.4 million yd^3 of gold-bearing material remains to be processed.

Oil and gas exploration and development occurring sporadically in the area result in minimal surface disturbance; however, the number of acres actually impacted and the volume of oil and gas removed could not be quantified.

The primary geologic impact of mining is the loss of resources for future generations. However, removal of resources is an inevitable result of mining.

4.6.2 Hydrology

The cumulative impacts for water resources extend from the Greyback, Percha, and Animas watersheds to the Palomas Basin, including the Caballo Reservoir subregion. Past mining activities in the Copper Flat area, particularly copper operations in the 1980s, have had the greatest effect on groundwater quality and quantity in the area. As identified in Tables 3-4 and 3-5, existing pit water quality and groundwater quality near the tailings impoundment do not meet State domestic use and human health water quality standards. Pit lake water appears to exceed State copper standards for livestock and wildlife, although it meets other parameters (Table 4-3A,B). Proposed operations are not expected to further deteriorate water quality in the area. As discussed in Section 4.1.2.2, Mine Closure and Reclamation, water quality may be improved by the Proposed Action through improved management of waste rock piles and groundwater pumping and monitoring in the vicinity of the tailings impoundment.

Water quantity in the cumulative effects area has also been affected by past mining practices, as discussed in Section 3.2.1, Surface Water Resources. During previous pumping operations in the 1980s at the production wells located east of the mine site, groundwater drawdown patterns probably approximated those predicted for the Proposed Project (see Figure 4-2), since the pumping rate was similar. However, the period that water was pumped during the 1982 operation was much shorter than that proposed for the

Copper Flat Project. Drawdown from the 1982 operation has since returned to pre-pumping levels. Proposed drawdown in the production well area would also return to pre-pumping levels once pumping ceased as discussed in Section 4.1.2.2, Mine Closure and Reclamation.

Previous pit lake pumping and evaporation also affected water quantity in the cumulative effects area; implementation of the Proposed Action would expand the pit drawdown cone of depression past its existing location. After approximately 140 years, this cone would reach a permanent steady state and local water tables would be permanently lowered (Section 4.1.2.2, Mine Closure and Reclamation).

Oil and gas exploration operations are not expected to have a cumulative impact on water resources, since they would be impacting a minimal area and using limited amounts of water. The number of acres impacted by oil and gas activities could not be quantified for this EIS. Livestock grazing is also expected to have minimal effects on water quality and quantity, since the density of cattle on the cumulative effects area allotment is approximately 1 per 100 acres.

In summary, the cumulative effects to both surface and groundwater in the cumulative effects area are not expected to be greater than the effects discussed for the Proposed Action in Section 4.1.2, Water Quantity and Quality. Implementation of the Reduced Stripping Ratio Alternative may reduce the extent of the cone of depression created by pit dewatering and evaporation as discussed in Section 4.3, Reduced Stripping Ratio Alternative.

4.6.3 Soils and Vegetation

The cumulative effects areas for soils and vegetation include the Greyback, Percha, and Las Animas watersheds. The Proposed Action would contribute incrementally to the disturbance of soils and vegetation in the proposed mine area. To date, approximately 690 acres have been disturbed by previous mining activities in the area. The Proposed Action would result in an additional 414 acres of new desert grassland disturbance, which represents about 38 percent of the total disturbance area following the development of the proposed Copper Flat Project. Of the 1,103 acres of total disturbance from mining activities (past, present, and Proposed Action), a total of 961 acres would be reclaimed and revegetated. The remaining 142 acres represents the open pit and diversion structures, which would not be revegetated under the Proposed Action.

Soil erosion rates would increase during the period between soil removal and successful reclamation of disturbed land. Reclamation material would be salvaged as available from the 1,103 acres of disturbance anticipated for the Proposed Action. Reclamation would include areas in the mine site disturbed during past operations. Reclamation under current regulations may improve revegetative success in these areas.

Reclamation of areas disturbed by current mining and processing is required by current laws and regulations for the majority of all lands, both private and public. Areas disturbed by these operations must be reclaimed and revegetated, in accordance with individual reclamation plans directed by the State and the BLM. Historically, mining operations in the cumulative effects area have not exhibited extensive revegetation success following mine reclamation, limiting the productivity, density, and diversity of the vegetation. In addition, the plant species and densities that could be established on these reclaimed surfaces may be different than the species that presently grow or could grow in the areas previously disturbed by mining that would be revegetated under the Proposed Action.

Primary impacts from oil and gas exploration and development would generally be attributed to road and drill pad construction, such as surface disturbances and sedimentation on relatively small acres of native soils and vegetation. The number of acres impacted by oil and gas activities within the cumulative effects area could not be quantified. Generally, these activities would result in incremental impacts to soils and vegetation and the reduction of range resources. The cumulative effects from livestock grazing to these surface resources would depend on the relative range condition and level of use within the cumulative effects area and how this would affect vegetation, habitat quality for wildlife, and overall range condition.

4.6.4 Wildlife, Fisheries, and Special Status Species

The cumulative effects area for wildlife and fisheries extends along the Greyback, Percha, and Las Animas watersheds and the Caballo Reservoir area of the Rio Grande. The habitat disturbances estimated for past and proposed mining activities are discussed above for soils, vegetation, and range. Assessing cumulative impacts quantitatively for wildlife resources is difficult and contains inherent biases. Therefore, the analysis was primarily based on overall qualitative values.

The primary cumulative impacts to wildlife resources would include incremental habitat loss and fragmentation, displacement, potential exceedances of associated carrying capacities, and increased harassment from human use. However, the location of the Proposed Action would limit these effects, since the area has been previously disturbed by past mining activities. Because of these past activities, the implementation of the Proposed Action would not further decrease the overall biodiversity of the area, compromising the integrity of the system. Based on limited data, the only special status groups that may be incrementally impacted by the past, present, and proposed cumulative activities would be sensitive bat species and nesting raptors. Because few data are available, however, the cumulative analysis only considers the overall qualitative effects that may occur to these species, as increased activities in the cumulative effects area potentially decrease the amount of available habitat and breeding opportunities for these groups.

The cumulative effects to natural springs, streams, or associated riparian habitat would be the most critical issue for the cumulative analysis. The cumulative loss of this habitat type from past and proposed mining activities would include effects to Greyback Wash; however, the incremental impacts from the Proposed Action would not increase impact levels for wildlife species much beyond the current levels. Other effects to area riparian habitats would be limited to livestock grazing, as exhibited by Warm Springs Canyon. These impacts are not quantifiable for this analysis and would be relative to the levels of water reduction and vegetation removal.

4.6.5 Noise

The cumulative effects area for noise resources includes the Greyback, Percha, and Las Animas watersheds. Existing noise levels in this area are currently at levels consistent with a rural environment. Sensitive receptors are located at distances and in terrain that would reduce noise levels from the mine area (Section 3.7, Noise). Noise levels at the proposed Copper Flat Mine would be greater than present levels (see Section 4.1.7, Noise); however, noise levels would be regulated by MSHA and OSHA, and sensitive receptors would still lie at distances and in terrain that would reduce effects. Noise from oil and gas operations and grazing are also expected to be minimal. Noise levels in the cumulative effects area are not expected to be greater than the effects discussed for the Proposed Action in Section 4.1.7, Noise.

4.6.6 Air Quality

The cumulative effects area for air quality is located in the Greyback watershed. Air quality in the area is generally good and meets State and Federal ambient air quality standards. Placer operations to the east of the Copper Flat Mine site may add fugitive dust emissions; however, these types of operations are generally required to control dust emissions and have air quality operating permits that require them to comply with State air quality standards. The Proposed Action would also have to comply with the requirements of their air permit and meet all State air quality standards. Air pollution controls to reduce emissions would be applied during construction and operation. Reclamation and revegetation would stabilize exposed soil and help control fugitive dust emissions. As vegetation becomes established, particulate levels should return to background levels. Air quality effects from oil and gas exploration and livestock grazing are also expected to be minimal. Cumulative air quality impacts are not expected to exceed effects discussed for the Proposed Action (Section 4.1.8, Air Quality).

4.6.7 Social and Economic Values and Transportation

The cumulative effects area for socioeconomics resources includes Sierra County. The cumulative effects area for transportation includes Highway 152 east to Hillsboro and west to I-25, and south on I-25 from the intersection with Highway 152. Existing socioeconomic conditions in the area are discussed in Chapter 3.0, Section 3.9. The current, relatively limited numbers of employees and operations expected to be associated with the placer operations near the Copper Flat Mine site, coupled with oil and gas exploration and livestock operations, are not expected to have a noticeable cumulative impact on the projected socioeconomic or transportation conditions associated with reopening of the Copper Flat Mine as discussed in Sections 4.1.9, Social and Economic Values and 4.1.10, Transportation. Cumulative socioeconomic and transportation effects are not expected to exceed those identified under the Proposed Action.

4.6.8 Land Use and Recreation

The cumulative effects area for land use and recreation resources includes the Greyback, Percha, and Animas watersheds. The Proposed Action and current uses in this area, including oil and gas exploration, placer mining, and livestock grazing are consistent with BLM management plans for the area. AUM levels in the immediate mine site area had been previously adjusted in 1983 to account for mine use and would remain at these levels. Cumulative land use and recreation resources effects are not expected to exceed those identified under the Proposed Action.

4.6.9 Visual Resources

The cumulative effects area for visual resources generally is located in the Greyback Wash drainage east along Highway 152 to I-25. Currently, the major effect on visual resources in the cumulative effects area is from past mining activities in the Copper Flat area as discussed in Section 3.13, Visual Resources. The Proposed Action would add to these visual effects as discussed in Section 4.1.13, Visual Resources. The Proposed Action, existing placer operations, and oil and gas exploration would be consistent with the objectives of the VRM Class III identified for the area. After reclamation, the visual contrast from past and proposed mining activities would be reduced. Visual contrast from oil and gas exploration and livestock grazing would be temporary. Cumulative effects to visual resources are not expected to exceed impacts identified under the Proposed Action.

4.6.10 Cultural Resources

The cumulative effects area for cultural resources included Greyback, Percha, and Animas watersheds. Oil and gas exploration and existing placer mining operations could impact cultural resources; however, these activities were and are required to obtain cultural clearance, including surveys, and conduct mitigation, if necessary, prior to any activity. Past mining operations in the Copper Flat area may have directly affected cultural resources. As discussed in Section 3.14, Cultural Resources, and Table 3-17, cultural surveys conducted in the 1970s located seven sites in areas directly disturbed in the 1982 mining operation (QMCS-2, QMCS-3, QMCS-5, QMCS-11, QMCS-12, QMCS-17, QMCS-2-1). These sites, however, may not have been correctly located due to the mapping methods in use at that time, so it is difficult to tell how many sites may have actually been impacted by past operations. The Proposed Action could directly impact 12 NRHP-eligible sites and 2 grave sites. Cumulative effects to cultural resources are not expected to significantly exceed impacts identified under the Proposed Action discussed in Section 4.1.14, Cultural Resources.

4.6.11 Paleontological Resources

The cumulative effects area for paleontology included the Greyback watershed. Although existing placer operations and the proposed mine could impact paleontological resources, no significant paleontological resources have been identified for this area and no important paleontological resources were identified during previous activities in the Copper Flat area. No cumulative impacts to paleontological resources beyond that identified in Section 4.1.15, Paleontology, are anticipated.

4.7 UNAVOIDABLE ADVERSE IMPACTS

Implementation of the environmental protection measures (see Section 2.2.14, Summary of Environmental Protection Measures) and the mitigation measures identified in Section 4.5, Potential Mitigation and Monitoring, would eliminate most adverse impacts that would result from the Proposed Action. Those unavoidable adverse impacts that would remain are summarized below by resource. Unavoidable adverse impacts for the Reduced Stripping Ratio and Consolidated Waste Rock Dumps Alternatives would be the same as those for the Proposed Action except where specifically noted. Table 2-4 provides a summary comparison of impacts among alternatives.

Water Quantity and Quality

- There would be a potential water table drawdown of 1 to 20 feet in the production well area and 10 to 100 feet in the pit area.

Soils

- Disturbance of 337 to 414 acres of previously undisturbed native soils would occur, depending on the alternative selected (see Table 2-4).

- There would be a temporary reduction in soil productivity on the 337 to 414 acres of previously undisturbed native soils to be reclaimed, depending on the alternative selected.

Vegetation

- Approximately 337 to 414 acres of previously undisturbed native vegetation would be cleared, depending on the alternative selected (see Table 2-4).

- Changes in vegetation composition would occur on the 337 to 414 acres of previously undisturbed native vegetation to be reclaimed, depending on the alternative selected.

- Poor quality riparian and wetland areas in Warm Springs Canyon may be affected by drawdown depending on the hydrologic source of the Warm Springs Canyon seeps.

Wildlife and Fisheries Resources

- Clearing of 337 to 414 acres of native wildlife habitat would occur, depending on the alternative selected

- There would be a permanent habitat loss of 125 to 152 acres, depending on the alternative selected, in the pit and diversion structure areas.
- Potential increases in vehicle-related wildlife mortalities, poaching, and harassment may occur.
- Terrestrial wildlife species would be displaced.
- There would be an increase in habitat fragmentation.

Threatened and Endangered Species

- Some loss of bat roost sites from mine development may occur.
- There may be potential impacts to the Texas horned lizard and its habitat.
- The loggerhead shrike could experience some long-term loss of nesting habitat.

Air

- Increased haul road traffic, construction, and high winds could cause blowing dust from disturbed areas and stockpiles. However, these impacts would be temporary and transitory in nature, generally within current applicable air standards, and the air quality in the region would return to its former natural state at the conclusion of the project and reclamation of disturbed areas.

Visual Resources

- Alteration of the existing visual resources and an increase in the visual contrast with existing landforms would occur.

Cultural Resources

- Cultural resources could experience direct and indirect impacts.

4.8 RELATIONSHIP BETWEEN THE LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-term is defined as the life of the Copper Flat Project through closure and reclamation. Long-term is defined as the future beyond reclamation. Many of the impacts associated with the Project would be short-term and would cease following successful reclamation.

Expected changes in long-term productivity include:

Water Resources

- Water table levels would be permanently reduced in the pit drawdown cone area.

Soils

- Long-term soil productivity would be reduced on the approximately 961 acres to be reclaimed.

Land Use

- Long-term productivity for grazing would be lost at the pit area.

4.9 IRREVERSIBLE/IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction and operation of the Project could result in either the irreversible or irretrievable commitment of certain resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over very long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. For example, livestock forage production from an area is lost irretrievably while an area is serving as a tailings impoundment area. The production lost is irretrievable, but the action is not irreversible. If the use changes and the mine is reclaimed, it is possible to resume forage production. Irreversible and irretrievable impacts of the Proposed Action are summarized in Table 4-7.

4.10 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Since the alternatives to the Proposed Action differ primarily in the design of the waste rock disposal areas there would be very little difference in the energy requirements of the Action Alternatives and only limited conservation potential. The following operational information for the Proposed Action would also apply to the alternatives. It should be noted that this information represents initial estimates of annual energy consumption for mine operations. All Action Alternatives would have generally the same energy consumption for transportation.

- Electricity (primarily for the office, lab, mill, and concentrator)
  Annual use - 250 million kWHrs
  Life-of-project (12 years) - 3 billion kWHrs

- Diesel fuel (primarily for haul trucks)
  Annual use - ranges from 1 to 1.5 million gallons
  Life-of-project (12 years) - 15 million gallons

Table 4-7

Irreversible/Irretrievable Commitment of Resources - Proposed Action

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Geology and Minerals	Yes	Yes	Once mineral reserves are mined, they would no longer be available for future production.
Water Quantity and Quality	Yes	Yes	The drawdown cone in the pit area would expand until it reaches steady state at approximately 140 years. At this point water table levels would remain below current levels indefinitely.
Soils	Yes	Yes	Soil from all disturbance areas will be salvaged, however, topsoil use would be temporarily reduced and soil development would experience a permanent lag due to disturbance.
Vegetation	Yes	Yes	Irreversible impacts to vegetation would result from pit and waste rock disposal area expansion.
Wildlife and Fisheries Resources	Yes	Yes	Removal of habitat would be a temporary impact during the life of the mine. Long-term losses in wildlife productivity following reclamation are not expected. Potential habitat would be irreversibly lost due to pit development.
Threatened, Endangered, or Candidate Species	Yes	Yes	Potential habitat for resident and migrant species would be irreversibly lost due to pit and waste rock disposal area development.
Air Quality	No	No	Emissions from the Project would not deteriorate air quality once operations are completed, and are not expected to exceed standards during operation.
Noise	No	No	Noise impacts should not adversely impact sensitive receptors during operation and once operations are completed.
Social and Economic Resources	No	No	There would be ongoing productivity from the mine for the life of the project including the creation of up to 170 mining jobs during operations with an annual payroll of $5.8 million, 126 additional indirect jobs, and additional revenue support for Sierra County and the State of New Mexico.
Transportation	No	No	No permanent or unacceptable impacts to transportation are anticipated.

Table 4-7 (Continued)

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Land Use	Yes	Yes	Acreage would be irreversibly lost for livestock grazing in the pit area. There would be an irretrievable loss of public land available for livestock grazing, wildlife habitat, and dispersed recreational opportunities until reclamation is sufficient to restore productivity and allow these activities to resume. Forage production is expected to recover in the long-term following reclamation.
Recreation	No	Yes	The acreage lost to pit development would minimally affect recreation. There would be an irretrievable loss of public land available for dispersed recreational opportunities until reclamation is sufficient to allow dispersed recreational activities to resume.
Visual Resources	Yes	No	Impacts to visual resources would be reduced through successful reclamation procedures and implementation of the environmental protection measures, however permanent changes would result.
Cultural Resources	Yes	Yes	If cultural sites are disturbed in the project area, permanent loss of site context could occur.
Paleontological Resources	No	No	No disturbance to paleontological resources is expected.

5.0 CONSULTATION AND COORDINATION

5.1 INTRODUCTION

This chapter is devoted to consultation and coordination activities carried out during the preparation of this Draft Environmental Impact Statement (EIS). Comments on the Draft EIS and responses will be included in this chapter in the Final EIS.

The Draft Copper Flat EIS was prepared by an interdisciplinary team of resource specialists from ENSR Consulting and Engineering (a third-party contractor) with direction from and review by BLM employees in the BLM Las Cruces District office, in New Mexico. Table 5-1 lists the EIS team members, their job titles, and their responsibility associated with the Copper Flat EIS.

Writing of the EIS document began in 1995, however, preceding the writing phase, data gathering and other preparatory activities occurred. This process included site visits, review of existing documents, public participation, and interagency coordination and review. Consultation and coordination with agencies, organizations, and the public also occurred throughout the EIS process. Documentation of public participation and interagency coordination is on file in the Las Cruces office.

5.2 FORMAL CONSULTATION

Consultation with the U.S. Fish and Wildlife Service (FWS) is required prior to initiation of any project by BLM that may affect any Federally listed special status species or its habitat. Consultation is required by Section 7 of the Endangered Species Act of 1973. This EIS is considered a major planning effort, and formal consultation has been initiated. Letters of formal consultation are on file in the BLM Las Cruces District office.

The New Mexico Department of Game and Fish (NMDGF) and the New Mexico Natural Resources Department have been contacted during preparation of this EIS in regard to State-listed threatened and endangered animal and plant species. This is consistent with legislation protecting State-listed species.

The BLM cultural resource management program operates in accordance with 36 Code of Federal Regulations (CFR), Part 800, which provides specific procedures for consultation between the BLM and the State Historic Preservation Office (SHPO). A Memorandum of Understanding (MOU) NMSO-168 between the SHPO, Advisory Council on Historic Preservation and the BLM New Mexico State Office became effective October 19, 1982. This MOU incorporates procedures for exchanging information with the SHPO concerning cultural resources on public and private lands. It defines activities requiring consultation and establishes reporting standards. The SHPO has been consulted during the development of the Copper Flat EIS.

Table 5-1

List of Preparers/Reviewers

BLM, Las Cruces District

Russ Jentgen
Team Leader/Geology/Paleontology
B.S. Geology;
25 years experience

Tim Murphy
Area Manager
B.S. Range Science
16 years experience

Tim Sanders
Management Oversight
M.S. Agricultural Economics;
17 years experience

Bill Gilbert
NEPA Compliance
B.S. Biology;
19 years experience

Rena Gutierrez
Writer-Editor
B.A. Journalism/Mass Communications;
16 years experience

Bruce Call
Soils/Water
B.S. Range/Soil Science;
18 years experience

Mike Howard
Wildlife/T & E Species
M.S. Wildlife Management;
16 years experience

Tom Custer
Hazardous Materials
B.S. Geology;
5 years experience

Walter Lujan
Range Conservation, Vegetation
B.S. Range Management;
20 years experience

Judith Kelley
Land Use
Realty Specialist;
12 years experience

Joe Sanchez
Recreation/Visual
B.S. Range Science;
20 years experience

Theresa Hanley
Cultural Resources
B.A., M.A. Anthropology;
10 years experience

Max Ogg
Transportation
B.S. Engineering;
26 years experience

BLM, New Mexico State Office-Santa Fe

Bill Dalness
State Office Coordinator/Scoping Moderator
B.S., M.S. Geology;
25 years experience

Bob Armstrong
Environmental Coordinator, NEPA Compliance
B.S. Range Management;
25 years experience

Mark Blakeslee
Hydrology
B.S. Wildlife Management and Watershed;
20 years experience

BLM, Albuquerque District

Dave Sitzler
Reclamation
B.S. Geological Engineering;
18 years experience

BLM, Service Center, Lakewood, Colorado

Scott F. Archer
Air Quality, Noise
B.S. Chemistry, B.S. Environmental Science;
15 years experience

BLM, Colorado State Office, Lakewood, Colorado

Jeanette Pranzo
Socioeconomics
M.A. Economics;
24 years experience

Table 5-1 (Continued)

Alta Gold Inc. Company

Jeff Parshley, SRK
B.A. Geology
15 years experience

Jim Goff
Civil Engineer
40+ years experience

Shepherd Miller, Inc. - EIS Subcontractor

Isobel McGowan
Groundwater Modeling
P.E.; M.S. Hydrology;
14 years experience

Robert C. Berry
Geology/Minerals, Groundwater
Ph.D. Geochemistry; B.S. Geology; Prof. Degree Hydrogeology;
18 years experience

ENSR Consulting and Engineering-EIS Contractor

Phil Hackney
Project Manager
B.S. Botany,
20 years experience

Sophie Sawyer
NEPA Specialist
M.Ed. Science Education; B.A. Biology;
16 years experience

Karen Caddis-Burrell
Project Coordinator, Cultural Resources, Paleontology;
B.A. Geography/Anthropology/Journalism;
B.S. Resource Management;
12 years experience

Karin Sable
Social and Economic Values
B.A. Economics;
5 years experience

Jon Alstad
Vegetation, T & E Species, Wetlands/Riparian, Grazing
M.S. Range Science; B.S. Animal Science;
8 years experience

Lori Nielsen
Wildlife, T & E Species, Wild Horses
B.S. Wildlife Ecology/Management;
9 years experience

Vince Scheetz
Air Quality
M.S. Systems Management; B.S. Mathematics;
24 years experience

Randy Rasmussen
Land Use, Access, Recreation, Visual Resources, Noise, Transportation
M.S. Candidate - Natural Resources Recreation and Tourism; B.S. Physical Geography;
6 years experience

Steve Blazek
Cultural Resources, Paleontology, Soils, Vegetation
B.S. Forest Management Service, M.S. Candidate - Environmental Policy and Management;
8 years experience

Kirstin Lindberg
Technical Editor
B.A. English and Comparative Literature Studies;
5 years experience

5.3 PUBLIC PARTICIPATION

In 1991, the BLM Las Cruces District Office published an EA for the Copper Flat Project. In October 1993, BLM management determined that an EIS would be required for the project, and a Notice of Intent (NOI) to prepare the EIS was published in the Federal Register on June 3, 1994. The NOI invited scoping comments to be sent to the BLM through July 22, 1994.

Formal public participation in the Copper Flats EIS occurred in the early stages of the development of the EIS. Public meetings to determine the scope of the EIS and to obtain input on issues and planning criteria were held in Truth or Consequences, New Mexico, on June 22, 1994, and in Hillsboro, New Mexico, on June 23, 1994. A Scoping Report, outlining issues and concerns identified during the scoping meetings, was distributed to individuals and agencies on the EIS mailing list in August 1994. In addition to formal public participation steps, informal contacts occurred with public land users and interested persons through telephone calls, informal meetings, or letters. The BLM mailed individual notifications to approximately 500 interested persons, agencies, or groups. As a result of the EIS scoping process, 255 comments were identified by the BLM. Eighty-one comment letters were received from 32 private individuals, agencies, organizations, groups, and private business. All applicable public participation is documented and analyzed in the process and kept on file in the Las Cruces District office.

Following issuance of the Draft EIS, public hearings will be held in Hillsboro and Truth or Consequences, New Mexico, during the public comment period.

5.4 PUBLIC REVIEW OF THE DRAFT EIS

In the course of preparation of the Draft EIS for the Copper Flat Project, the BLM communicated with and received input from many Federal, State, and local agencies; elected representatives; environmental and citizens groups; industries; and individuals.

Approximately 600 copies of the Draft EIS are being distributed by mail to various individuals, organizations, and government agencies. Table 5-2 is a partial listing of various Federal, State, and local agencies, organizations, Indian Tribes, and individuals to which the Draft EIS is being sent for review and comment.

Informal and formal coordination with the public has taken place throughout the planning process through personal contacts, phone calls and letters, and will continue throughout the remainder of the EIS process.

Table 5-2

Partial Listing of Document Recipients

Federal Government Agencies

U.S. Department of Agriculture
- Farmers Home Administration - Las Cruces, New Mexico
- Forest Service
  - Gila National Forest - Silver City, New Mexico
  - Black Range Ranger District
- Natural Resources Conservation Service - Truth or Consequences, New Mexico
  - State Conservationist - Albuquerque, New Mexico
- Jornada Resource Conservation and Development Council

U.S. Department of Commerce, NOAA - Washington, DC
U.S. Department of Defense
- Army Corps of Engineers - San Francisco, California; Albuquerque, New Mexico
- U.S. Army - WSMR, New Mexico; Fort Bliss, Texas

U.S. Department of Energy - Carlsbad, New Mexico
- Western Area Power Administration - Golden, Colorado

U.S. Department of the Interior
- Bureau of Mines, Washington, DC
- Bureau of Reclamation - Albuquerque, New Mexico; Denver, Colorado
- Fish and Wildlife Service - Albuquerque, New Mexico; Washington, DC
- Geological Survey - Reston, Virginia
- Heritage Conservation and Recreation Service - Washington, DC
- Minerals Management Service - Washington, D.C.
- National Park Service - Washington, D.C.
- Office of Offshore Environmental Assessment Division - Washington, DC
- Office of the Secretary - Environmental Policy and Compliance - Albuquerque, New Mexico; Washington, DC

U.S. Environmental Protection Agency - Washington, DC
- EPA Region 6 - Dallas, Texas

International Boundary and Water Commission - El Paso, Texas
Public Land Council - Washington, DC
Department of Transportation - Santa Fe, New Mexico
- Office of Transportation and Regulatory Affairs - Washington, D.C.

State Government Agencies/Universities

Eastern New Mexico University - Portales, New Mexico
Forestry and Resource Conservation District - Santa Fe, New Mexico
Governor
- Texas
- New Mexico

Museum of New Mexico - Santa Fe, New Mexico
New Mexico Bureau of Mines and Mineral Resources - Socorro, New Mexico
New Mexico Department of Agriculture - Las Cruces, New Mexico
New Mexico Department of Commerce and Industry - Santa Fe, New Mexico
New Mexico Department of Finance and Administration - Santa Fe, New Mexico
New Mexico Department of Game and Fish - Truth or Consequences, Santa Fe, New Mexico
New Mexico Department of Revenue, Property Tax Division
New Mexico District Attorney - Las Cruces, New Mexico
New Mexico Economic Development and Tourism Department - Santa Fe, New Mexico
New Mexico Energy, Mineral, and Natural Resources Department - Santa Fe, New Mexico
New Mexico Environment Department - Santa Fe, New Mexico
- Air Quality Bureau
- Evaluating and Planning Section
- Groundwater Bureau
- Health Program
- Office of the Secretary
- Surface Water Bureau

New Mexico Health and Environmental Department - Santa Fe, Las Cruces, New Mexico
New Mexico Livestock Board - Albuquerque, New Mexico
New Mexico State Heritage Program - Albuquerque, New Mexico
New Mexico State Historic Preservation Office
New Mexico Oil Conservation - Santa Fe, New Mexico
New Mexico State Engineer's Office - Santa Fe, New Mexico
- New Mexico Interstate Stream Commission - Santa Fe, New Mexico

New Mexico State Highway and Transportation Department, Planning and Development - Santa Fe, New Mexico
New Mexico State Highway Commission - Santa Fe, New Mexico
New Mexico State Land Office - Santa Fe, Mesilla Park, Socorro, Albuquerque, New Mexico
New Mexico State Library - Santa Fe, New Mexico
New Mexico State Police - Santa Fe, Las Cruces, New Mexico
New Mexico State University - Las Cruces, New Mexico
New Mexico Tech Library - Socorro, New Mexico
Northwestern University, Center for Urban Affairs and Policy Research
State of Texas, Rio Grande Compact Commission - El Paso, Texas
University of New Mexico, Bureau of Business and Economic Research
University of Texas at El Paso

Local Governments

Alamogordo
- Chamber of Commerce
- Public Library

County Agent - Truth or Consequences, New Mexico

El Paso
- Chamber of Commerce
- Museum
- Public Library

Hillsboro Mutual Domestic Water Consumers

Las Cruces
- Branigan Memorial Library
- Economic Development Council

Otero Board of County Commissioners - Alamogordo, New Mexico

Sierra County (Truth or Consequences)
- Assessor's Office
- County Commissioners
- Economic Development Council
- Fire Marshall
- Landfill Supervisor
- County Road Supervisor
- Sheriff's Department
- County Treasurer

Table 5-2 (Continued)

Truth or Consequences, City of
- Chamber of Commerce
- Municipal School District
- Police Department
- Public Library
  - Hillsboro Branch
- Utilities Department

Tribal Governments

Jicarilla Apache Tribe - Dulce, New Mexico
Mescalero Tribe - Mescalero, New Mexico
Piro - Manso - Tiwa Indian Tribe - Las Cruces, New Mexico
San Carlos Apache Tribe - San Carlos, Arizona
Ysleta Del Sur Pueblo - El Paso, Texas

Local Agencies

Elephant Butte Irrigation District - Las Cruces, New Mexico
South Central New Mexico Planning and Development - Las Cruces, New Mexico
Southwest New Mexico Council of Governments - Silver City, New Mexico
Southeast New Mexico Economic Development District - Hobbs, New Mexico

About 138 special interest groups and 206 businesses and individuals also will receive copies of the Draft EIS.

APPENDIX A

HYDROLOGIC DATA

APPENDIX A-1

GROUNDWATER MODELING SUMMARY

HILLSBORO MINING DISTRICT AND PALOMAS BASIN

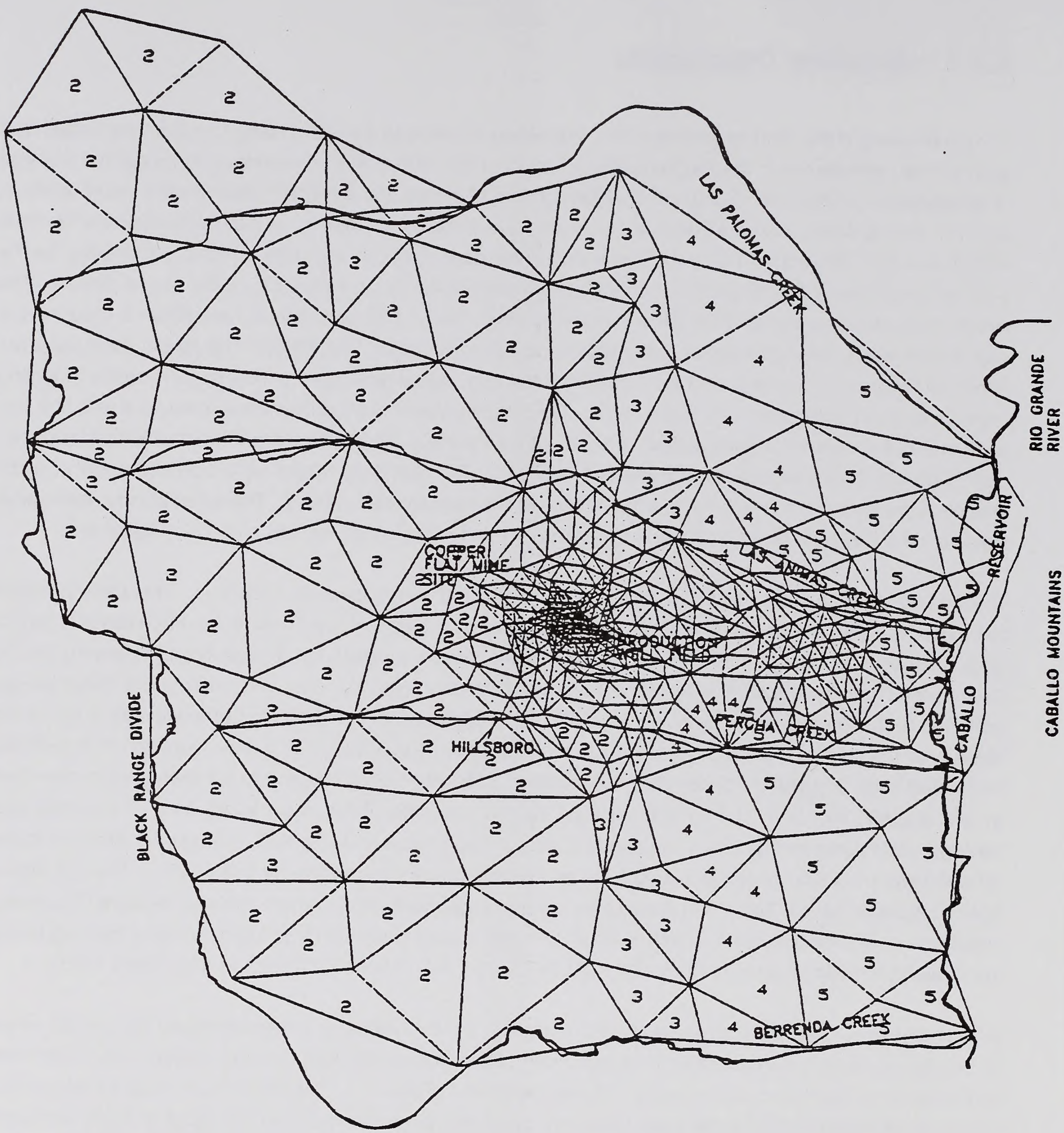
APPENDIX A.1 GROUNDWATER MODELING SUMMARY

A.1.1 Modeling Description

A 2-dimensional finite element groundwater model was developed by SRK (1995) to model the impacts of groundwater withdrawal in the Palomas Basin due to production well field pumping, to model the impacts of groundwater withdrawal due to pit dewatering, and to model the expected steady-state water levels in both the mining district and the Palomas Basin after the cessation of mining. A 3-dimensional finite element model was also developed using the same computer code and run with similar input parameters as the 2-dimensional model to compare the change in potential impacts as a function of the model design. The model code chosen was ABCFEM (Brown and Hertzman 1994). This code allows for infiltration of rain water and stream water, evapotranspiration by plants, and stream-aquifer interaction. The model grids used are shown in Figures A-1 and A-2, and a schematic of the conceptual groundwater flow model used in modeling impacts is given in Chapter 3.0, Figure 3-10. The single layer in the 2-dimensional models was 2,000 feet thick and did not allow for vertical flow, while the layers in the 3-dimensional model were 200 feet, 800 feet, and 1,000 feet thick, respectively, for layers 1 through 3. The two lower layers were confined and the upper shallow layer was unconfined; vertical flow between the layers was modeled. The initial steady-state water levels for the Palomas Basin and the mining district used in the modeling are shown in Figure A-3.

The hydraulic parameters used for input into the model are summarized in Table A-1. This table is keyed to Figures A-1 and A-2 to indicate which hydraulic parameters go with each cell in the finite element model grids. Previous studies of the Palomas Basin by Newcomer et al. (1993) and Greene and Halpenny (1977) have shown that the transmissivity of the Palomas Formation gravels, silts, and clays in the basin ranges from 345 to 2,900 gallons per day/foot (gpd/ft) (45 to 380 square feet/day) along the western edge of the basin near the tailings impoundment to 6,500 to 43,000 gpd/ft (870 to 5,700 square feet/day) in the vicinity of the well field. Hydraulic conductivity ranges from 10 to 220 feet/year (0.03 to 0.6 feet/day) on the west to 500 to 3,600 feet/year (1.4 to 9.8 feet/day) on the east side of the basin in the area of the well field. Storage coefficients for the basin sediments have not been measured. Specific storage values used in the groundwater modeling were calculated from estimated aquifer compressibility (SRK 1995). The calculated specific storage values (Table A-1) would give storage coefficients in the range of those measured for similar sediments in the Mesilla Basin, which is another major alluvial basin like the Palomas Basin that lies to the south along the Rio Grande in the vicinity of Las Cruces, New Mexico (Nickerson and Myers 1993).

SRK (1995) measured the transmissivity and hydraulic conductivities of sediments along the central reach of Las Animas Creek as part of their investigation of the interconnection between water in the creek and groundwater in the Palomas Formation. These are given in Table A-1. Values for transmissivity were in the range of 5,200 gpd/ft (697 square feet/day) and hydraulic conductivity was in the range of 4,000 feet/year (11.0 feet/day). There have been no attempts to measure the hydraulic properties of bedrock in the mining district; SRK (1995) utilized estimated pit refilling rates as a guide for inputing starting values for transmissivity and hydraulic conductivity of the bedrock units. The final values, which are shown in Table A-1, are the result of steady-state calibration of the groundwater flow model. Because aquifer studies in the Palomas Basin are limited, SRK (1995) relied on steady-state calibration of the groundwater model to determine the final input values for hydraulic parameters used in modeling potential impacts of groundwater withdrawal in the Palomas Basin and the mining district.



KEY:
1 : ANDESITE/QUARTZ MONZONITE
2 : PALEOZOIC AND VOLCANIC
3 : WEST PALOMAS BASIN ALLUVIUM
4 : WELL FIELD ALLUVIUM
5 : EAST PALOMAS BASIN ALLUVIUM
6 : PIT VOID

SCALE IN MILES
0 3 6

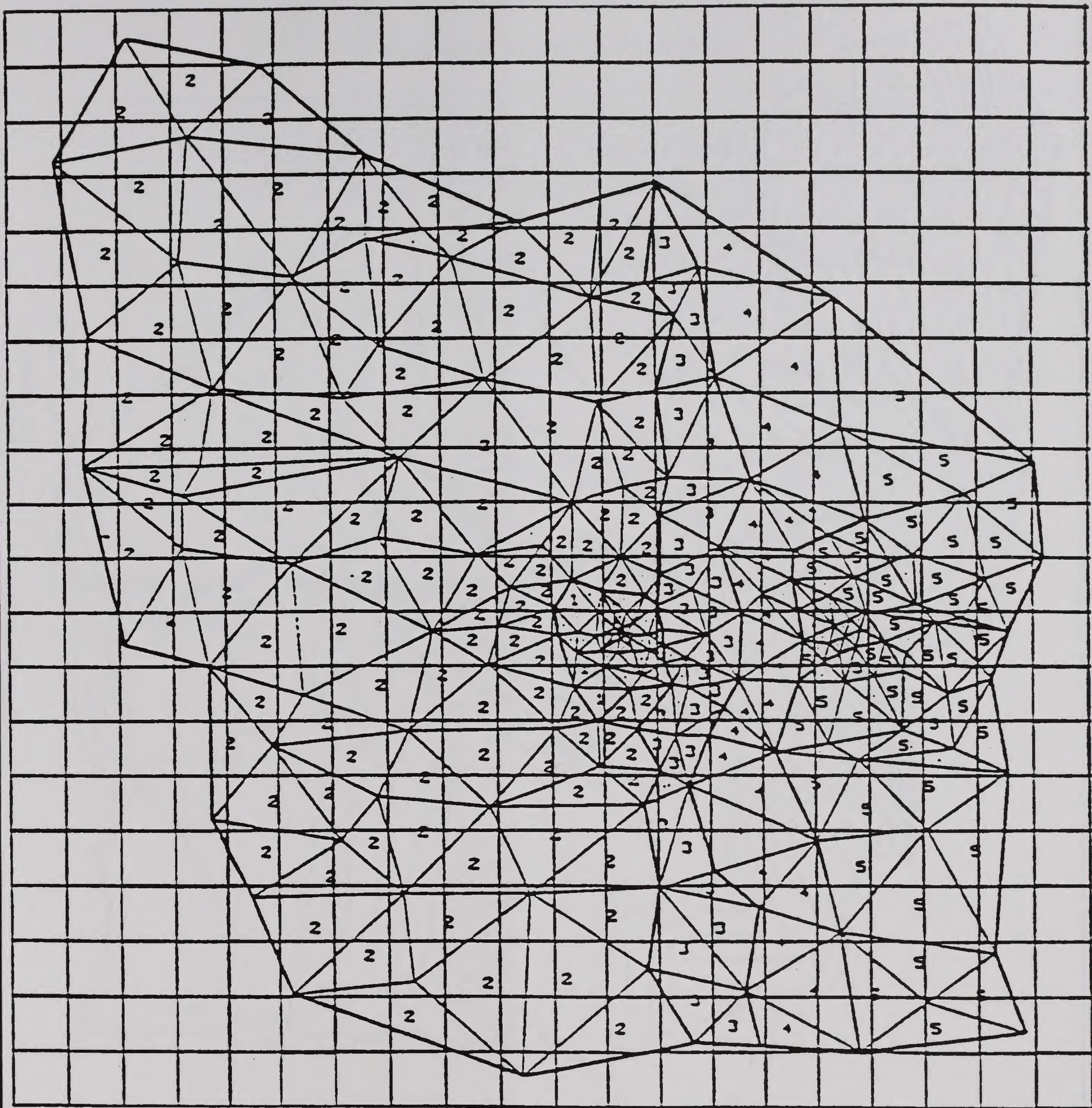
NORTH

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-1
MATERIAL ZONATION
IN 2D MODEL

DATE: JUNE/12/1995 ACAD FILE: 476\MODEL



KEY:
1 : ANDESITE/QUARTZ MONZONITE
2 : PALEOZOIC AND VOLCANIC
3 : WEST PALOMAS BASIN ALLUVIUM
4 : WELL FIELD ALLUVIUM
5 : EAST PALOMAS BASIN ALLUVIUM
6 : PIT VOID

SCALE IN MILES
0 3 6

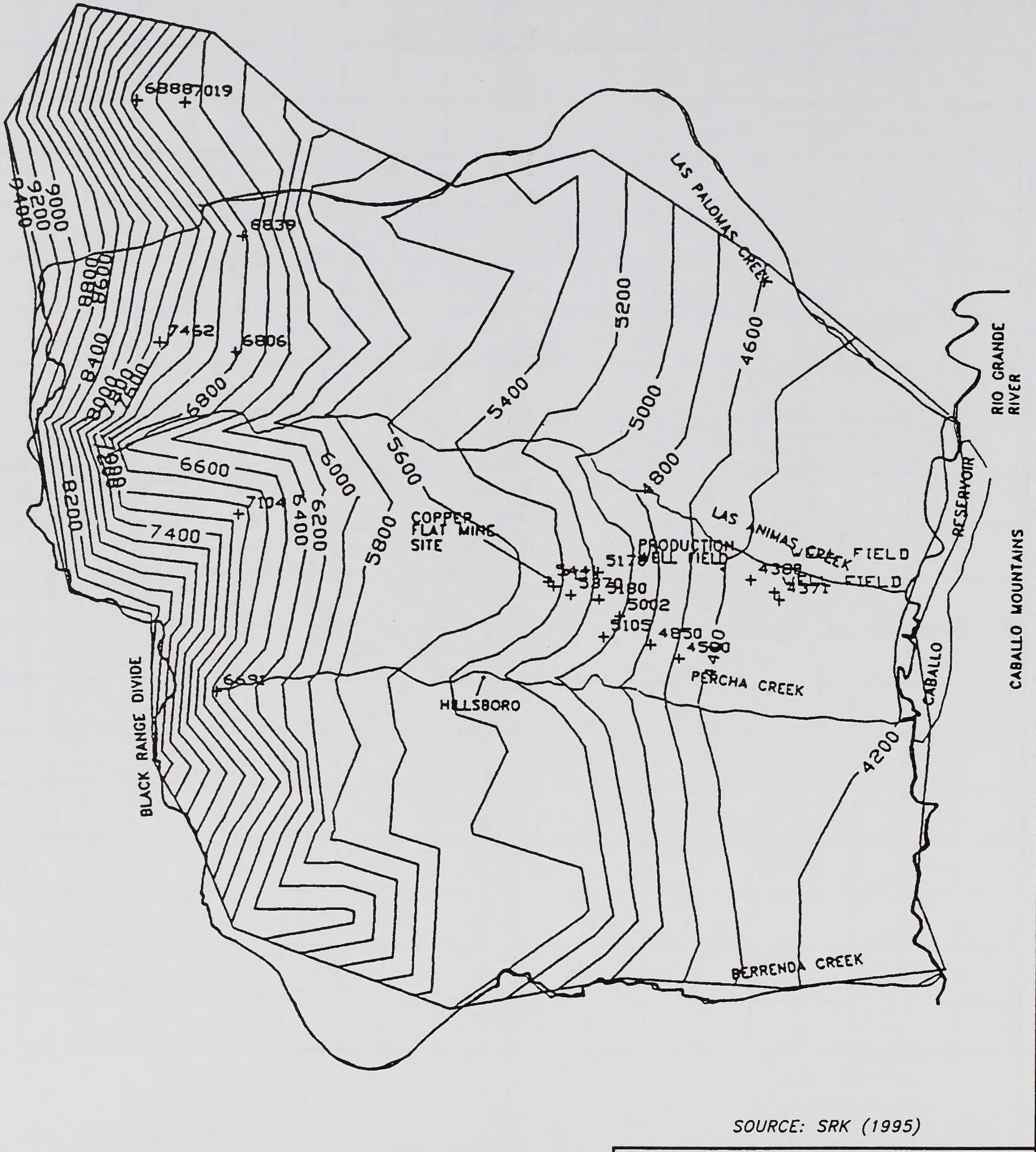
NORTH

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-2
MATERIAL ZONATION
IN 3D MODEL

DATE: JUNE/12/1995 ACAD FILE: 476\MODEL



COPPER FLAT PROJECT

FIGURE A-3
STEADY-STATE
MODEL CALIBRATION RESULTS

DATE: JUNE/12/1995 ACAD FILE: 476\MODEL

Table A-1

Groundwater Modeling Parameters

Mat'l #	Hydraulic Conductivity (feet/year)	Specific Storage (1/ft)	Specific Yield (ratio)	Lithologic Type
1	14	6.38E-6	0.04	Andesite/Monzonite
2	10	6.38E-6	0.04	Paleozoics/Volcanics
3	20	5.04E-5	0.16	West Palomas Basin Santa Fe alluvium
4	40	5.04E-5	0.20	Palomas Basin alluvium in well field
5	2800	2.54E-5	0.23	Palomas Basin alluvium east of well field
6	14	6.40E-6	0.04	Pit area bedrock

See Figures A-1 and A-2 for placement of material numbers in modeling grids.

Source: SRK 1995.

The groundwater models were calibrated against 17 target values that included spring and water table elevations. The root mean square error (RMS) on the calibration ranged from 52 to 68 feet and head differences of 167 feet and a minimum difference of 0 feet. The closeness of the calibration is illustrated in Figures A-4 and A-5. Sensitivity was run on hydraulic conductivity values for layers in the Palomas Basin.

The 2-dimensional (2-D) modeling approach chosen by SRK (1995) provides a maximum impact assessment for withdrawal of water from the Caballo Reservoir and the Rio Grande system because the 2-D approach assumes that the Rio Grande and the Caballo Reservoir are fully penetrating and thus can interact with the aquifer in the Palomas Basin over a vertical distance of 2,000 feet. However, the valley alluvium along the Rio Grande system is probably 100 to 150 feet thick and no thicker than 300 to 500 feet. Thus, the actual interaction with the aquifer in the Palomas Formation is probably only over a maximum distance of approximately 500 feet. Impacts to wells between the production well field and the Rio Grande system are probably minimized by this model approach because the maximum possible withdrawal of water from the Caballo Reservoir is allowed, thus minimizing the water removed from storage in the aquifer and therefore minimizing the drawdown of the water table near wells. Both unconfined (Case A) and confined 2-D (Case B) modeling scenarios were considered by SRK (1995) and were evaluated for impact assessment (SRK 1995).

The 3-D modeling approach chosen by SRK (1995) allows for a comparison of impacts with the 2-D modeling approach with vertical flow now allowed between layers in the Palomas Basin. A range of possible vertical hydraulic conductivities was presented by SRK (1995); however, only the case where the vertical hydraulic conductivity was approximately 1 percent of the horizontal hydraulic conductivity (Case I; SRK 1995) was considered for impact assessment because studies in the Mesilla Basin by Nickerson and Meyers (1993) have shown that this is the relationship in a basin that is a close analog to the Palomas Basin.

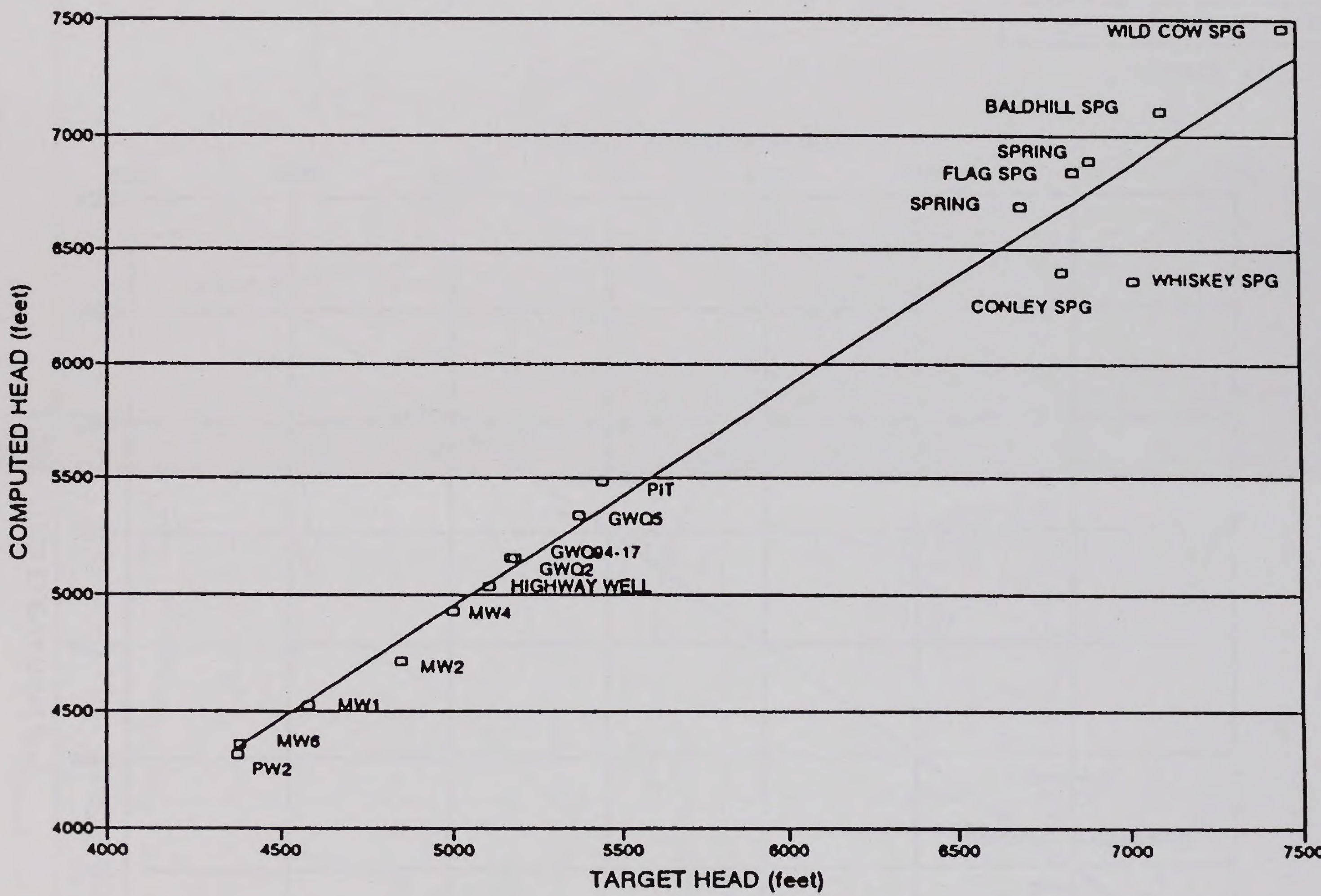
A.1.2 Modeling Results

All results listed below were summarized from review of the Copper Flat Hydrogeologic Report (SRK 1995) on file in the BLM's district office in Las Cruces, New Mexico.

A.1.2.1 Unconfined Groundwater Model (Case A)

The 2-D unconfined groundwater model (Case A) determined that, after 10 years of mining, the pumping of the pit lake could cause a drawdown of the water table of approximately 3 to 4 feet at the Hillscher Well, located west of the tailings impoundment area, and no drawdown at the Highway 90 well, located south of the tailings impoundment. There also may be no drawdown in Tank Canyon, north of the mine area; however, the Pague Well, located north of the pit, could experience 2 to 3 feet of drawdown. No drawdown of the water table in Warm Springs Canyon located approximately 2 miles west of the mine area is expected (Figure A-6).

Drawdown of the water table could be approximately 18 feet in the production well field area after 10 years of pumping and could decrease outward to 1 foot or less at Caballo Reservoir (Figure A-6). Drawdown on the lower reaches of Percha Creek could be around 1 foot and drawdown on the lower reaches of Las

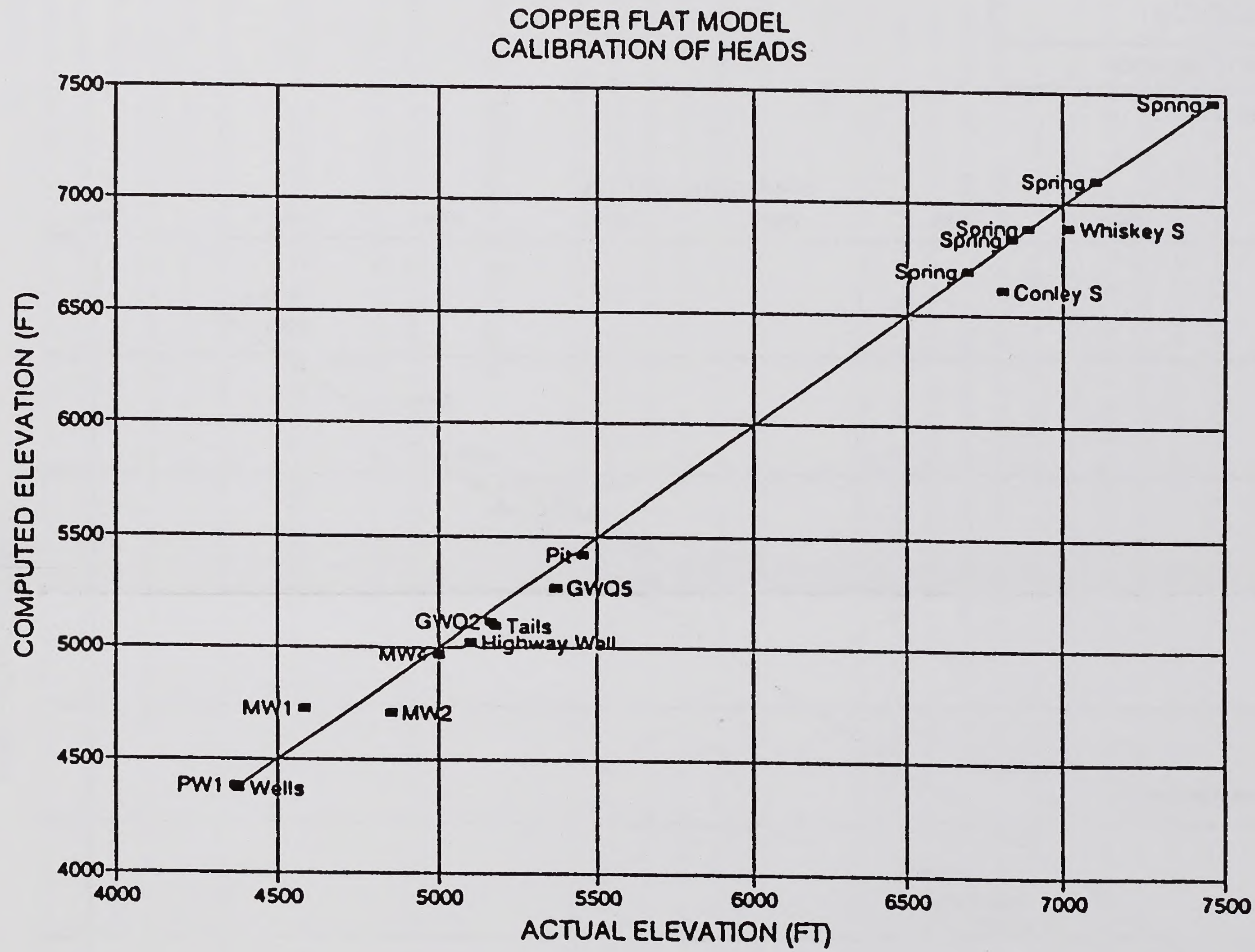


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-4
2-D MODEL CALIBRATION
LINEAR REGRESSION ANALYSIS

DATE: JUN/12/1995 12-476\GRAPH-1

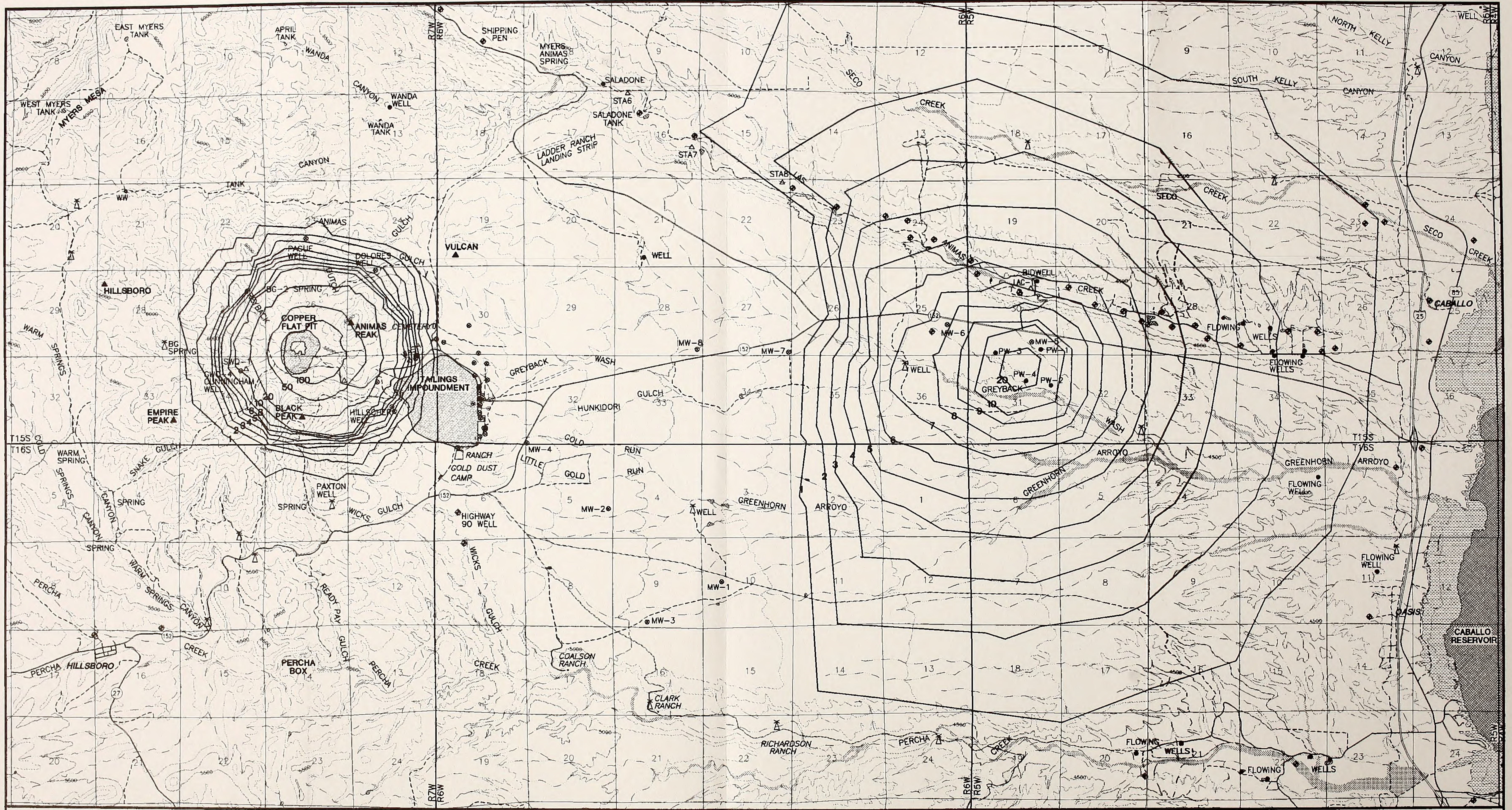


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-5
3-D MODEL CALIBRATION
LINEAR REGRESSION ANALYSIS

DATE: JUN/12/1995 12-476\GRAPH-1



SOURCE: SRK (1995)

LEGEND:

- MONITORING WELL
- WELL
- IRRIGATION WELL
- WINDMILL
- SPRING
- STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

CASE A = 2-D UNCONFINED

NORTH

0 5,825 11,650
FEET

COPPER FLAT PROJECT

FIGURE A-6
DRAWDOWN COPPER FLAT AREA
10 YEARS AFTER MINING
(2-DIMENSIONAL UNCONFINED CASE-A)

DATE: NOV/17/1995 ACAD FILE: 12-476\CASE-A

Animas Creek could be approximately 6 to 8 feet after 10 years of pumping. Private wells between the well field and Caballo Reservoir could experience a drawdown of 1 to 5 feet after 10 years of pumping, in this scenario.

About 140 years after mining commences, evaporation from the pit lake could create a drawdown cone that may cause water level drops of 20 to 30 feet in portions of the Ladder Ranch located adjacent to the mine area. The 10-foot drawdown contour could be located within a mile of the Percha Box and Warm Springs Canyon could experience permanent drawdowns of 10 feet (Figure A-7). Drawdown levels in the Palomas Basin are expected to have returned to pre-pumping levels after 140 years.

Case A would have a maximum withdrawal rate of 599 acre-feet/year at year 10 to 11 of mining.

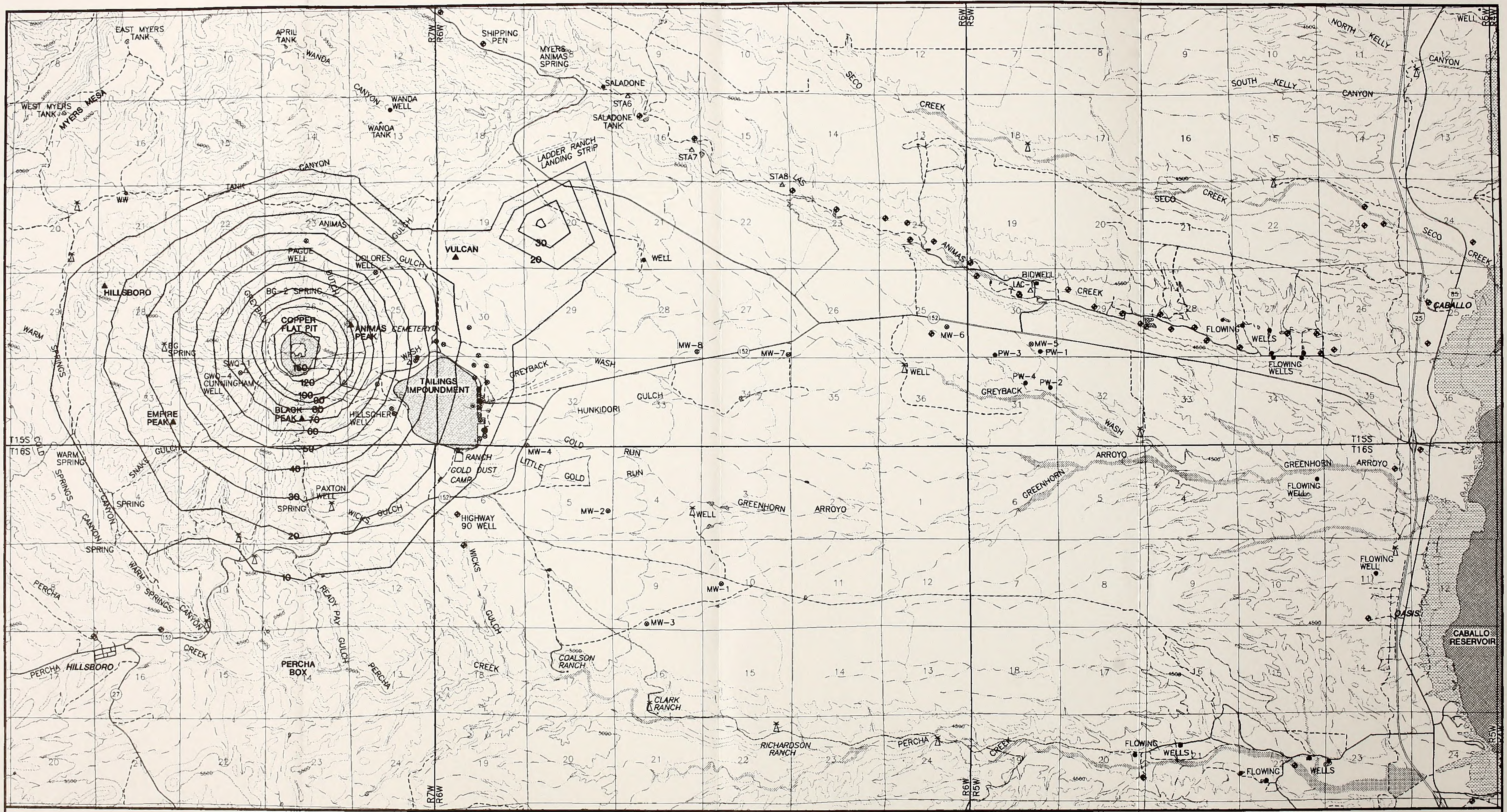
A.1.2.2 2-D Confined Groundwater Model (Case B)

The worst case scenario for pit dewatering would be the 2-D confined flow model (Case B) (Figure A-8). Under this modeling scenario, after 10 years of mining there could be 1 to 2 feet of drawdown in Warm Springs Canyon, 3 to 5 feet of drawdown in Tank Canyon, and 20 to 40 feet of drawdown in the area of the Pague and Dolores wells. This amount of drawdown in these two wells could render either or both of them unusable. The drawdown in Tank Canyon might reduce the amount of flow from Tank Canyon into Las Animas Creek and the projected drawdown in Warm Springs Canyon could reduce the flow in the natural springs found along the canyon. After 10 years of production well pumping, the 1-foot drawdown contour could reach to Caballo Reservoir, the lower reaches of Las Animas and Percha Creeks could experience drawdown levels of 1 to 11 feet and 1 to 4 feet, respectively (Figure A-8).

After 140 years, the drawdown at the Highway 90 well could be 10 to 20 feet, Tank Canyon could experience 20 to 30 feet of drawdown, and Warm Springs Canyon could experience a permanent decline in the water table of about 10 feet up to a maximum of 20 feet (Figure A-9). The Pague and Dolores wells would experience a drawdown of 40 to 50 feet. The Ladder Ranch would experience a permanent decline in the water table of 10 to 40 feet in the portion of the ranch located northeast of the proposed mine area. The Percha Box area might experience a decline of 1 to 2 feet. Drawdown levels in the production well area are expected to have returned to pre-pumping conditions after 140 years (Figure A-9).

A.1.2.3 3-D Unconfined Groundwater Model (Case I)

Ten years after mining began, drawdown from pit dewatering under Case I (Layer 1 to top 200 feet) could range from 0 in Warm Springs Canyon and the Highway 90 Well to 1 foot in Tank Canyon, and 90 feet in the pit area (Figure A-10). Drawdown levels in the production well area after 10 years of pumping could be from 1 foot to 10 feet along the lower reaches of Las Animas Creek. Percha Creek should not be affected. For wells between the production well field and the Caballo Reservoir, expected drawdown after 10 years of pumping could be 1 to 6 feet. Another version of the Case I modeling scenario, Layer 2 (200 to 1,000 feet), could have similar drawdowns (Figure A-11).



LEGEND:

- ◉ MONITORING WELL
- • WELL
- ◈ IRRIGATION WELL
- CASE A = 2-D UNCONFINED
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

NORTH

0 5,825 11,650

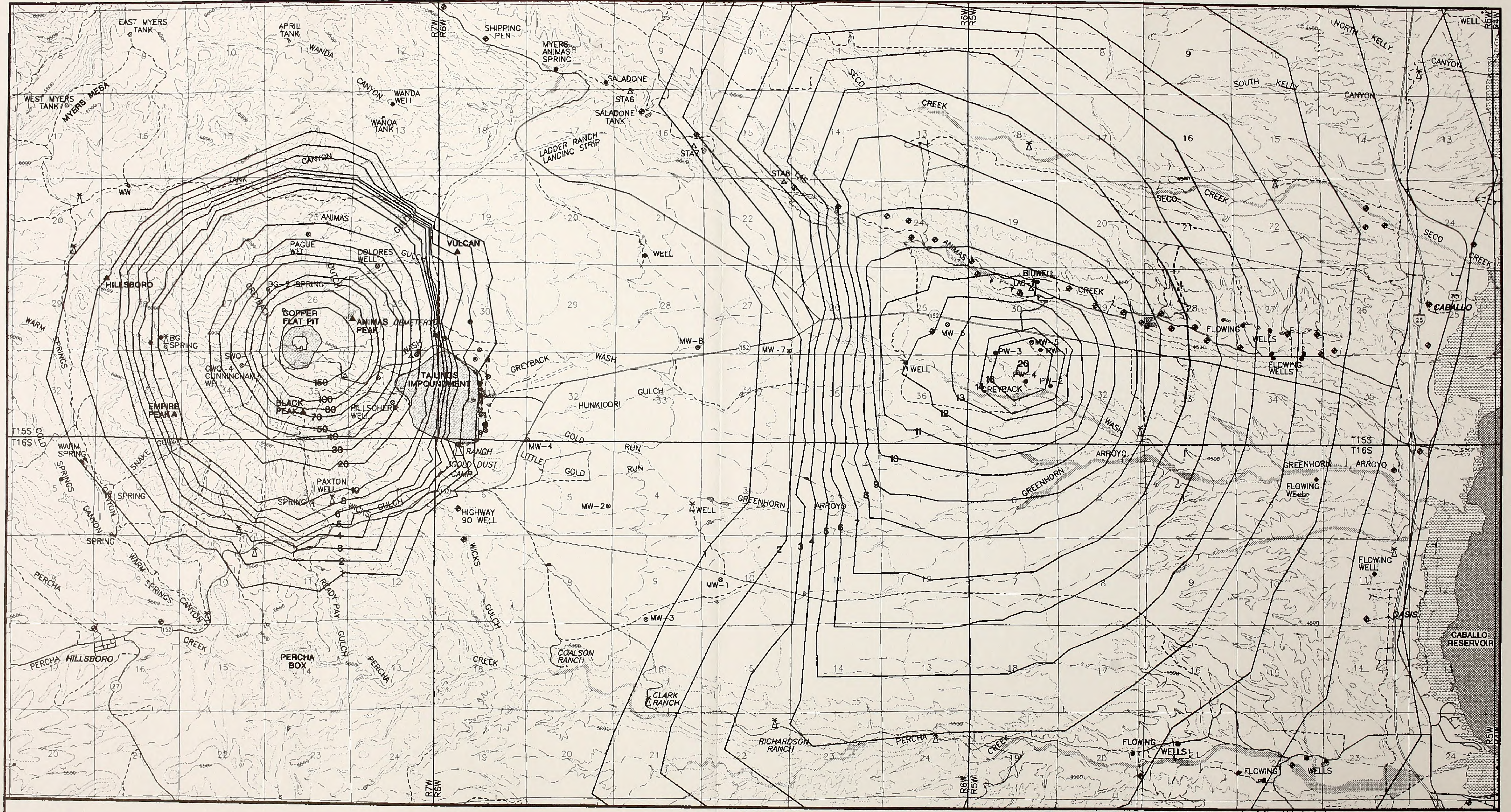
FEET

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-7
DRAWDOWN COPPER FLAT AREA
140 YEARS AFTER MINING
(2-DIMENSIONAL UNCONFINED CASE-A)

DATE: NOV/17/1995 ACAD FILE: 12-476\CASE-A



LEGEND:

- ⊛ MONITORING WELL
- • WELL
- ⊕ IRRIGATION WELL
- CASE B = 2-D CONFINED
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

NORTH

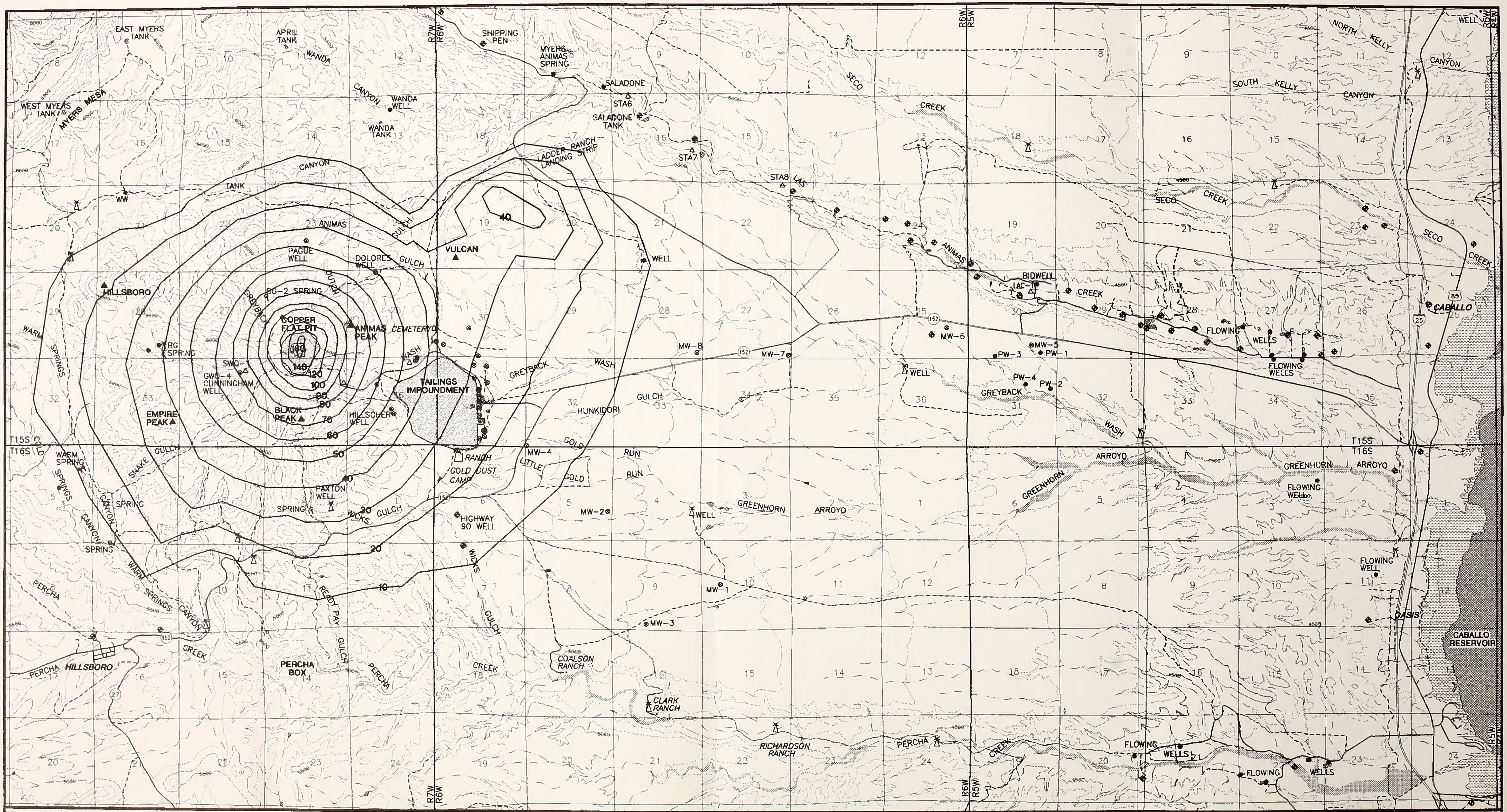
0 — 5,825 — 11,650
FEET

SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-8
DRAWDOWN COPPER FLAT AREA
10 YEARS AFTER MINING
(2-DIMENSIONAL CONFINED CASE-B)

DATE: NOV/7/1995 ACAD FILE: 12-476\CASE-B



SOURCE: SRK (1995)

LEGEND:

- ⊗ MONITORING WELL
- • WELL
- ◈ IRRIGATION WELL
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

CASE B = 2-D CONFINED

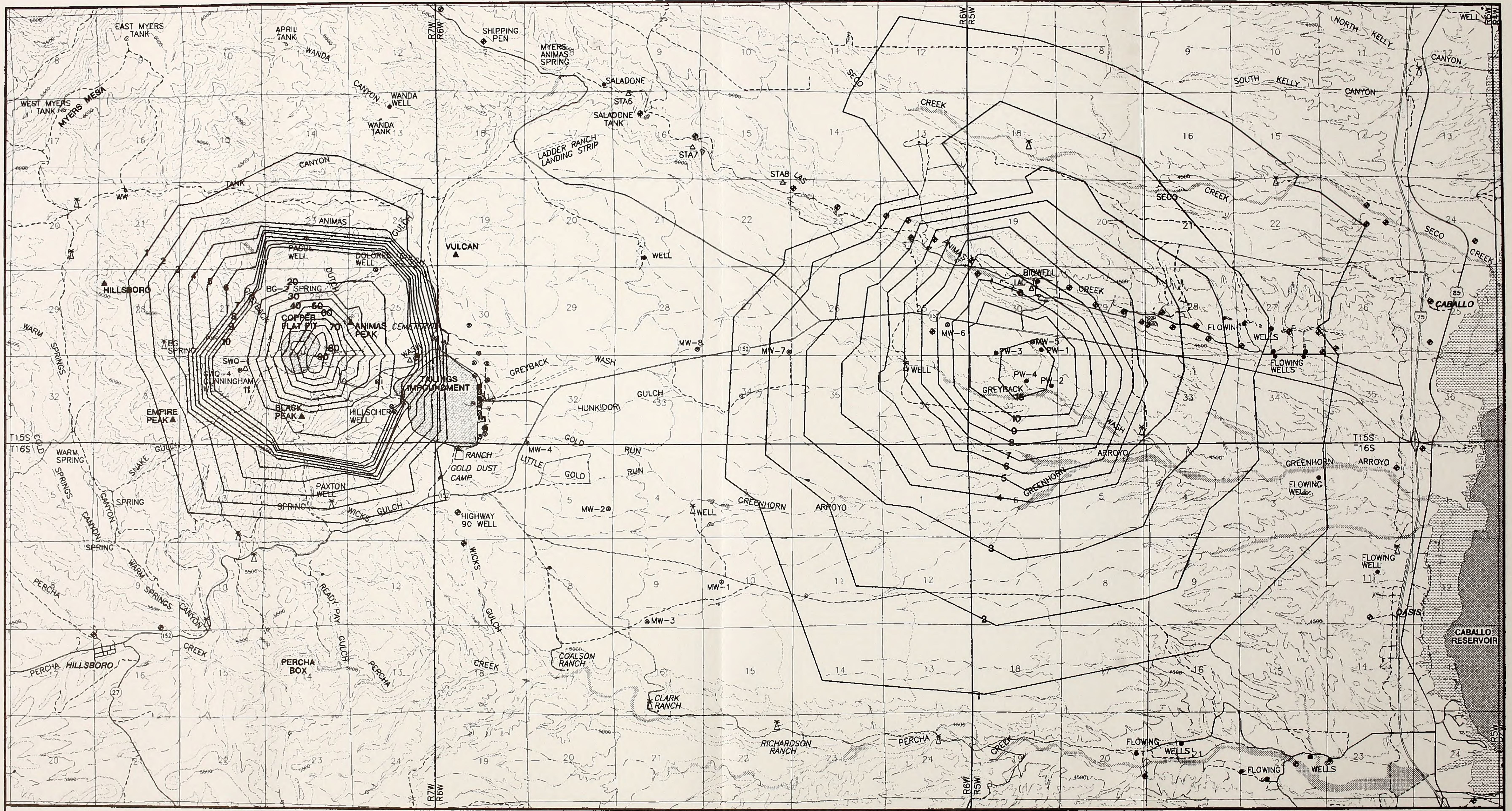
NORTH

0 — 5,825 — 11,650
FEET

COPPER FLAT PROJECT

FIGURE A-9
DRAWDOWN COPPER FLAT AREA
140 YEARS AFTER MINING
(2-DIMENSIONAL CONFINED CASE-B)

DATE: NOV/7/1995 ACAD FILE: 12-476\CASE-B



SOURCE: SRK (1995)

LEGEND:

- ⊗ MONITORING WELL
- • WELL
- ⊕ IRRIGATION WELL
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

CASE I = 3-D UNCONFINED

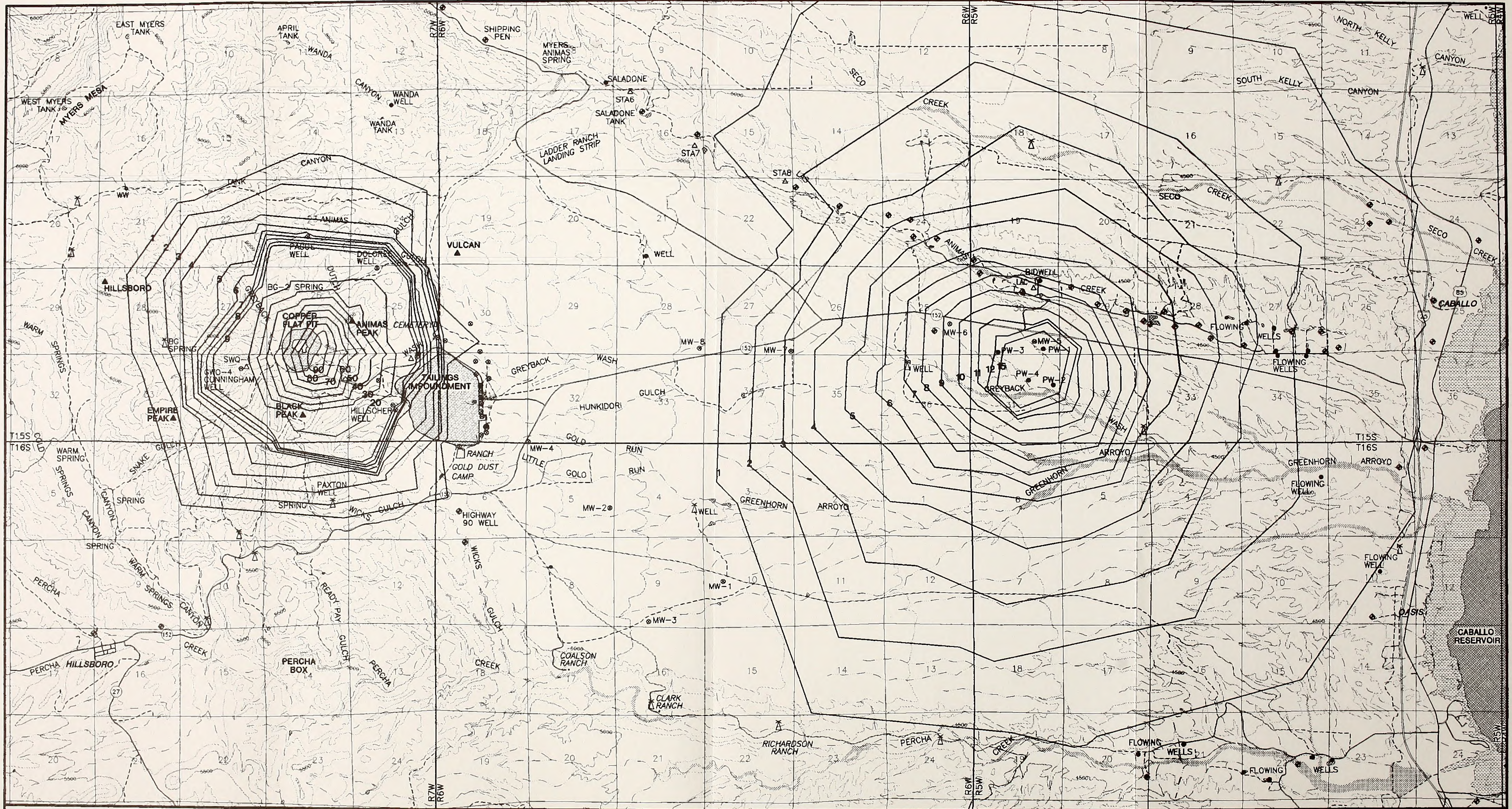
NORTH

0 5,825 11,650
FEET

COPPER FLAT PROJECT

FIGURE A-10
DRAWDOWN COPPER FLAT AREA
10 YEARS AFTER MINING
(3-DIMENSIONAL UNCONFINED CASE I, LAYER 1)

DATE: NOV/17/1995 ACAD FILE: 12-476\CASE-I



LEGEND:

- ⊗ MONITORING WELL
- • WELL
- ⊗ IRRIGATION WELL
- CASE I = 3-D UNCONFINED
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

NORTH

0 — 5,825 — 11,650 FEET

SOURCE: SRK (1995)

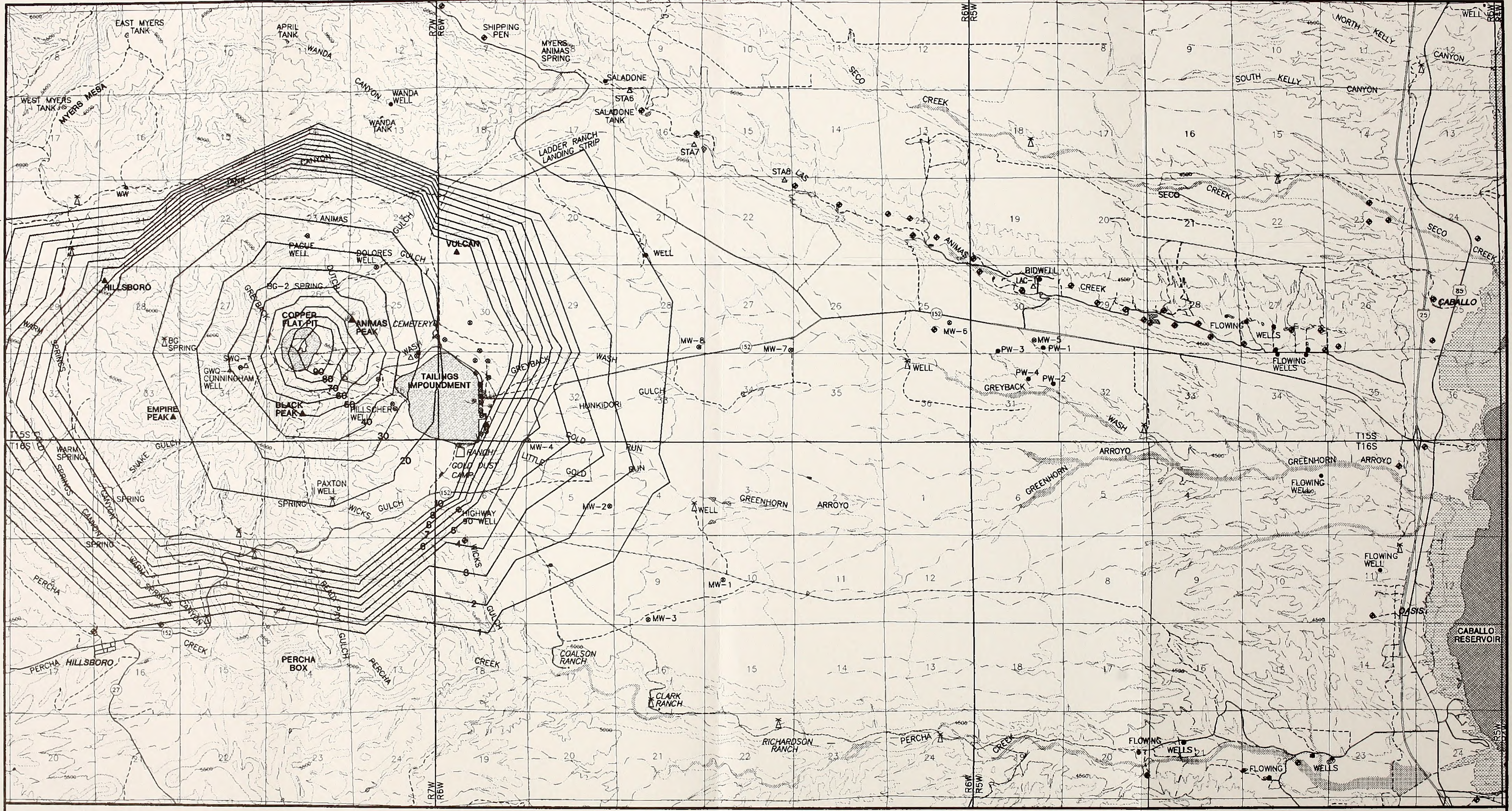
COPPER FLAT PROJECT

FIGURE A-11
DRAWDOWN COPPER FLAT AREA
10 YEARS AFTER MINING
(3-DIMENSIONAL UNCONFINED CASE I, LAYER 2)

DATE: NOV/17/1995 ACAD FILE: 12-476\CASE-I

After 190 years, the drawdown at the Highway 90 well as a result of pit lake evaporation could be 5 to 7 feet, Tank Canyon could experience a drawdown of 10 to 20 feet, and Warm Springs Canyon could have a permanent decline in the shallow water table (top 200 feet; model layer 1) of about 10 feet (Figure A-12). The Pague and Dolores wells could experience a decline in water levels of 20 to 30 feet. The Ladder Ranch could experience a maximum decline of 1 to 2 feet in the water table. Water table levels in the production well area of the Palomas Basin are expected to have slowly returned to pre-pumping conditions after 190 years (Figure A-12).

Case I would have a maximum withdrawal rate of 467 acre-feet/year occurring at year 15 after mining commenced. Figure A-13 shows the average annual depletion rate of the Rio Grande system for each modeling case, while Figure A-14 shows the cumulative depletion for each case. Figure A-15 compares the well drawdown and recovery for all three modeling cases. Tables A-2 to A-3 give the groundwater removal rates for the three modeling cases, and Table A-4 summarizes the depletion of the Rio Grande system as modeled by the two 2-D and one 3-D cases.



SOURCE: SRK (1995)

LEGEND:

- ⊚ MONITORING WELL
- • WELL
- ⊛ IRRIGATION WELL
- CASE I = 3-D UNCONFINED
- WINDMILL
- SPRING
- △ STREAM GAGING STATION OR SURFACE WATER SAMPLE SITE

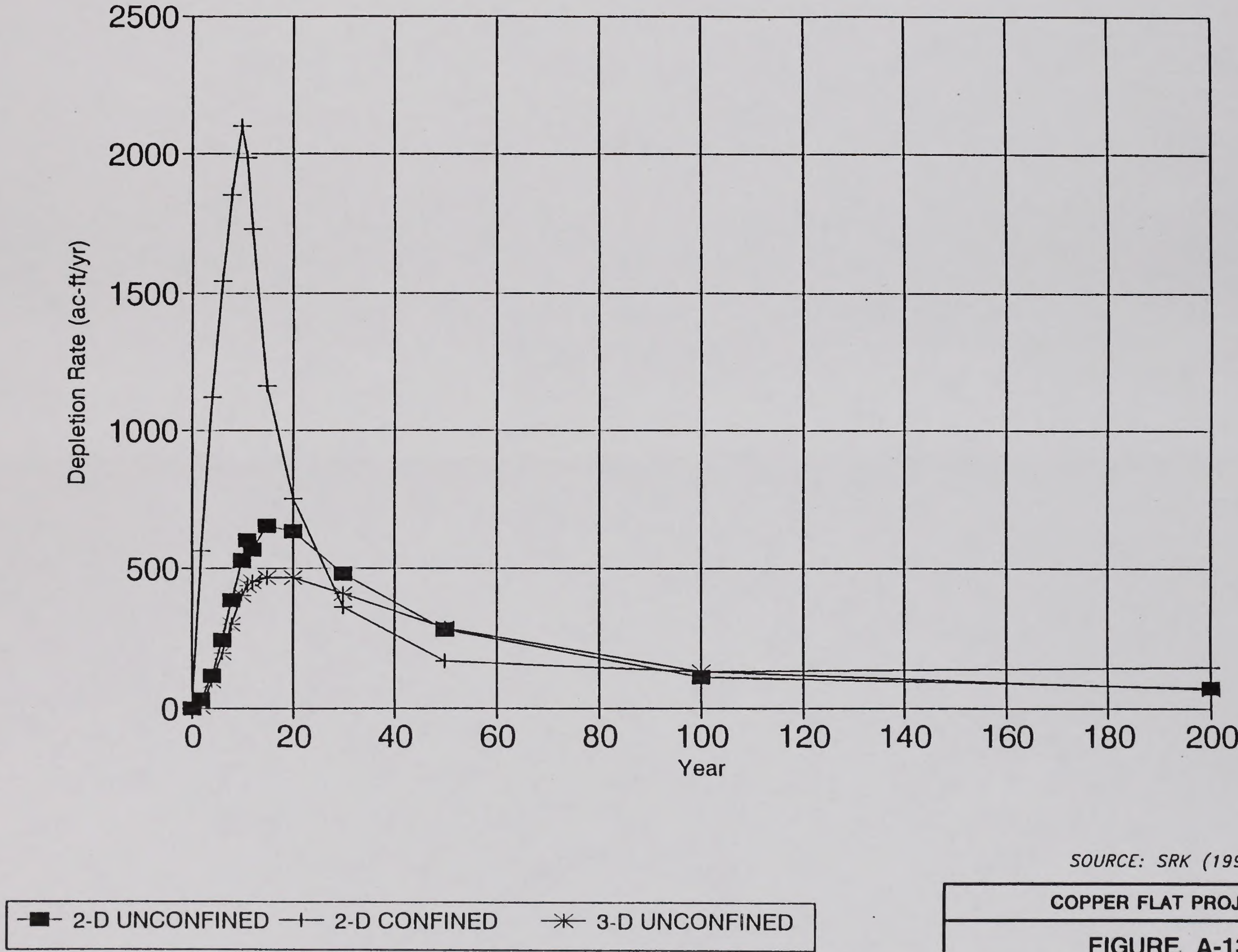
NORTH

0 5,825 11,650
FEET

COPPER FLAT PROJECT

FIGURE A-12
DRAWDOWN COPPER FLAT AREA
190 YEARS AFTER MINING
(3-DIMENSIONAL UNCONFINED CASE I, LAYER 1)

DATE: NOV/17/1995 ACAD FILE: 12-476\CASE-I

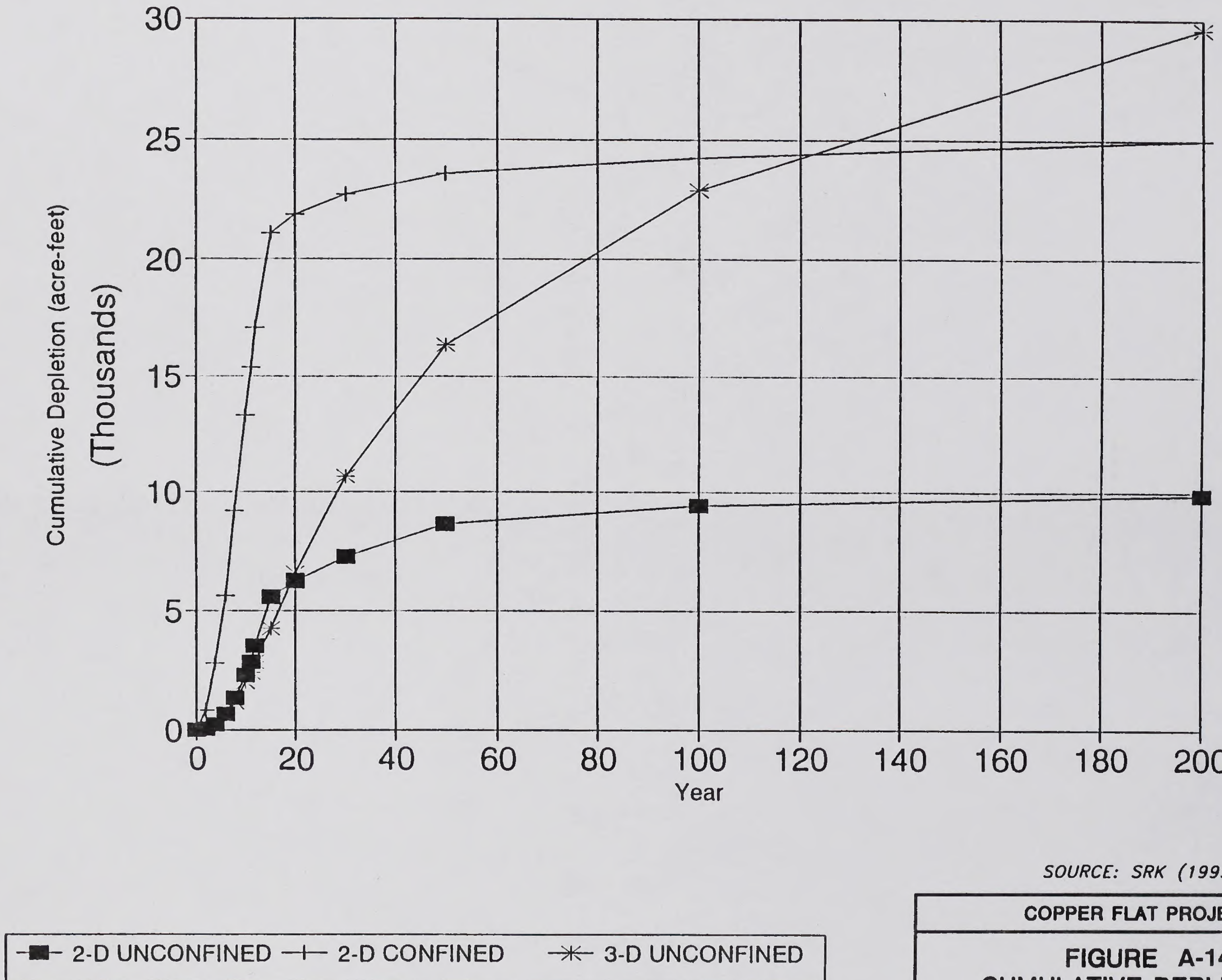


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-13
ANNUAL DEPLETION
RIO GRANDE

DATE: JUN/12/1995 12-476\GRAPH-1

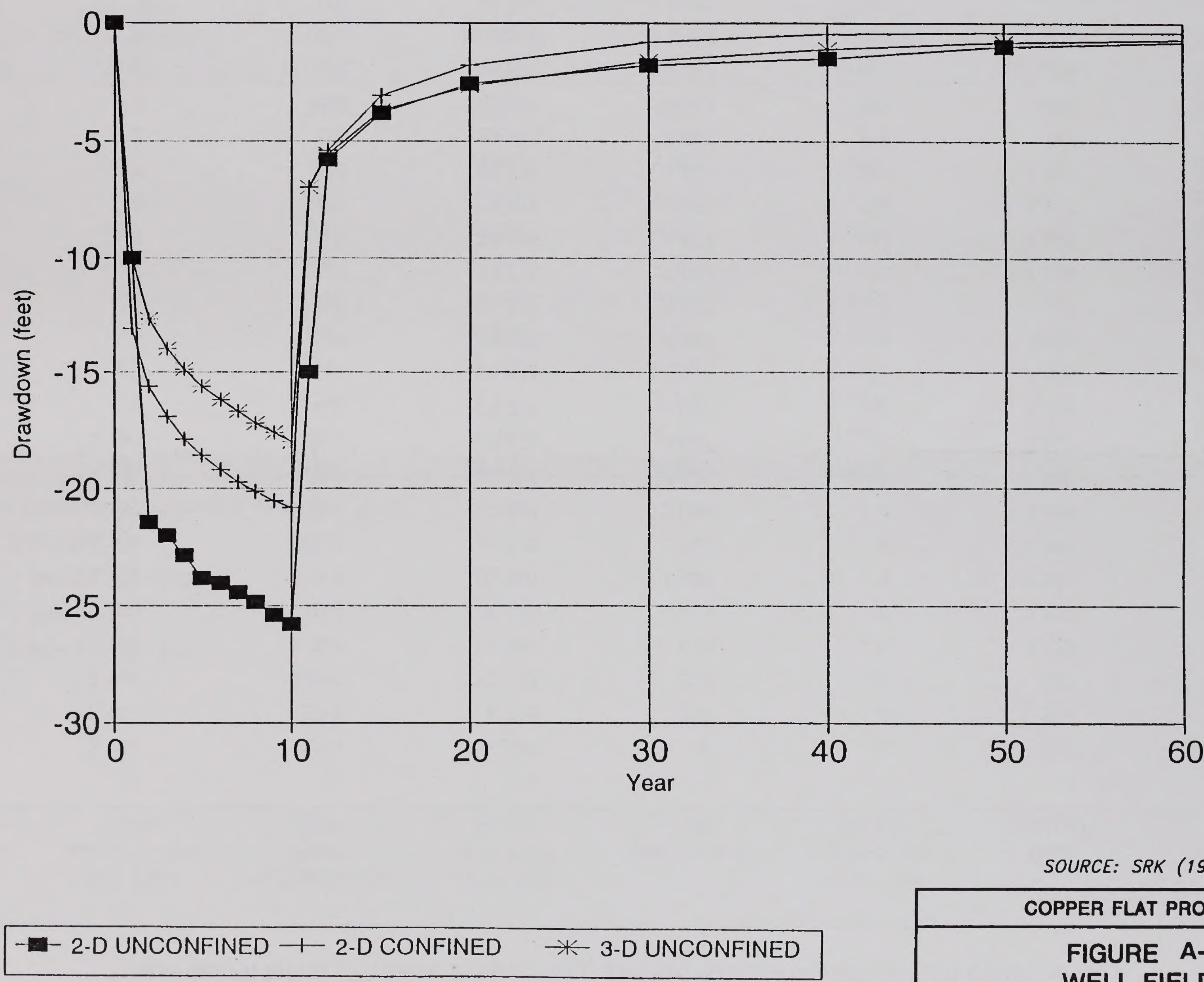


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-14
CUMULATIVE DEPLETION
RIO GRANDE

DATE: JUN/12/1995 12-476\GRAPH-1



SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A-15
WELL FIELD
DRAWDOWN AND RECOVERY

DATE: JUN/12/1995 12-476\GRAPH-1

Table A-2

Predicted Pit Inflow, Pit Lake Evaporation, and Rio Grande Depletion: 2-D Confined Case[1]

Year Ending	Well Field Pumping Rate (gpm)	Pit Dewatering Rate (gpm)	Total from Well Field (ac-ft)[1]	Total From Pit (ac-ft)[1]	Total From Evaporation (ac-ft)[1]	Rio Grande Depletion	
						Rate (ac-ft/yr)	Cumulative (ac-ft)
0	0	0.0	0	0	0	0	0
1	2,100	46.8	3,388	76	0	241	241
2	2,100	109.5	6,775	252	0	558	799
3	2,100	166.0	10,163	520	0	860	1,658
4	2,100	219.2	13,550	874	0	1,122	2,781
5	2,100	270.3	16,938	1,309	0	1,347	4,128
6	2,100	319.9	20,325	1,825	0	1,541	5,668
7	2,100	368.3	23,713	2,420	0	1,708	7,377
8	2,100	415.8	27,100	3,090	0	1,856	9,232
9	2,100	462.5	30,488	3,836	0	1,985	11,218
10	2,100	508.6	33,875	4,657	0	2,101	13,318
10.25	0	0.0	33,875	4,657	-40	2,109	13,846
10.5	0	0.0	33,875	4,657	-25	2,089	14,368
10.75	0	0.0	33,875	4,657	-10	2,045	14,879
11	0	0.0	33,875	4,657	6	1,986	15,376
12	0	0.0	33,875	4,657	72	1,730	17,105
13	0	0.0	33,875	4,657	147	1,506	18,611
14	0	0.0	33,875	4,657	232	1,320	19,931
15	0	0.0	33,875	4,657	322	1,165	21,096
20	0	0.0	33,875	4,657	418	747	21,843
25	0	0.0	33,875	4,657	537	505	22,348
30	0	0.0	33,875	4,657	673	361	22,709
35	0	0.0	33,875	4,657	822	273	22,982
40	0	0.0	33,875	4,657	981	219	23,201
45	0	0.0	33,875	4,657	1,146	186	23,388

Table A-2 (Continued)

Year Ending	Well Field Pumping Rate (gpm)	Pit Dewatering Rate (gpm)	Total from Well Field (ac-ft)[1]	Total From Pit (ac-ft)[1]	Total From Evaporation (ac-ft)[1]	Rio Grande Depletion	
						Rate (ac-ft/yr)	Cumulative (ac-ft)
50	0	0.0	33,875	4,657	1,318	166	23,553
60	0	0.0	33,875	4,657	1,494	147	23,701
70	0	0.0	33,875	4,657	1,677	139	23,840
80	0	0.0	33,875	4,657	1,864	137	23,977
90	0	0.0	33,875	4,657	2,055	137	24,113
100	0	0.0	33,875	4,657	2,248	138	24,251
110	0	0.0	33,875	4,657	2,442	140	24,391
120	0	0.0	33,875	4,657	2,638	142	24,532
130	0	0.0	33,875	4,657	2,834	144	24,677
140	0	0.0	33,875	4,657	3,032	147	24,824
150	0	0.0	33,875	4,657	3,230	150	24,974

[1]Numbers indicative of cumulative totals.

Source: SRK 1995.

gpm = gallons per minute

ac-ft = acre feet

ac-ft/yr = acre feet per year

Table A-3

PREDICTED PIT INFLOW, PIT LAKE EVAPORATION, AND RIO GRANDE DEPLETION: 3-D UNCONFINED CASE

YEAR ENDING	WELL FIELD PUMPING RATE (gpm)	PIT DEWATERING RATE (gpm)	TOTAL FROM WELL FIELD (ac-ft)	TOTAL FROM PIT (ac-ft)	TOTAL FROM EVAPORATION (ac-ft)	RIO GRANDE DEPLETION RATE (ac-ft/yr)	RIO GRANDE DEPLETION CUMULATIVE (ac-ft)
0	0	0	0	0	0	0	0
2	2,135	104	6,887	274	0	1	3
4	2,135	192	13,774	776	0	95	193
6	2,135	272	20,661	1,490	0	196	584
8	2,135	348	27,548	2,404	0	299	1,183
10	2,135	422	34,435	3,512	0	406	1,995
11	0	0	34,435	3,512	-49	437	2,432
12	0	-0	34,435	3,512	-49	451	2,883
15	0	-0	34,435	3,512	30	467	4,285
20	0	-0	34,435	3,512	394	465	6,609
30	0	0	34,435	3,512	1,477	408	10,692
50	0	-0	34,435	3,512	4,091	284	16,382
100	0	0	34,435	3,512	10,999	130	22,886
200	0	0	34,435	3,512	24,815	67	29,601
300	0	0	34,435	3,512	38,631	73	36,931

SOURCE: SRK (1995)

Table A-4

DEPLETION OF RIO GRANDE BY WELL FIELD PUMPING

YEAR	RIO GRANDE ANNUAL DEPLETION RATE (AC-FT/YR)			RIO GRANDE CUMULATIVE DEPLETION (AC-FT)		
	CASE A	CASE B	CASE I	CASE A	CASE B	CASE I
0	0	0	0	0	0	0
2	29	558	1	36	799	3
4	116	1122	95	217	2781	193
6	242	1541	196	634	5668	584
8	384	1856	299	1331	9232	1183
10	529	2101	406	2317	13318	1995
11	599	1986	437	2890	15376	2432
12	565	1730	451	3539	17105	2883
15	648	1165	467	5608	21096	4285
20	631	747	465	6239	21843	6609
30	480	361	408	7272	22709	10692
50	282	166	284	8657	23553	16382
100	112	130	130	9460	24251	22886
200	75	150	67	9885	24974	29601

NOTE: CASE A = 2-D UNCONFINED; CASE B = 2-D CONFINED; CASE I = 3-D UNCONFINED
CASES CORRESPOND TO SRK (1995). AC-FT = ACRE-FEET

APPENDIX A-2

WELL DATA

HILLSBORO MINING DISTRICT AND PALOMAS BASIN

Table A2-1

Identification of Wells

Key	SMI Well #[1]	DTW	Date Msd Elev	Rate	Date Msd Rate	Sp Capacity	Sp Conductance	Temp	Date Msd Temp	Chemistry Table
2	15.5.12.221	67	11/2/66							
3	15.5.12.332	82	11/16/66							
4	15.5.18.412	198	11/2/66							
5	15.5.19.333									
6	15.5.22.122	37	6/20/46				1450	25	7/31/75	CH
6	15.5.22.122	50	11/1/66							CH
7	15.5.23.231	32	11/1/66							
8	15.5.23.411	32.28	7/31/74							
9	15.5.23.412	32.13	7/31/74							
10	15.5.24.414			420	8/1/74		360		8/1/74	
11	15.5.25.143						340		8/1/74	
12	15.5.25.332						980		8/1/74	
13	15.5.26.334	23	6/20/46							
14	15.5.27.311	-10	6/13/46	20.1				23.3		
15	15.5.27.324	-17.8	12/7/66	210	7/11/74		1100		7/11/74	
15	15.5.27.324	-13	6/13/46	43	6/13/46			21.1	6/13/46	
16	15.5.27.333	-16.2		5			370		7/12/74	
17	15.5.27.344	-999		120						
18	15.5.27.413	-37	6/12/46	75	6/12/46			72	6/12/46	CH
18	15.5.27.413	-16.2	12/7/66	150	12/7/66		1620	22.2	5/8/74	CH
19	15.5.27.442			22			1550		7/11/74	CH
20	15.5.27.443	-999		55			700	21.1	7/11/74	CH
21	15.5.27.444	-14.3	12/7/66	20						
22	15.5.28.134	12	8/14/66							
23	15.5.28.313	6	8/16/66							
23	15.5.28.313	12.12	5/7/74	600			440		5/8/74	
24	15.5.28.323						580		7/25/74	
25	15.5.28.413	-6.8	12/7/66	10			640		7/25/74	
26	15.5.28.421									
27	15.5.28.432	-999		200	1/22/66		390		5/8/74	
28	15.5.29.114									
29	15.5.29.144	10	8/16/66							
30	15.5.29.421	9	8/15/66				610		7/25/74	
31	15.5.29.424	19.79	2/23/77	1000	1/22/66					CH
31	15.5.29.424	23.8	5/8/74	1000	1/22/66		455		5/8/74	CH
32	15.5.30.111	-11	3/2/67							
32	15.5.30.111	11	3/1/67							
33	15.5.30.223	7.07	2/23/77							
33	15.5.30.223	7.38	5/20/76							
33	15.5.30.223	12	8/1/66							

Table A2-1 (Continued)

Key	SMI Well #[1]	DTW	Date Msd Elev	Rate	Date Msd Rate	Sp Capacity	Sp Conductance	Temp	Date Msd Temp	Chemistry Table
33	15.5.30.223	12	8/31/66							
34	15.5.30.231	11	9/1/66							
35	15.5.30.343	346.1	5/1/93	1500	1/27/76	14.2	360		1/27/76	
35	15.5.30.343	348.9	1/1/76	1500	1/27/76	14.2	360		1/27/76	
35	15.5.30.343	351.2	5/20/76	1500	1/27/76	14.2	360		1/27/76	
36	15.5.30.432	190	6/6/81							
36	15.5.30.432	190	6/6/81							
36	15.5.30.432	333.48	2/23/77							
36	15.5.30.432	335.42	1/24/76							
36	15.5.30.432	337	1/1/76							
37	15.5.30.442									
38	15.5.30.443	327.69	2/23/77	1500	12/20/76	30.6	340		12/20/75	
39	15.5.31.213	290.3	12/1/80							
40	15.5.31.242	306.8	5/20/76	2.02	1/5/76	19.6	350		1/15/76	
41	15.5.32.444	108	7/2/74				375		7/2/74	
42	15.6.07.111	12	8/9/66							
43	15.6.07.142	5.8	5/21/75							
43	15.6.07.142	11	12/1/92							
43	15.6.07.142	18	8/10/66							
44	15.6.08.444									
44	15.6.08.444	7	12/1/92							
45	15.6.16.141									
46	15.6.16.421									
47	15.6.23.111									
48	15.6.23.142	10	3/2/67							
49	15.6.24.133									
50	15.6.24.143									
51	15.6.24.321	11	9/1/66							
51	15.6.24.321	14.05	7/9/74							
53	15.6.25.414	361.6	2/23/77							
53	15.6.25.413	384.92	1/24/76							
54	15.6.25.423	385	11/1/75							
55	15.6.27.444									
56	15.6.28.433	366	10/1/75							
57	15.6.30.323	60	6/6/81							
57	15.6.30.323	60	6/6/81							
57	15.6.30.323	60	11/1/82							
58	15.6.30.331									
59	15.6.31.431	34	3/1/93							
60	15.6.31.122						700		5/15/75	
60	15.6.31.122	68	11/1/82							
60	15.6.31.122	83.55	6/9/81							

Table A2-1 (Continued)

Key	SMI Well #[1]	DTW	Date Msd Elev	Rate	Date Msd Rate	Sp Capacity	Sp Conductance	Temp	Date Msd Temp	Chemistry Table
60	15.6.31.122	83.55	6/9/81							
61	15.6.31.124									
62	15.6.31.142									
63	15.6.31.144									
64	15.6.31.211	-999	3/1/93							
64	15.6.31.211	70.6	6/11/81							
64	15.6.31.211	70.6	6/11/81	150		1.4				
64	15.6.31.211	72	6/1/81							
65	15.6.31.211A	64.2	6/11/81							
65	15.6.31.211A	64.2	6/11/81							
66	15.6.31.231	60	4/1/72							
66	15.6.31.231	197	6/10/81							
66	15.6.31.231	197	6/10/81	115		0.5				
67	15.6.31.322									
68	15.6.31.324									
69	15.6.31.324									
69	15.6.31.324	98.11	6/6/81							
69	15.6.31.324	98.11	6/6/81							
70	15.6.31.344									
71	15.6.31.431	76.39	6/9/81							
71	15.6.31.431	76.39	6/9/81							
71	15.6.31.431	78	10/1/81							
71	15.6.31.431	83	11/17/66							
72	15.6.31.431A	17	3/1/93							
72	15.6.31.431A	77	6/1/81							
72	15.6.31.431A	77	6/9/81							
72	15.6.31.431A	77	6/9/81							
73	15.6.31.444	122.87	6/9/81							
73	15.6.31.444	122.87	6/9/81	60		0.24				
73	15.6.31.444	123	6/1/81							
74	15.6.36.123	355.4	5/20/76				290	21	5/20/76	
75	15.7.13.124									
76	15.7.23.324									
77	15.7.25.121									
78	15.7.25.442	8.6	6/6/81							
78	15.7.25.442	8.6	6/6/81							
78	15.7.25.442	11	11/1/82							
79	15.7.26.131									
80	15.7.26.324	28.4	6/11/81							
80	15.7.26.324	28.4	6/11/81							
81	15.7.26.344	56.5	1/11/81							
81	15.7.26.344	56.5	6/11/81							

Table A2-1 (Continued)

Key	SMI Well #[1]	DTW	Date Msd Elev	Rate	Date Msd Rate	Sp Capacity	Sp Conductance	Temp	Date Msd Temp	Chemistry Table
82	15.7.26.431	34.5	6/11/81							
82	15.7.26.431	34.5	6/11/81							
83	15.7.28.443									
84	15.7.34.214									
85	15.7.34.223									
85	15.7.34.223	35	6/10/81							
85	15.7.34.223	35	6/10/81							
86	15.7.36.141	10	6/1/81							
86	15.7.36.141	10.45	6/10/81							
86	15.7.36.141	10.45	6/10/81							
87	15.7.36.212	4	11/1/82							
87	15.7.36.212	5.94	6/9/81							
87	15.7.36.212	5.94	6/9/81							
88	15.7.36.322A	20	3/1/93							
88	15.7.36.322A	25.45	6/9/81							
89	15.7.36.322A	23.26	6/9/81							
89	15.7.36.322A	25	6/1/81							
90	15.7.36.322B	16	4/1/93							
90	15.7.36.322B	31	11/1/82							
91	16.5.01.112	85								
92	16.5.02.223									
93	16.5.03.244	-999								
94	16.5.11.233	-999								
95	16.5.11.433	-16	6/12/46	8	6/12/46			22.7		
96	16.5.20.243	28.2	7/10/74	65	5/3/74	6	435		5/3/74	CH
97	16.5.20.424	30.1	5/3/74							
98	16.5.21.141	34.23	7/10/74							
99	16.5.22.313	13.9	7/10/74	900	5/3/74	8	410		5/3/74	CH
100	16.5.22.412	-999					360	24	7/10/74	
101	16.5.23.311	1.82	7/10/74	230	5/3/74	1.9	415		5/3/74	
102	16.5.25.212	23.14	8/1/77							
102	16.5.25.212	24.72	2/10/72							
103	16.6.04.424	328.4	4/15/75				470		4/13/75	
104	16.6.06.314	101	3/1/93							
105	16.6.07.121	56.7	3/1/93							
106	16.6.09.112	136.05	5/19/75							
106	16.6.09.112	160	5/1/75							
107	16.6.10.312	343.1	4/15/75							
108	16.6.16.344									
109	16.6.22.223	33.5	7/10/74							
110	16.6.24.231	85.8	7/10/74							
111	16.7.01.421						550		4/15/75	

Table A2-1 (Continued)

Key	SMI Well #[1]	DTW	Date Msd Elev	Rate	Date Msd Rate	Sp Capacity	Sp Conductance	Temp	Date Msd Temp	Chemistry Table
112	16.7.02.423									
113	16.7.05.242									
114	16.7.09.443	13.51	7/11/74							
115	16.7.16.111	20.29	7/7/74				570		7/2/74	CH
116	15.6.16.111									
117	15.6.16.424									
118	15.6.22.222									
134	15.6.24.413	14	8/1/66							
134	15.6.24.413	15	7/9/74	450						
134	15.6.24.413	17	8/30/66	450						
135	15.6.30.344	-999	3/1/93							
135	15.6.30.344	40	11/8/82							

[1]See Figure A2-1 for a description of New Mexico's well and spring numbering system.

Sources: Davie and Spiegel 1967; Murray 1959; Newcomer et al. 1993; Wilson et al. 1981; SRK 1995.

Table A2-2

Well Locations
Hillsboro Mining District and Palomas Basin

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
1	15.6.31.233			Mine Area	Well	Skute Stone Arroyo		GQW94-17	713550.1	603464.1	5183	3.6	150	120				4		
2	15.5.12.221			Animas/ Seco Creek	Well	Williamsburg	Rex Morgan	15.5.12.221			4270		155		D,I		B	10		
3	15.5.12.332	45		Animas/ Seco Creek	Well	Williamsburg	Velma Hopkins	15.5.12.332			4308				S		B	4		Windmill
4	15.5.18.412	42		Animas/ Seco Creek	Well	Saladone Tank	John Gordon	15.5.18.412			4607				S		B	6		Windmill
5	15.5.19.333	18	51	Animas/ Seco Creek	Well	Skute Stone Arroyo		15.5.19.333												
6	15.5.22.122	43	39	Animas/ Seco Creek	Well	Caballo	John Gordon	15.5.22.122			4394		211		S	CLY	A,B,C	6		Windmill
7	15.5.23.231	44		Animas/ Seco Creek	Well	Caballo	W.M. Dawson	15.5.23.231			4335		550		U		B	16		
8	15.5.23.411			Animas/ Seco Creek	Well	Caballo	W.M. Dawson	15.5.23.411			4320		404		S,U		B,C	13		
9	15.5.23.412			Animas/ Seco Creek	Well	Caballo	W.M. Dawson	15.5.23.412			4315		301		S,U		B,C	5.5		
10	15.5.24.414		40	Animas/ Seco Creek	Well	Caballo	Ed Hopkins	15.5.24.414			4250				D,I,S		B,C			
11	15.5.25.143			Animas/ Seco Creek	Well	Caballo		15.5.25.143			4282				D		C			
12	15.5.25.332			Animas/ Seco Creek	Well	Caballo	J.P. Savage	15.5.25.332			4250		160		D		C	12		
13	15.5.26.334	5	41	Animas/ Seco Creek	Well	Caballo	Gregorio Chavez	15.5.26.334			4257		174		A					
14	15.5.27.311	8	45	Animas/ Seco Creek	Well	Caballo	W.B. Jones/ Gabriel Miranda	15.5.27.311			4312				I,S		A,B	8		
15	15.5.27.324	7	46	Animas/ Seco Creek	Well	Caballo	Rubin Chavez	15.5.27.324			4340		475		D,I,S		A,B,C	8		Flowing

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
16	15.5.27.333			Animas/ Seco Creek	Well	Caballo	John Gordon/ Dick Hansen	15.5.27.333			4325		340		I	SNTF	B,C	6		
17	15.5.27.344		47	Animas/ Seco Creek	Well	Caballo	I. Emery	15.5.27.344			4306				I		B	6		
18	15.5.27.413			Animas/ Seco Creek	Well	Caballo	O. Williams	15.5.27.413			4305		323		I,S	QA	A,B,C			
19	15.5.27.442			Animas/ Seco Creek	Well	Caballo	Mrs. John Gordon	15.5.27.442			4290		375		D,I	SNTF	B,C	6		
20	15.5.27.443	6	48	Animas/ Seco Creek	Well	Caballo	Howard Young/ Caleb J. Hyatt	15.5.27.443			4290		260		I	SNTF/QA	B,C	6		
21	15.5.27.444		49	Animas/ Seco Creek	Well	Caballo	H.F Davis	15.5.27.444			4285		350				B			
22	15.5.28.134	10		Animas/ Seco Creek	Well	Caballo	F.A Weaver	15.5.28.134			4378				D		B			
23	15.5.28.313			Animas/ Seco Creek	Well	Caballo	George Green/ Gertrude VanEaten	15.5.28.313			4400		175		I		B,C	10		
24	15.5.28.323			Animas/ Seco Creek	Well	Caballo	C.E. Caume	15.5.28.323			4365		120		I		C	8		
25	15.5.28.413			Animas/ Seco Creek	Well	Caballo	P.L. Watson	15.5.28.413			4350		180		D	SNTF	B,C	6		
26	15.5.28.421	9	50A	Animas/ Seco Creek	Well	Caballo	W.B. Jones	15.5.28.421			4345		435		I,S		B	8		Flowing
27	15.5.28.432			Animas/ Seco Creek	Well	Caballo	C.A Gilsoul	15.5.28.432			4355		325		D		B,C	8		
28	15.5.29.114	12		Animas/ Seco Creek	Spring	Skute Stone Arroyo	A.C. Hobbs	15.5.29.114			4430				B					Spring Seep
29	15.5.29.144	11		Animas/ Seco Creek	Well	Skute Stone Arroyo	Dan Evans	15.5.29.144			4410				I		B	6		
30	15.5.29.421			Animas/ Seco Creek	Well	Caballo	Mrs. I. Peck	15.5.29.421			4390		57		D	SNTF	B,C	6		
31	15.5.29.424			Animas/ Seco Creek	Well	Caballo	George Green	15.5.29.424			4400		168		I	SNTF	B,C	16		

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
32	15.5.30.111	15-17		Animas/ Seco Creek	Well	Skute Stone Arroyo	John Woods	15.5.30.111			4497		20		I		A,B			Dug Sump Well
33	15.5.30.223	13	52	Animas/ Seco Creek	Well	Skute Stone Arroyo	B.B. Bidwell	Bidwell			4457				I,U		B,C			
34	15.5.30.231	14		Animas/ Seco Creek	Well	Skute Stone Arroyo	J. Turner	15.5.30.231			4452		30				B	60		Dug Sump
35	15.5.30.343			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	PW-3	716342	634110.5	4717	347.1	970		M	SNTF	C,SRK	24	Steel	PI=380-965
36	15.5.30.432			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	MW-5	716976.1	636267.9	4700	329.62	970		U	SNTF	C,SRK	6	Steel	PI=380-965,LG, Test Well
37	15.5.30.442			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo		15.5.30.442												
38	15.5.30.443			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	PW-1	716656.7	636685.2	4693	325.02	960		M	SNTF	C,SRK	24	Steel	PI=365-951, LG
39	15.5.31.213			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	PW-4	716347.9	631462.3	4645	285.42	957		M		SRK	24	Steel	
40	15.5.31.242			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	PW-2	714391.4	637429.6	4670	302.92	1000		M	SNTF	C,SRK	24	Steel	PI=376-995, LG
41	15.5.32.444	3		Palomas between Animas and Percha Creek	Well	Caballo	John Gordon	15.5.32.444			4509				S		B,C	6		Windmill

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (In)	Constr #	Remarks
42	15.6.07.111	26		Animas/ Seco Creek	Well	Bell Mountain	Ladder Ranch	15.6.07.111			4900				U		B	12		
43	15.6.07.142	28		Animas/ Seco Creek	Well	Saladone Tank	Ladder Ranch-Shipping Pen	Shipping Pen			4850		42		S,I	SNTF	C	10		
44	15.6.08.444	27	53	Animas/ Seco Creek	Well	Saladone Tank	Ladder Ranch-Saladone Well	Saladone			4760				S,I		B	10		
45	15.6.16.141	36		Animas/ Seco Creek	Well	Saladone Tank		Saladone Tank												
46	15.6.16.421	25		Animas/ Seco Creek	Well	Saladone Tank		15.6.16.421												
47	15.6.23.111	24	54	Animas/ Seco Creek	Well	Skute Stone Arroyo		15.6.23.111												
48	15.6.23.142	23		Animas/ Seco Creek	Well	Skute Stone Arroyo	J. Chatfield	15.6.23.142			4585				I		B			Dug Sump
49	15.6.24.133	22		Animas/ Seco Creek	Well	Skute Stone Arroyo		15.6.24.133												
50	15.6.24.143	21		Animas/ Seco Creek	Well	Skute Stone Arroyo		15.6.24.143												
51	15.6.24.321	20		Animas/ Seco Creek	Well	Skute Stone Arroyo	J.D. Owen	15.6.24.321			4540		22		U,I		B,C	24		Dug Sump
53	15.6.25.413			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	15.6.25.413			4765				U		C	6		LG
54	15.6.25.423			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	MW-6	718004.2	631023.2	4756	384.5	1000		D		SRK	6	Steel	Windmill
55	15.6.27.444			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	MW-7, Bird			4870		944		D					Test Well

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
56	15.6.28.433			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	MW-8	716385.7	614160	5012	358.93	1000		D		SRK	6	Steel	Test Well
57	15.6.30.323			Mine Area	Well	Skute Stone Arroyo		GWQ-2 McCravey/Dutch Gulch	718012	602536.5	5216	3.12	500		MI	SNTF	SRK	8	Steel	Capped
58	15.6.30.331			Mine Area	Well	Hillsboro		Ladder Ranch	717012	601017	5233							8	Stone	Destroyed, buried
59	15.6.31.431			Mine Area	Well	Skute Stone Arroyo		Irwin	711784.9	603515.4	5171		500				SRK	8	Steel	Electric Pump
60	15.6.31.122		55	Mine Area	Well	Skute Stone Arroyo	Quintana Minerals	GWQ-8 Greer Windmill	715757	602842.9	5203		500		S	SNTF	C,SRK	8	Steel	Windmill, caved to 156ft
61	15.6.31.124			Mine Area	Well	Skute Stone Arroyo		NP-4	714995.4	602881.9	5200	27.85	11[illegible]		MW		SRK	2	Steel	Measured depth = 100.35
62	15.6.31.142			Mine Area	Well	Skute Stone Arroyo		GWQ-10	714312.9	603227.2	5200	17.98	121		MW		SRK	3	PVC	E. side of tailing pond
63	15.6.31.144			Mine Area	Well	Skute Stone Arroyo		NP-3	713588.1	603228.8	5187	5.9	100		MW		SRK	2	Steel	Measured depth = 76.25
64	15.6.31.211			Mine Area	Well	Skute Stone Arroyo		GWQ-1 N. Inspiration	715721.6	603595.1	5183	0	401		MI	SNTF	SRK	14	Steel	S.C. = 1.4gpm/ft @150gpm
65	15.6.31.211A			Mine Area	Well	Skute Stone Arroyo		15.6.31.211A			5190				U	SNTF		9		
66	15.6.31.231			Mine Area	Well	Skute Stone Arroyo	Quintana Minerals	GWQ-9 S.Inspiration; IDW-1	714726.2	603650.8	5195	14.94	767		MI	SNTF	SRK	16	Steel	S.C. = .5gpm/ft@ 115gpm, Sealed
67	15.6.31.322			Mine Area	Well	Skute Stone Arroyo		GWQ-11	713229.1	603265.1	5183	17.71	84.5		MW		SRK	3	PVC	E. Side Tailing pond
68	15.6.31.324			Mine Area	Well	Skute Stone Arroyo		NP-5	712724.4	603232.7	5186	18.74	40.6		MW		SRK	2	Steel	
69	15.6.31.324			Mine Area	Well	Skute Stone Arroyo		NP-2	712426.9	603242.7	5179	26.7	110		MW,U	SNTF	SRK	2	Steel	Measured depth = 97.7
70	15.6.31.344			Mine Area	Well	Skute Stone Arroyo		NP-1	711323.4	603248.3	5176	26.45	105.6		MW		SRK	2	Steel	
71	15.6.31.431			Mine Area	Well	Skute Stone Arroyo	Buck Greer	Irwin			5171		500		MI,D	SNTF	C	6		Windmill
72	15.6.31.431A			Mine Area	Well	Skute Stone Arroyo	Quintana Minerals	GWQ-7 Old Office	711844.2	603518.8	5172	18.78	500		MI	SNTF	SRK	8	Steel	Measured depth = 56.87

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
73	15.6.31.444			Mine Area	Well	Skute Stone Arroyo	Quintana Minerals	MW-4	710945.9	605940.3	5135	78.9	1500		MW	SNTF	SRK	6	Steel	S.C. = .24gpm/ft @60gpm
74	15.6.36.123			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	John Gordon	15.6.36.123			4743				S		B,C	6		Windmill
75	15.7.13.124	37		Animas/ Seco Creek	Well	Bell Mountain		Wanda Well												
76	15.7.23.324			Animas/ Seco Creek	Well	Hillsboro		Pague Well	723140	592575	5550	5.5	26				SRK	36	Conc.	Hand Dug
77	15.7.25.121			Mine Area	Well	Hillsboro		Dolores Well			5380	31.6	56				SRK	6	Steel	Old Shaft, not found
78	15.7.25.442			Mine Area	Well	Hillsboro	Quintana Minerals	GWQ-3 Shale/Shack Well	717067.3	600780.8	5250	10.6	33		U	AA	SRK	36	Conc.	Hand Dug, buried
79	15.7.26.131			Mine Area	Spring	Hillsboro		BG-2 Sp.			5960									
80	15.7.26.324			Mine Area	Mine Shaft	Hillsboro		15.7.26.324			5531				U	IGN.		60		Abandoned Mine Shaft
81	15.7.26.344			Mine Area	Mine Shaft	Hillsboro		15.7.26.344			5480				U	IGN.		48		Abandoned Mine Shaft
82	15.7.26.431			Mine Area	Mine Shaft	Hillsboro		15.7.26.431			5335				U	IGN.		96		Abandoned Mine Shaft
83	15.7.28.443			Mine Area	Spring	Hillsboro		Big Sp.			5765									
84	15.7.34.214			Mine Area	Surface	Hillsboro		SWQ-1												Surface Water Sampling Pit
85	15.7.34.223			Mine Area	Well	Hillsboro	Quintana Minerals	GWQ-4 Cunningham	715420.5	589028.8	5539				S	AA	SRK	8	Steel	Windmill
86	15.7.36.141			Mine Area	Well	Hillsboro	Quintana Minerals	GWQ-5 Rock Lined			5353		21		U	AA		48	Steel	Hand Dug
87	15.7.36.212			Mine Area	Well	Hillsboro		Guest House	716105.3	599402	5283	5.5	28		U	AA	SRK	30	Conc.	Hand Dug
88	15.7.36.322A			Mine Area	Well	Hillsboro	Quintana Minerals	GWQ-6 Hillsher House West			5385		85		MW	IGN.		8	Steel	not found
89	15.7.36.322A ?			Mine Area	Well	Hillsboro		15.7.36.322A			5372		8		U	IGN.		60		
90	15.7.36.322B			Mine Area	Well	Hillsboro		Hillsher House East			5380	31	39					60	Conc.	Hand Dug

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
91	16.5.01.112			Palomas between Animas and Percha Creek	Well	Caballo	Carley	16.5.01.112			4302		100							
92	16.5.02.223		58	Palomas between Animas and Percha Creek	Well	Caballo		16.5.02.223												
93	16.5.03.244	2		Palomas between Animas and Percha Creek	Well	Caballo	John Gordon	16.5.03.244			4355									
94	16.5.11.233	1	59	Palomas between Animas and Percha Creek	Well	Caballo	Unknown	16.5.11.233			4310									
95	16.5.11.433	53	60	Palomas between Animas and Percha Creek	Well	Caballo	C.A. Moore	16.5.11.433			4305		232			QA	A	6		
96	16.5.20.243		61	Percha Creek	Well	Caballo	J.J. Holden	16.5.20.243			4400		190		I	SNTF	C	6		Casing 6-96,OP. Flowing
97	16.5.20.424			Percha Creek	Well	Caballo		16.5.20.424			4382				I		C			
98	16.5.21.141		62-63	Percha Creek	Well	Caballo		16.5.21.141			4376				I		C	12		Flowing Well
99	16.5.22.313		64	Percha Creek	Well	Caballo	Frank Burris	16.5.22.313			4325		265		I	SNTF	C	12		Flowing Well
100	16.5.22.412			Percha Creek	Well	Caballo	W.F. Hanna	16.5.22.412			4300		100		D		C	6		Flowing Well
101	16.5.23.311		65	Percha Creek	Well	Caballo	Dawson	16.5.23.311			4282		280		I	SNTF	C	8		Flowing Well
102	16.5.25.212		67	Percha Creek	Well	Caballo	U.S. Gov't	16.5.25.212			4200				U		C			Observ. Well
103	16.6.04.424			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo		16.6.4.424			4936				S		C	6		Windmill

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
104	16.6.06.314			Mine Area	Well	Skute Stone Arroyo		Highway 90			5206		135		S					Flowing Well
105	16.6.07.121			Percha Creek	Spring	Skute Stone Arroyo		16.6.07.121			5100									Spring
106	16.6.09.112			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	MW-2	700122.3	613218.1	4980	142.25	1500		U		C,SRK	6	Steel	Windmill
107	16.6.10.312			Palomas between Animas and Percha Creek	Well	Skute Stone Arroyo	Quintana Minerals	MW-1	705109.7	612379.6	4995		1000		MW		C,SRK	6	Steel	Test Well, windmill
108	16.6.16.344		71	Percha Creek	Well	Skute Stone Arroyo	Clark Ranch	Clark Ranch Well												Windmill
109	16.6.22.223			Percha Creek	Well	Skute Stone Arroyo	Richardson	Richardson Ranch Well			4626				S		C	8		Windmill
110	16.6.24.231			Percha Creek	Well	Skute Stone Arroyo	Richardson	16.6.24.231			4512				S		C	8		
111	16.7.01.421			Mine Area	Well	Hillsboro		16.7.01.421			5260				S		C			
112	16.7.02.423			WICKS GULCH	Well	Hillsboro		Paxton	707250	592875	5500		30				SRK			Hand Dug, not found
113	16.7.05.242			Warm Spring Canyon	Spring	Hillsboro		Warm Sp.			5530									
114	16.7.09.443			Percha Creek	Well	Hillsboro	Roy Schoenradt	16.7.09.443			5240		175		D	SNTF	C	8		
115	16.7.16.111			Percha Creek	Well	Hillsboro	Hillsboro Domestic Users Assoc	16.7.16.111			5240		250		P		C	6		PI=180-259
116	15.6.16.111			Animas/ Seco Creek	Well	Saladone Tank		STA6												
117	15.6.16.424			Animas/ Seco Creek	Well	Saladone Tank		STA7												
118	15.6.22.222			Animas/ Seco Creek	Well	Skute Stone Arroyo		STA8												
119	15.6.31.322			Mine Area	Well	Skute Stone Arroyo		SRKBH-1-94	713227.2	602905.1	5218		53	36				2		
120	15.6.31.322			Mine Area	Well	Skute Stone Arroyo		SRKBH-2-94	713220.6	602919.1	5218		33.5	28.5				2		
121	15.6.31.322			Mine Area	Well	Skute Stone Arroyo		GQW94-13	713542.5	603272.3	5186	6	104.5	73.95				4.5		

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
122	15.6.31.411			Mine Area	Well	Skute Stone Arroyo		GQW94-14	713428.5	603828.5	5178	-0.75	157.5	127.5				4.5		
123	15.6.31.411			Mine Area	Well	Skute Stone Arroyo		GQW94-15	712920.8	603805.4	5168	-1.5	142	112				4		
124	15.6.31.322			Mine Area	Well	Skute Stone Arroyo		GQW94-16	713188.5	603249	5183	16	45	25				4		
125	16.6.6.112			Mine Area	Well	Skute Stone Arroyo		GWQ-12	710530	610869	5223	76.03	130				SRK	3	PVC	Plugged, So. side tailing
126	15.6.31.411			Mine Area	Well	Skute Stone Arroyo		GQW94-18	713358.6	603381.9	5181	-1111	50	10				4		
127	15.6.31.233			Mine Area	Well	Skute Stone Arroyo		GQW94-19	713750.6	603379	5189	50	51	15				4		
128	15.6.31.144			Mine Area	Well	Skute Stone Arroyo		GQW94-20	713668.9	603233.6	5189	22	338	288				4.5		
129	15.6.31.233			Mine Area	Well	Skute Stone Arroyo		GQW94-21A	713493.6	604084.4	5177	-0.1	263	213				2		
130	15.6.31.233			Mine Area	Well	Skute Stone Arroyo		GQW94-21B	713493.6	604084.4	5177	0.84	324	285				2		
131	15.5.30.223			Animas/ Seco Creek	Well			MW-9	719953.2	636689.9	4443.5	68.7	250	200.75				4.5		
132	15.5.30.223			Animas/ Seco Creek	Well			MW-10	719968.3	636741	4442.6	68.2	120.45	80.36				4.5		
133	15.5.30.223			Animas/ Seco Creek	Well			MW-11	719920.3	636727.7	4442.8	8.21	31.84	12				4.5		
134	15.6.24.413	19		Animas/ Seco Creek	Well	Skute Stone Arroyo	Harvey Chatfield	Barnhouse			4525		280		I	SNTF	C	15		Dug Sump
135	15.6.30.344			Mine Area	Well	Skute Stone Arroyo		McCravey-Greyback	716338.4	603107.9	5195	40	500				SRK	8	Steel	Not found
136				Mine Area				Tailings Decant									SRK			
137	15.7.36.212			Mine Area	Surface	Bell Mountain		SWQ-3									SRK			
138	15.7.35.242			Mine Area	Surface	Bell Mountain		SWQ-2									SRK			
139	15.7.26.343			Mine Area	Pit	Bell Mountain		Pit-Shore									SRK			
140	15.7.26.343			Mine Area	Pit	Bell Mountain		Pit-40 ft.									SRK			
141	15.7.26.343			Mine Area	Pit	Bell Mountain		Pit-10 ft.									SRK			
142				Mine Area				Alluvium Decant									SRK			
143				Mine Area				Acid Rock Drainage									SRK			

Table A2-2 (Continued)

Key	SMI Well #[1]	Lac Rpt #	Hot spg Rpt #	Area	Sample Source	Topo Sheet	Owner	Existing Well Name	North	East	Surface Elev	DTW	TD Well	Screen top	Water Use	Geologic Unit	Reference	Diameter (in)	Constr #	Remarks
144				Rio Grande	Surface			Rio Grande R. @ El Paso									SRK			
145	15.5.30.213			Animas/ Seco Creek	Well	Skute Stone Arroyo		15.5.30.213									C			
146	15.7.26.341			Mine Area	Pit	Hillsboro		NLP									SRK			200 ft. S. of N. shore-3m deep
147	15.7.26.341			Mine Area	Pit	Hillsboro		NLP									SRK			200 ft. S. of N. shore-8m deep
148	15.7.26.343			Mine Area	Pit	Hillsboro		SPL									SRK			200 ft. N. of S. shore-3m deep
149	15.7.26.343			Mine Area	Pit	Hillsboro		SPL									SRK			200 ft. N. of S. shore-5m deep
150	15.7.26.344			Mine Area	Pit	Hillsboro		CF-Pit									SRK			S. Shore - surface
151	15.7.26.343			Mine Area	Pit	Hillsboro		CF-Pit2									SRK			center of lake - 7m deep
152				Caballo Resevoir	Surface	Caballo		CF-Caballo									SRK			3m deep
153				Mine Area	Surface			GRYBK-Outfall									SRK			Greyback Gulch-culvert outfall
154	16.7.14.234			Percha Box	Surface	Hillsboro		PC-2									SRK			Percha Box
155	16.7.14.234			Percha Box	Surface	Hillsboro		PC-4									SRK			Percha Box
156	16.7.14.234			Percha Box	Surface	Hillsboro		PC-6									SRK			Percha Box
157	15.5.30.214			Animas/ Seco Creek	Surface			LAC-1									SRK			Las Animas Cr.-near Irwin house
158	15.6.31.144			Mine Area	Well	Skute Stone Arroyo		IW-1	713567.5	603227.9	5186	18.7	49				SRK	4	PVC	
159	15.6.31.144			Mine Area	Well	Skute Stone Arroyo		IW-2	713909	603214.1	5195	32	44.15				SRK	4	PVC	
160	15.6.31.142			Mine Area	Well	Skute Stone Arroyo		IW-3	714269.4	603206.8	5200	31	44.9				SRK	4	PVC	

[1]See Figure A2-1 for a description of New Mexico's spring and well numbering system.

Sources: Davie and Spiegel 1967; Murray 1959; Newcomer et al. 1993; Wilson et al. 1981; SRK 1995.

APPENDIX A-3

WATER QUALITY DATA

HILLSBORO MINING DISTRICT AND PALOMAS BASIN

1. Stiff Diagrams

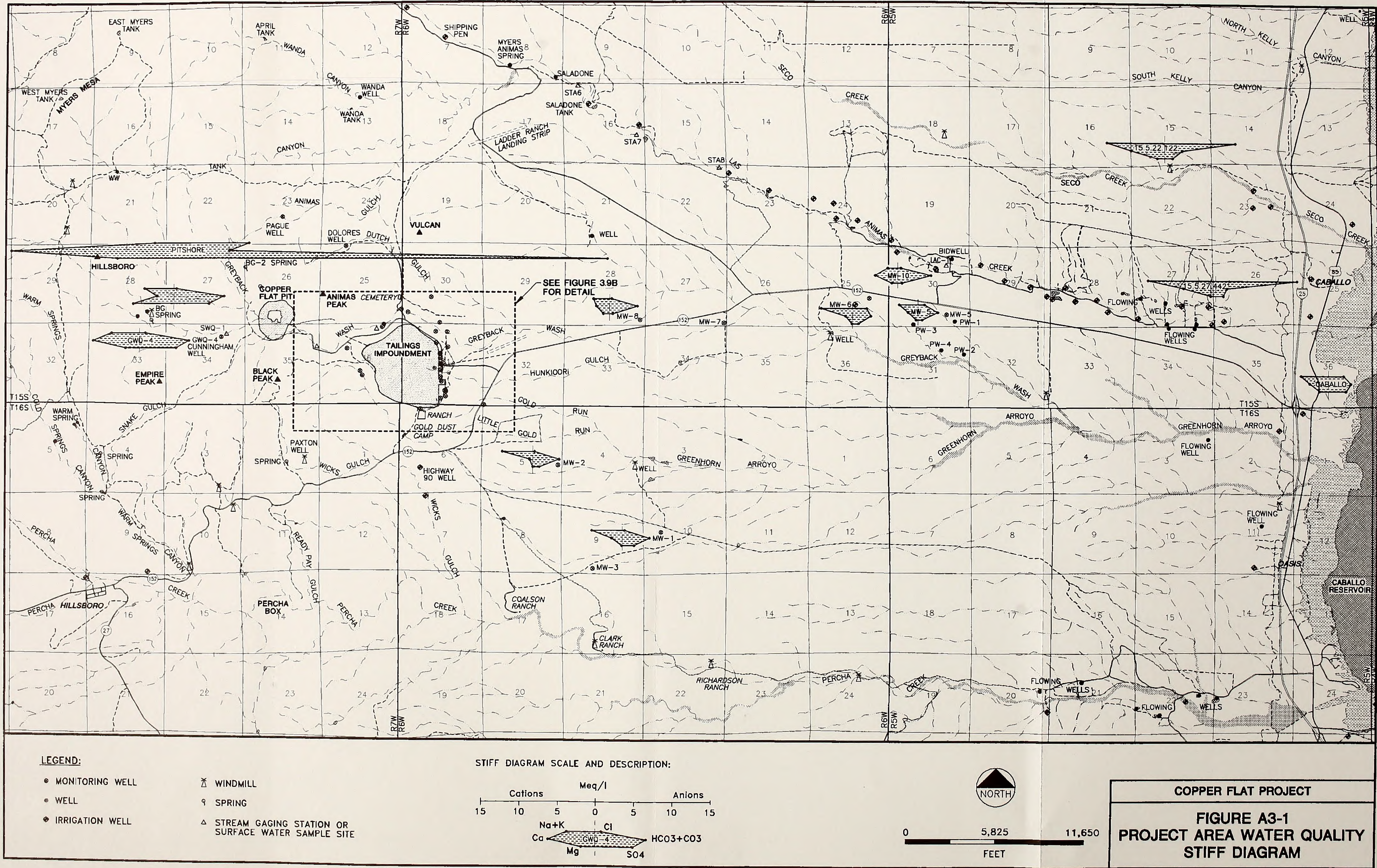
A Stiff Diagram is used for visual comparison of basic water quality parameters, such as sulfate, calcium, etc. The concentrations of the ions are converted to milliequivalents of charge, expressed as milligrams per liter (mg/l), so that all ions are compared on an equal basis, regardless of their charge. The graphical display is for comparative purposes only, so that the reader may see how one ion compares to another (e.g., sulfate to carbonate) in a given sample and how this comparative relationship changes from location to location, such as from well to well or along the course of a stream. Figures A3-1 and A3-2 are Stiff Diagrams that depict water quality in the project area.

2. Piper Diagrams

The purpose of the Piper Diagram is for trend analysis. The ions are grouped and the percentage of that group is calculated and plotted on these trilinear diagrams. The result is a grouping of water quality samples of similar major ion chemistry. If a trend exists from one grouping of samples to another, and so forth, that trend will be revealed on the main large diagram that resembles a diamond. Sometimes these trends are significant in showing a pattern of groundwater or surface water contamination. In mining districts, these trends can show the influence of mine pits, waste rock, and tailings impoundments on water quality for both surface water and groundwater. Figure A3-3 is a Piper Diagram that depicts water quality trends in the project area.

3. Kinetic Test Results

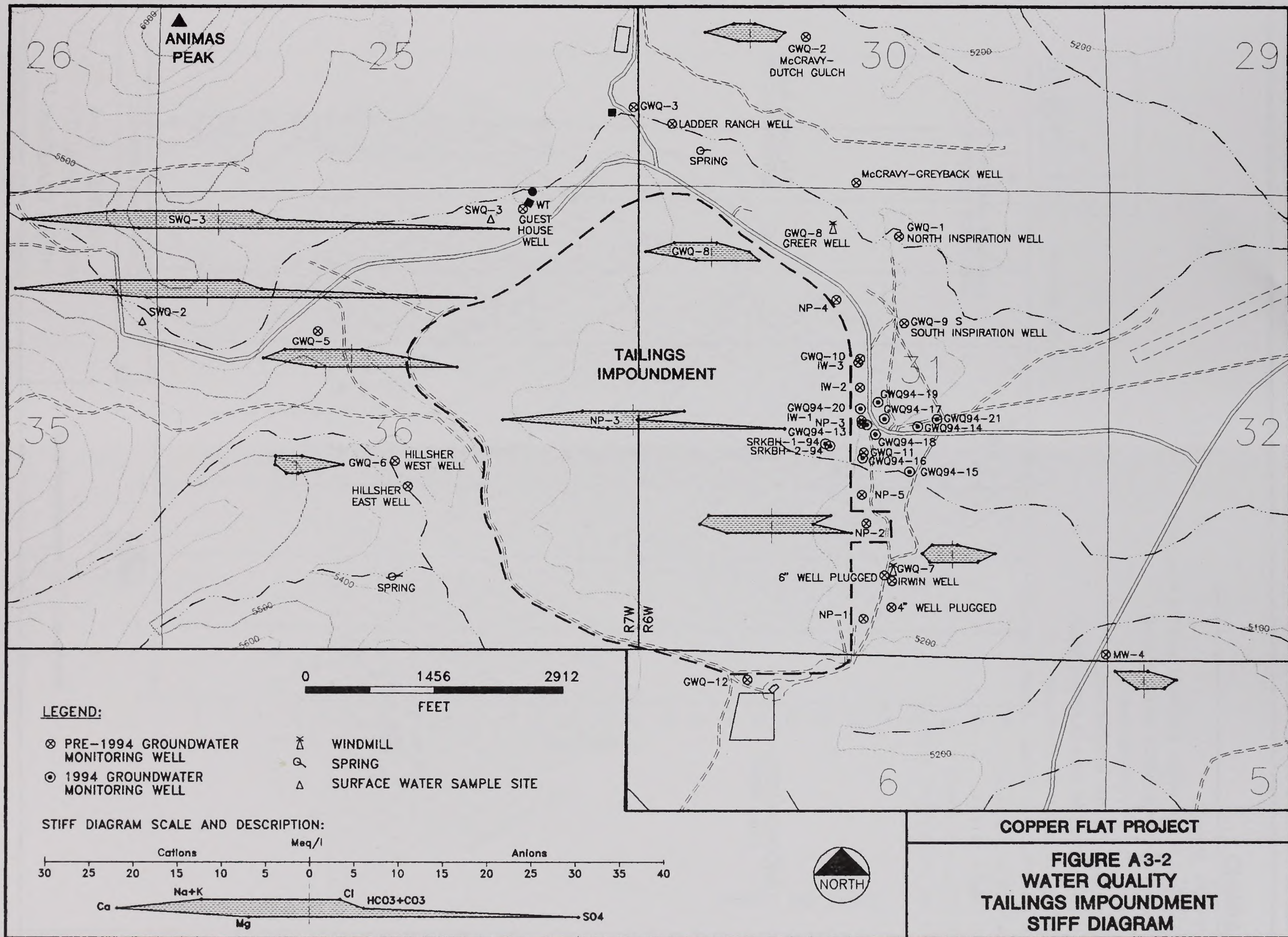
Tables A3-4 to A3-7 outline the results for specific kinetic tests on waste rock samples taken from locations within the mine area.



COPPER FLAT PROJECT

FIGURE A3-1
PROJECT AREA WATER QUALITY STIFF DIAGRAM

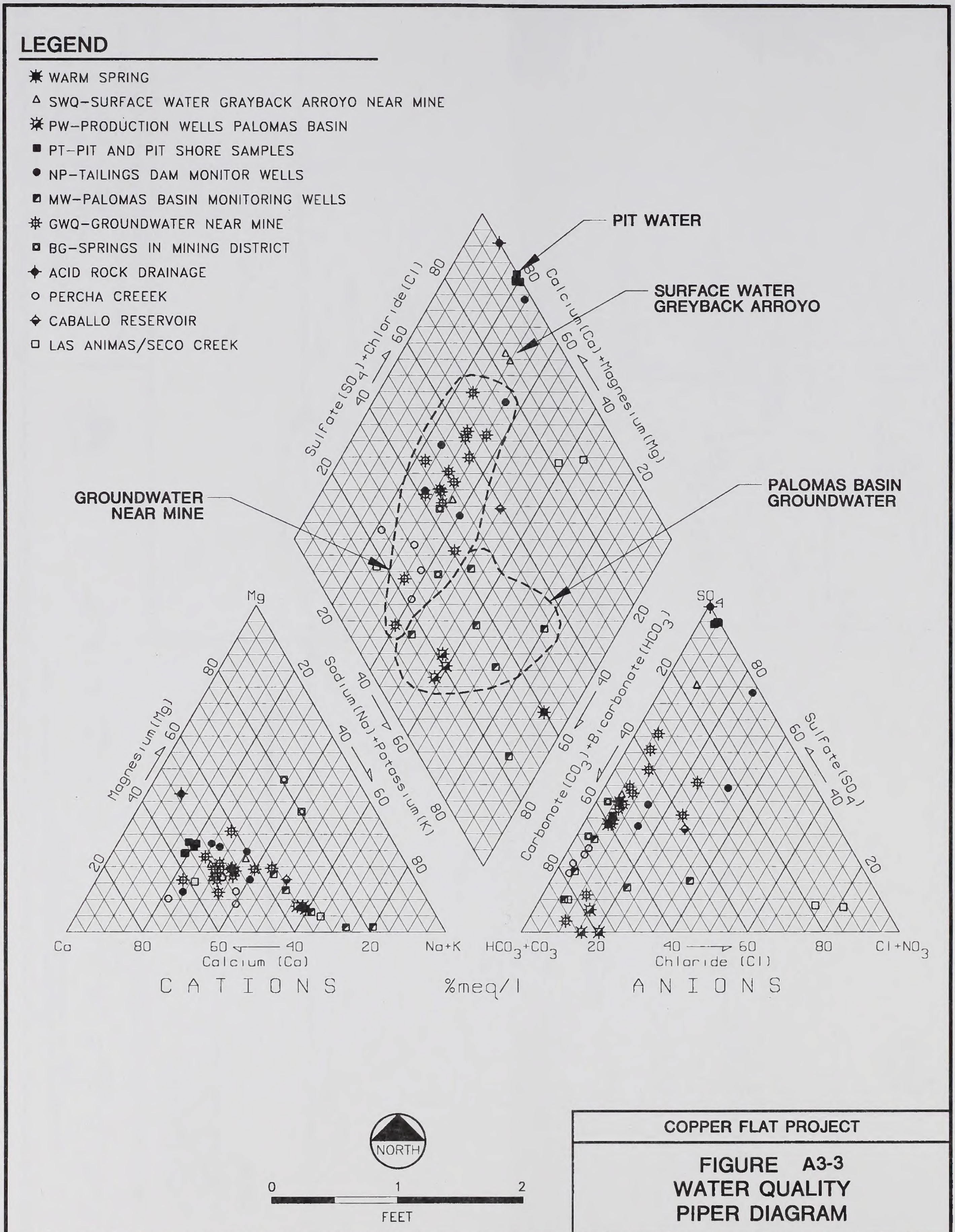
DATE: NOV/17/1995 ACAD FILE: 476\STIFF-1



COPPER FLAT PROJECT

FIGURE A3-2
WATER QUALITY
TAILINGS IMPOUNDMENT
STIFF DIAGRAM

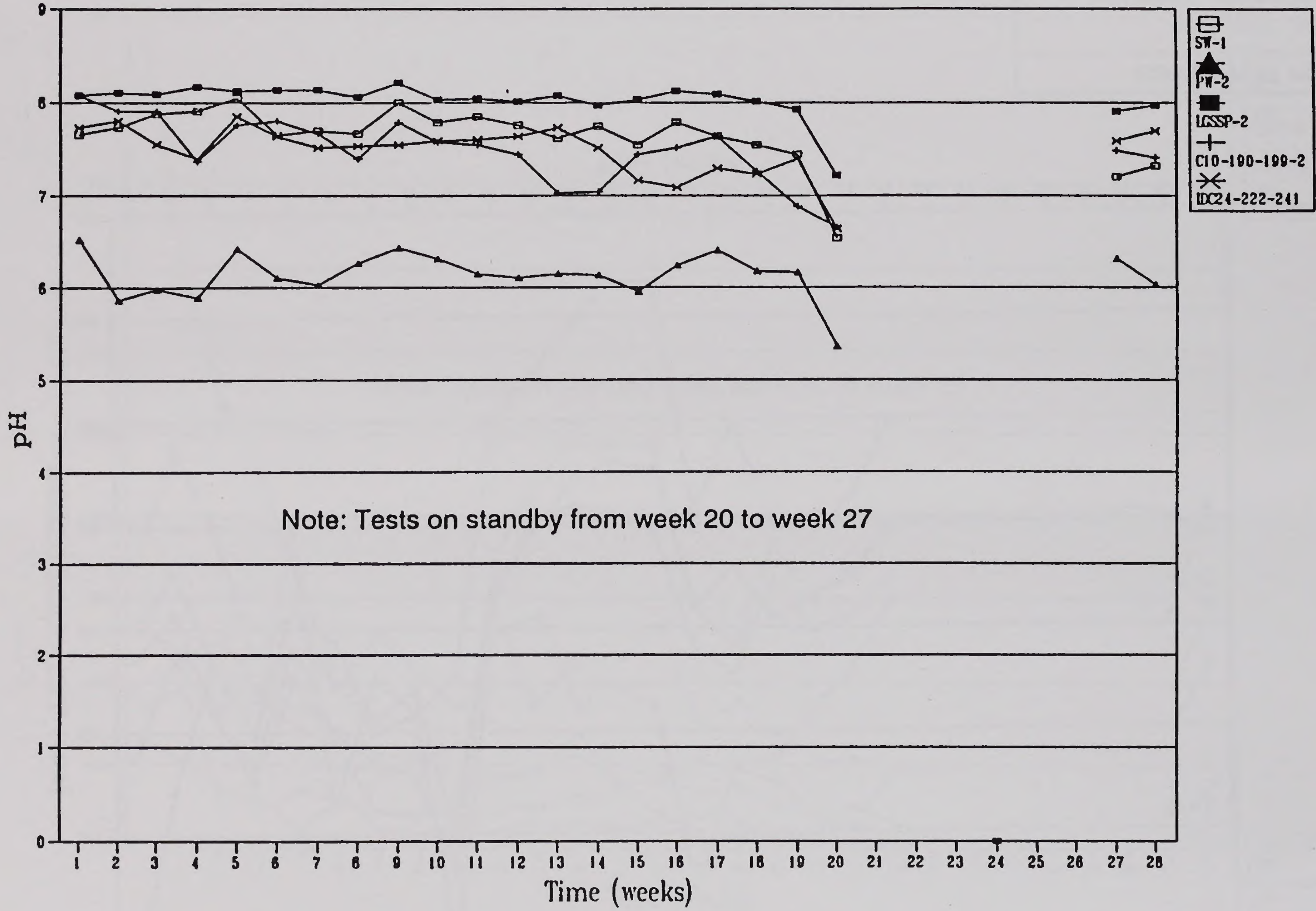
DATE: JUN/5/1995 ACAD FILE: 476\STIFF-2



COPPER FLAT PROJECT

FIGURE A3-3
WATER QUALITY
PIPER DIAGRAM

DATE: JUN/6/1995 ACAD FILE: 476\PIPER-1

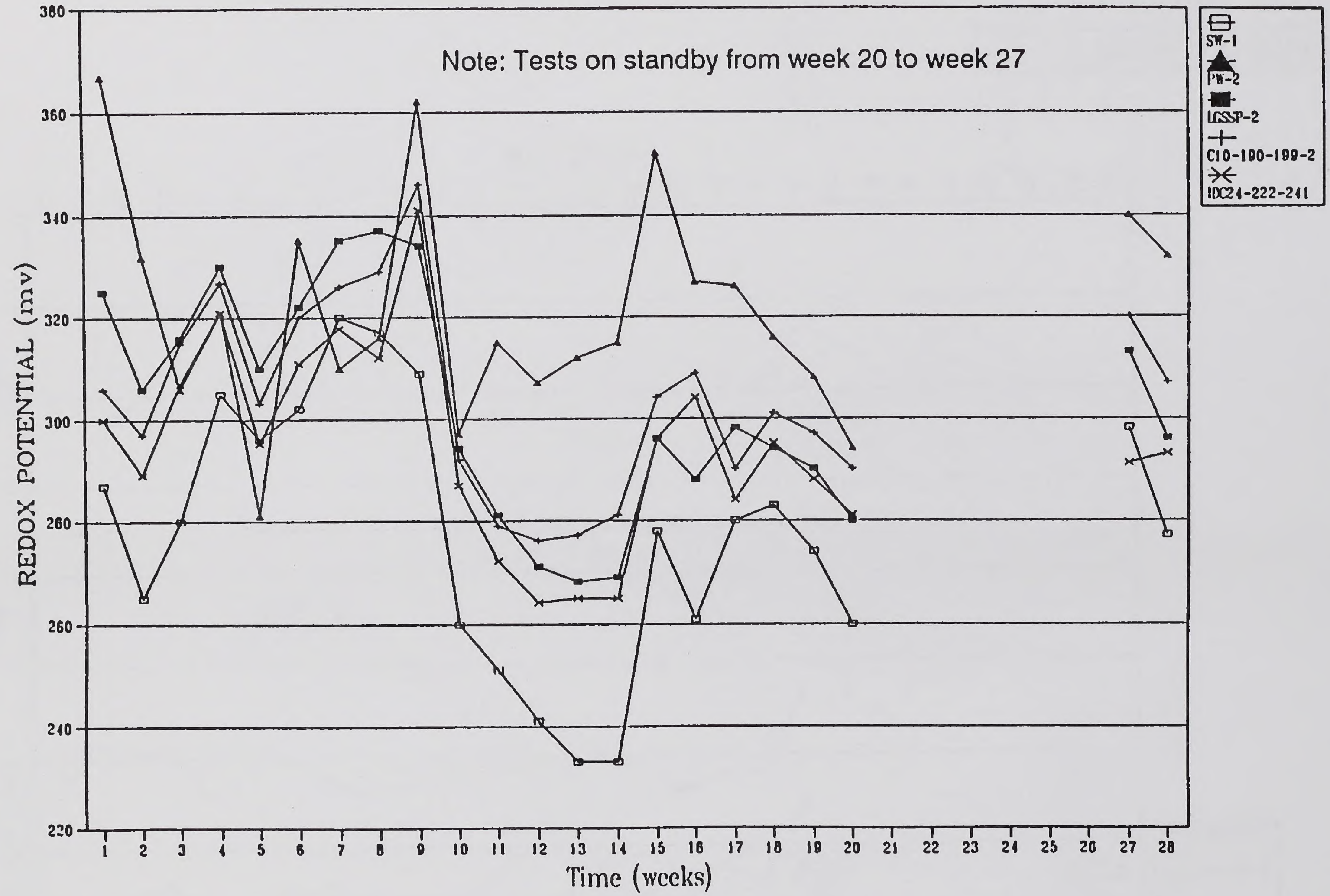


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A3-4
KINETIC TEST RESULTS
pH VERSUS TIME

DATE: JUN/12/1995 ACAD FILE: 476\KINET

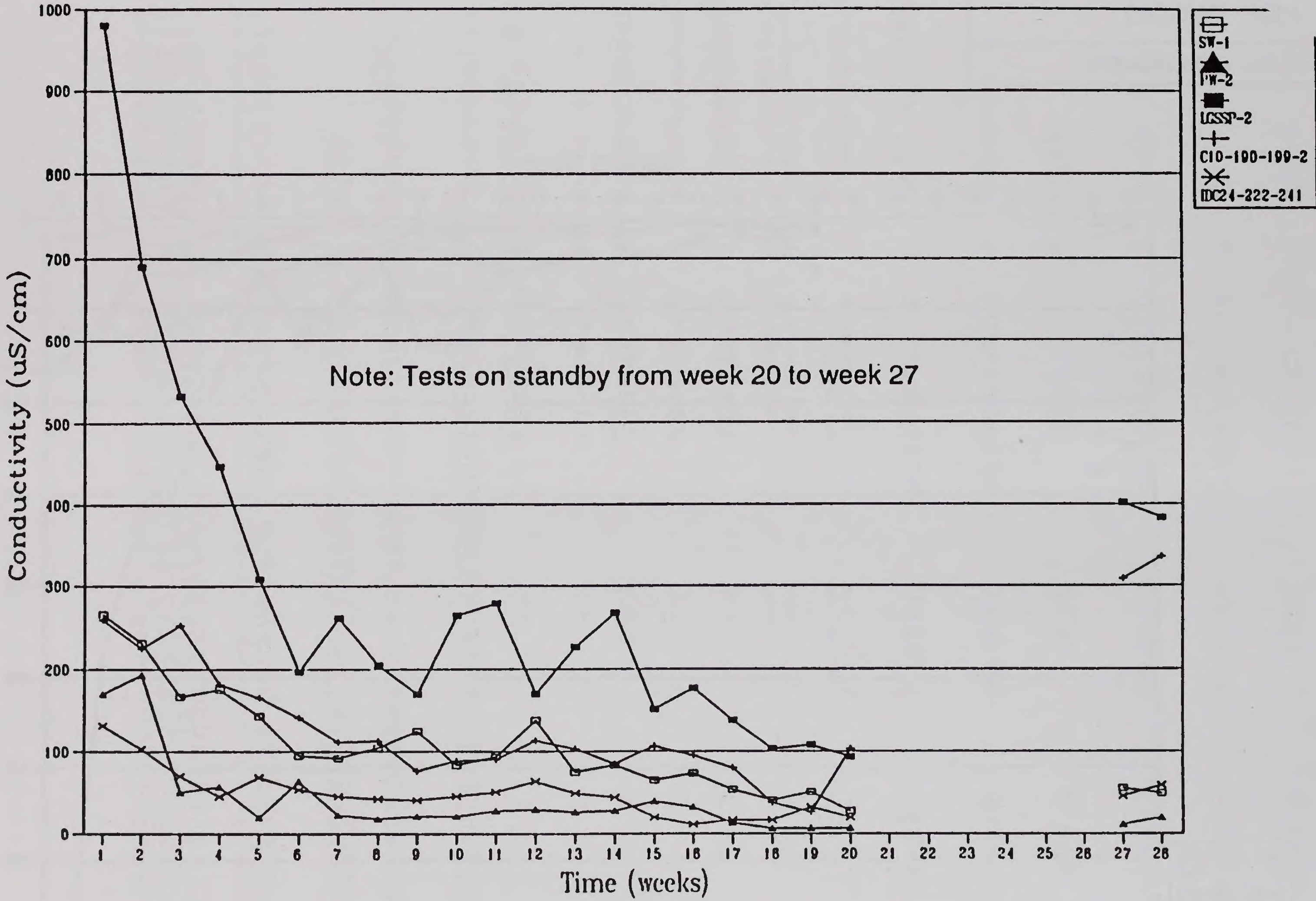


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A3-5
KINETIC TEST RESULTS
REDOX POTENTIAL VERSUS TIME

DATE: JUN/12/1995 ACAD FILE: 476\KINET

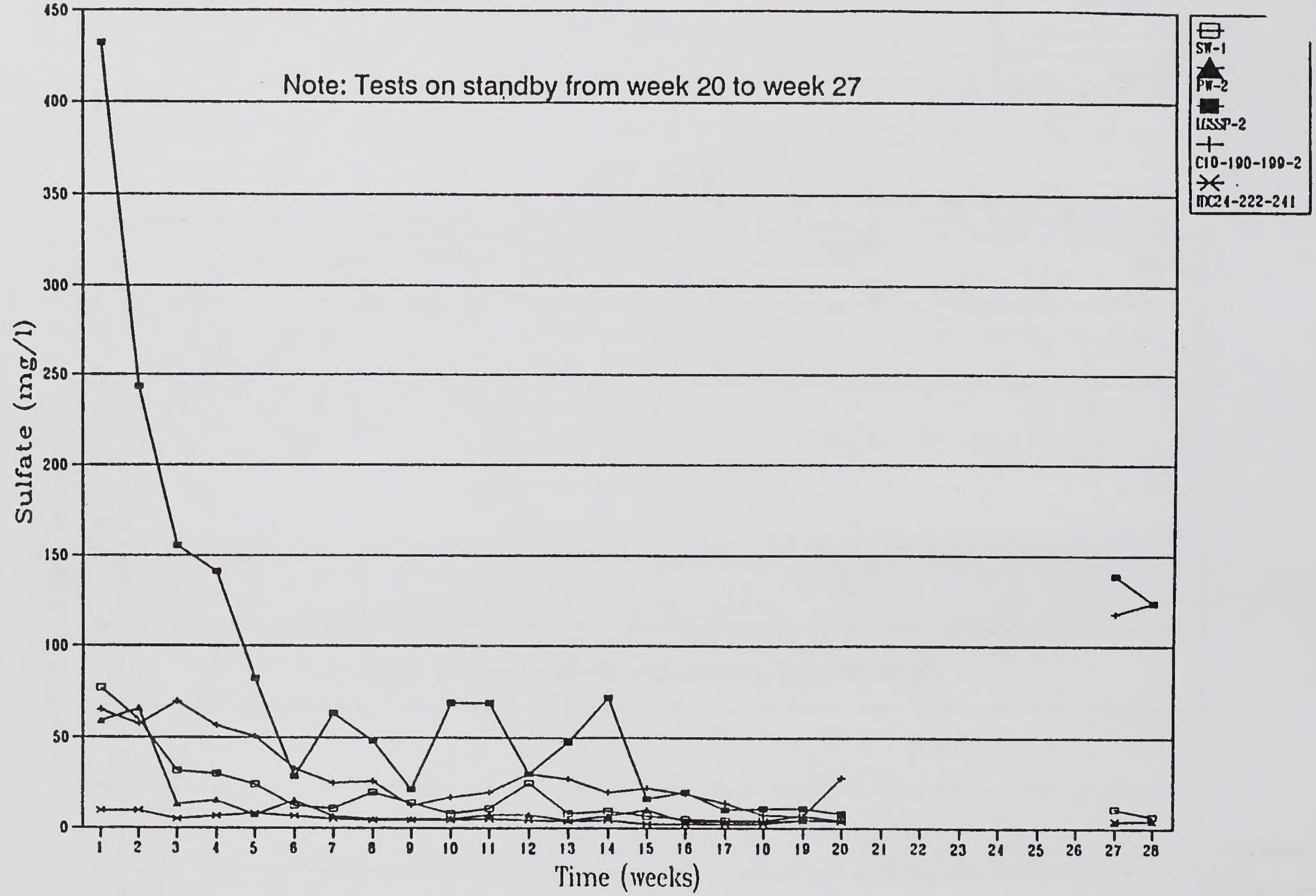


SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A3-6
KINETIC TEST RESULTS
CONDUCTIVITY VERSUS TIME

DATE: JUN/12/1995 ACAD FILE: 476\KINET



SOURCE: SRK (1995)

COPPER FLAT PROJECT

FIGURE A3-7
KINETIC TEST RESULTS
SULFATE VERSUS TIME

DATE: JUN/22/1995 ACAD FILE: 476\KINET

Sample Location	Date	pH	Tds	Cl	SO4	HCO3	CO3	Ca	Mg	Na	K	NO3	F	Fe	As	Cu	Mn	Cr	Zn
ANIMAS/SECO CREEK																			
15.5.22.122	7/31/74	8.00		330	49	140		89	12	170	9.6	.7	.90						
15.5.27.333	7/12/74	8.10		26	16	153		22	3	46	4.9	.6	.60						
15.5.27.413	5/07/74	8.00		420	61	117	0	110	13	180	11.0	.5	.50	0.00					
15.5.27.442	7/11/74	8.00		380	48	89		85	8	200	9.1	.6	.70						
15.5.27.443	7/11/74	8.00		120	25	141		38	5	80	6.5	.4	.70	.05					
15.5.29.424	5/07/74	8.20		16	13	242	0	43	6	46	3.1	.1	.40	0.00					
15.5.30.213	7/09/74	7.90		15	29	300		75	11	32	2.4	.1	.50	.01			.01		
LAC-1	1/01/01	7.81	300	15	18	246	0	72	9	21	1.9	-1.0	.46	-.05	-.005	-.03	-.03	-.03	-.05
MW-9	11/16/94	8.11	190	12	12	149	0	12	1	54	2.3	-1.0	1.40	-.05	-.005	-.03	-.03	-.03	-.05
MW-10	11/16/94	7.84	310	14	25	262	0	59	9	29	1.9	-1.0	.43	-.05	-.005	-.03	-.03	-.03	-.05
MW-11	11/16/94	7.79	314	15	21	263	0	63	10	23	1.5	-1.0	.45	-.05	-.005	-.03	-.03	-.03	-.05
CABALLO RESEVOIR																			
CF-Caballo	11/16/94	7.97	440	71	110	180	0	49	14	79	5.8		.57	-.05	-.005	-.03	-.03	-.03	-.05
MINE AREA																			
Tailings Decant	5/07/93	7.80	2,320	82	1,440	88	0	331	61	318	17.9	.9	1.46	.08		-.02	-.02		.03
Alluvium Decant	5/06/93	7.10	1,072	1	-2	56	0	44	3	16	4.1	.7		2.01		-.02	.14		.07
Acid Rock Drainage	5/07/93	1.90	17,020	35	10,000	0	0	446	236	93	3.1	.9	11.10	375.00		684.00	142.00		51.00
GWQ-2 McCravey/Dutch Gulch	6/15/81	7.30	530	20	140	242	0	102	16	42	2.3	5.6	.50	-.10	-.010	-.05	-.05	-.01	.16
McCravey-Greyback	3/31/93	7.80	632	30	207	302	0	97	24	78	2.0	3.0	.51	.05	-.005	-.01	-.02	-.02	.01
GWQ-8 Greer Windmill	10/15/81	7.40	608	24	134	283	-1	73	12	84	4.2	2.8	.59	-.10	-.004	-.05	.05	-.05	.69
GWQ-8 Greer Windmill	3/31/93	7.60	764	38	283	298	0	132	18	94	1.8	6.3	.51	-.05	-.005	.01	-.02	-.02	.09
GWQ-8 Greer Windmill	3/31/93	7.70	290	22	260	262	0	149	21	94	3.5	5.7	.53	.04	-.005	-.01	-.01	-.01	.08
NP-4	7/12/82	9.50	270	28	115							-.2	.40	-.10		-.05	-.05		
NP-4	8/09/83	8.80	430	94	156							-.2	.30	-.10		-.05	-.05		
NP-4	11/27/84	8.50	740	140	354							-.2	.30	-.10		-.05	-.05		
NP-4	2/11/91		676	126	289														
NP-4	3/15/92	8.85	465	103	217														
NP-4	5/25/92	8.60	439	106	171														
NP-4	7/16/92	7.60	458	94	177														
NP-4	12/16/92	9.50	424	84	151														
NP-4	3/31/93	7.60	504	45	134	275	0	76	17	79	2.2	3.7	.53	.62	-.005	.01	.84	-.02	2.41
GWQ-10	10/15/81	7.50	528	24	143	219	-1	74	11	59	8.3	.2	1.14	2.31	-.004	-.05	-.05	-.05	.23
GWQ-10	10/27/81	8.20	520	22	168			68				1.1	.60	-.01	-.010	-.05	-.05	-.01	.25
GWQ-10	10/30/81	8.10	588	23	122							.7	.98	-.10	-.050	-.05	-.02	-.05	.24
GWQ-10	7/12/82	8.00	510	20	160							3.3	.60	.62		-.05	-.05		
GWQ-10	8/09/83	7.90	510	36	142							2.4	.60	-.10		-.05	-.05		
GWQ-10	2/11/91		696	78	214														
GWQ-10	3/15/92	7.90	641	83	192														
GWQ-10	5/25/92	7.40	621	84	169														
GWQ-10	7/16/92	7.50	626	76	167														
GWQ-10	12/16/92	7.48	582	91	169														
GWQ-10	3/30/93	7.80	642	94	183	254	0	104	27	71	2.3	3.9	.52	-.05	-.005	-.01	-.02	-.02	.11
GWQ-10	11/27/94	7.70	580	64	163							4.9	.60	-.10		-.05	-.05		
NP-3	10/15/81	7.00	460	29	95	211	-1	41	10	79	9.7	-.1	1.58	-.10	.005	-.05	.81	-.05	1.25
NP-3	10/27/81	8.00	390	28	148			41				.4	1.90	-.05	-.010	-.05	1.00	-.01	.98
NP-3	10/30/81	7.90	428	31	102							-.1	1.60	-.10	-.005	-.05	1.03	-.05	.93
NP-3	1/26/82	8.10	400	30	151							.2	1.00	-.10		-.05	.70		
NP-3	8/09/83	7.80	630	114	100							2.3	.50	-.10		-.05	-.05		
NP-3	11/27/84	7.80	1,150	290	348							3.5	.40	-.10		-.05	-.05		
NP-3	2/12/91		1,551	256	971														
NP-3	3/15/92	7.60	1,664	228	921														
NP-3	5/25/92	7.90	1,607	216	753														
NP-3	7/16/92	7.30	1,578	226	802														
NP-3	12/16/92	7.75	1,558	223	545											.01			
NP-3	3/30/93	7.40	1,560	205	825	29	0	296	35	129	4.1	0.0	.54	4.99	-.005	.01	.32	-.02	6.98
GQW94-20	11/15/94	7.66	370	19	40	296	0	48	10	67	3.2	1.0	.36	-.05	-.005	-.03	.42	-.03	-.05

" - " Indicates concentration is below given detection limit

Sample Location	Date	pH	Tds	Cl	SO4	HCO3	CO3	Ca	Mg	Na	K	NO3	F	Fe	As	Cu	Mn	Cr	Zn
MINE AREA																			
GWQ-1 N. Inspiration	5/16/75			20	130	273		81	14	57	2.1	2.8	.50						
GWQ-1 N. Inspiration	2/02/81	7.90	520	20	156	276	0	74	20	60				1.70					
GWQ-1 N. Inspiration	6/15/81	7.40	500	16	148	251	0	82	19	57	2.0	5.1	.50	-.10	-.010	-.05	-.05	-.01	.12
GWQ-1 N. Inspiration	3/31/93	7.70	536	22	160	297	0	82	21	67	2.1	4.9	.54	-.05	-.005	-.01	-.02	-.02	-.01
GWQ-9 S.Inspiration;IDW-1	2/02/81	7.90	510	20	156	273	0	73	24	49				1.80					
GWQ-9 S.Inspiration;IDW-1	8/14/81	8.00	470	22	148	268	0	76	20	47		1.4	.50	.49	-.010	-.05	-.02		.96
GWQ-9 S.Inspiration;IDW-1	10/15/81	7.20	476	22	133	302	0	52	17	71	3.3	1.0	.60	-.10	-.004	-.05	-.05	-.05	.35
GWQ-9 S.Inspiration;IDW-1	8/09/83	8.00	480	20	135							.9	.50	-.10		-.05	-.05		
GWQ-9 S.Inspiration;IDW-1	11/27/84	7.90	470	16	132							1.5	.50	-.10		-.05	1.18		
GQW94-17	11/15/94	7.71	820	110	240	232	0	120	33	62	2.4	2.4	.46	-.05	-.005	-.03	-.03	-.03	-.05
GQW94-21A	11/13/94	7.25	480	18	130	267	0	82	23	39	2.1	1.0	.57	-.05	-.005	-.03	.20	-.03	-.05
GQW94-21B	11/13/94	7.57	440	19	130	255	0	71	18	56	2.6	-1.0	.39	-.05	-.005	-.03	.37	-.03	-.05
GWQ-11	10/15/81	7.40	612	37	123	237	-1	68	14	48	7.9	1.0	.90	1.14	-.004	-.05	.45	-.05	-.05
GWQ-11	10/27/81	8.10	550	36	183			72				.7	1.00	-.10	-.010	-.05	-.05	-.01	.17
GWQ-11	10/30/81	8.40	636	39	101							.6	.96	-.10	-.005	-.05	-.02	-.05	.23
GWQ-11	7/12/82	7.90	590	44	198							2.3	.80	.39		-.05	-.05		
GWQ-11	8/09/83	7.90	580	46	168							2.0	.80	-.10		-.05	-.05		
GWQ-11	11/27/84	7.70	570	60	165							2.3	.80	-.10		-.05	-.05		
GWQ-11	2/11/91		790	89	233														
GWQ-11	3/15/92	7.90	765	65	260														
GWQ-11	5/25/92	7.50	761	96	258														
GWQ-11	12/16/92	7.59	741	98	220											.02			
GWQ-11	3/30/93	7.70	776	104	271	227	0	126	34	68	2.9	4.1	.52	.33	-.005	-.01	.03	-.02	.03
GQW94-13	11/15/94	7.74	1,570	190	720	159	0	270	56	110	3.9	4.6	.36	.11	-.005	-.03	-.03	-.03	-.05
GQW94-16	11/13/94	7.55	1,140	190	410	199	0	190	51	78	3.7	3.8	.66	-.05	-.005	-.03	.04	-.03	-.05
NP-5	11/10/81	8.00	570	50	196			86				4.1	1.30	-.10	-.010	-.05	.10	-.01	.14
NP-5	1/26/82	8.00	440	32	158							2.9	1.10	-.10		-.05	-.05		
NP-5	7/12/82	8.10	460	28	133							3.9	.90	.36		-.05	-.05		
NP-5	8/09/83	8.10	460	26	108							1.2	.80	-.10		-.05	-.05		
NP-5	11/27/84	8.20	420	28	120							3.2	.80	-.10		-.05	-.05		
NP-5	3/15/92	7.90	456	47	141														
NP-5	5/25/92	7.80	490	76	131														
NP-5	7/16/92	7.60	476	38	132														
NP-5	12/16/92	7.80	402	40	104											.03			
NP-5	3/30/93	7.80	488	39	146	221	0	76	26	43	2.5	4.0	.77	.29	-.005	-.01	.02	-.02	.19
NP-2	10/15/81	7.40	476	45	198	159	-1	46	15	94	9.6	.2	1.78	-.10	.024	-.05	.62	-.05	.31
NP-2	1/26/82	8.00	450	24	160							1.1	.70	-.10		-.05	.34		
NP-2	7/12/82	7.80	510	26	128							1.8	.50	-.10		-.05	.08		
NP-2	8/09/83	7.90	560	36	148							1.6	.60	-.10		-.05	-.05		
NP-2	11/27/84	7.90	470	20	125							1.7	.60	-.10		-.05	-.05		
NP-2	3/15/92	8.10	467	68	194														
NP-2	5/25/92	8.30	456	67	162														
NP-2	7/16/92	8.10	479	65	184														
NP-2	12/16/92	8.43	612	83	167														
NP-2	3/30/93	7.70	1,310	239	436	289	0	163	61	163	.9	3.3	1.33	1.85	-.005	.01	.07	-.02	.67
NP-1	10/15/81	7.60	496	25	108	266	-1	56	14	62	8.3	.5	.84	.27	-.004	-.05	.92	-.05	.40
NP-1	7/12/82	7.70	500	18	143							1.1	.60	-.10		-.05	.18		
NP-1	11/27/84	7.80	480	16	144							1.1	.60	-.10		-.05	-.05		
NP-1	3/15/92	7.80	510	22	146														
NP-1	5/25/92	7.50	608	29	128														
NP-1	7/16/92	7.10	487	22	142														
NP-1	12/16/92	7.58	502	24	125														
NP-1	3/30/93	7.70	496	22	145	306	0	79	27	52	1.8	1.1	.59	.17	-.005	-.01	-.02	-.02	1.13
NP-1	8/09/93	7.80	480	22	130							1.1	.60	-.10		-.05	-.05		
GQW94-14	11/15/94	7.95	560	22	140	279	0	81	23	46	1.9	1.3	.52	-.05	-.005	-.03	-.03	-.03	-.05
GQW94-15	11/14/94	7.74	790	110	180	265	0	110	29	68	2.5	2.1	.46	-.05	-.005	-.03	-.03	-.03	-.05
GWQ-7 Old Office	2/02/81	7.90	530	20	156	278	0	74	27	51				3.80					
GWQ-7 Old Office	8/14/81	7.70	490	24	162	229	0	68	21	48			.60	1.70	-.010	-.05			.63

" - " Indicates concentration is below given detection limit

Sample Location	Date	pH	Tds	Cl	SO4	HCO3	CO3	Ca	Mg	Na	K	NO3	F	Fe	As	Cu	Mn	Cr	Zn
MINE AREA																			
GWQ-7 Old Office	10/23/81		500	26	162			70				1.2	.50	-.10	-.010	-.05	-.05	-.01	.16
GWQ-7 Old Office	8/09/83	8.00	490	22	130							1.3	.60	-.10		-.05	-.05		
GWQ-7 Old Office	11/27/84	7.70	490	18	144							1.0	.60	-.10		-.05	-.05		
GWQ-7 Old Office	3/30/93	7.80	482	21	138	298	0	68	31	52	1.6	1.4	.56	-.05	-.005	-.01	-.02	-.02	.10
MW-4	6/13/75	7.90		15	110	226	0	46	10	73	4.4		.63						
GWQ-3 Shale/Shack Well	6/15/81	7.00	890	32	383	327	0	146	33	95	1.7	.1	.70	-.10	-.010	-.02	-.02	-.01	.32
GWQ-3 Shale/Shack Well	7/12/82	7.60	860	48	365							.4	.70	-.10		-.05	-.05		
GWQ-3 Shale/Shack Well	8/09/83	7.80	1,060	78	385							-.2	.70	.11		-.05	-.05		
BG-2 Sp.	4/01/93	8.20	690	15	184	535	0	49	56	124	1.1	0.0	.82	-.05	-.005	-.01	.10	-.02	-.01
Pit-Shore	2/11/91	7.10	2,711	80	2,437	55	0	600	156	224	16.4	.1	4.58	.16	-.001		1.82	.06	
Pit-Shore	2/11/91	7.20	2,704	83	2,464	45	0	611	157	224	16.4	.1	4.77	.18	-.001		1.84	-.02	
Pit-Shore	3/15/92	4.90	3,819	85	2,857														
Pit-Shore	5/25/92	4.80	3,846	90	2,665														
Pit-Shore	7/16/92	4.40	4,229	76	2,397														
Pit-Shore	12/16/92	6.00	4,151	89	2,902											3.21			
Pit-Shore	2/12/93	5.60	3,776	96	2,390	7	0	583	181	222	10.0		6.21	.10	-.005	2.60	4.90	-.10	1.80
Pit-40 ft.	4/01/93	6.70	4,030	95	2,610	16	0	600	189	265	11.0	.5	5.28	-.05	-.005	1.63	4.17	-.02	1.45
Pit-10 ft.	4/01/93	6.60	4,080	95	2,620	16	0	608	181	261	11.0	.5	5.34	-.05	-.005	1.45	4.26	.02	1.48
CF-Pit2	11/16/94	7.71	4,600	140	2,910	102	0	580	250	350	17.0	-5.0	8.10	-.05	-.005	.03	3.60	-.03	.10
CF-Pit	11/16/94	7.52	4,380	130	2,970	104	0	550	250	320	18.0	-5.0	8.10	-.05	-.005	.03	3.40	-.03	.09
Big Sp.	4/01/93	8.00	680	13	228	411	0	45	66	90	.8	0.0	.86	-.05	-.005	-.01	.20	-.02	-.01
SWQ-1	7/16/92	7.40	965	47	298														
SWQ-1	4/01/93	8.30	782	27	276	430	0	109	36	107	1.8	0.0	.53	-.05	-.005	-.01	-.02	-.02	-.01
GWQ-4 Cunningham	6/15/81	7.20	770	30	270	376	0	137	27	91	1.2	1.1	.60	-.10	-.010	-.05	-.05	-.01	.06
GWQ-4 Cunningham	4/01/93	7.60	702	27	235	404	0	125	23	86	1.0	.1	.73	.20	-.005	.01	-.02	-.02	.38
SWQ-2	7/16/92	7.60	2,305	93	1,155														
SWQ-2	3/31/93	7.70	2,720	123	1,460	376	0	436	83	279	2.1	14.5	.63	-.05	-.005	.01	.03	-.02	.01
GWQ-5 Rock Lined	6/15/81	7.30	1,260	42	575	398	0	200	49	173	1.1	.6	1.00	-.10	-.010	-.05	-.05	-.01	.06
SWQ-3	3/15/92	8.10	2,393	99	1,248														
SWQ-3	5/25/92	8.10	2,380	103	1,185														
SWQ-3	7/16/92	7.70	3,364	129	1,654														
SWQ-3	3/31/93	8.10	2,950	135	1,580	409	0	445	109	271	2.2	6.9	.97	-.05	-.005	.01	-.02	-.02	-.01
GWQ-6 Hillsher House West	6/15/81	7.30	420	28	37	317	0	73	16	61	1.6	3.8	1.20	-.10	-.010	-.05	.11	-.01	-.05
GWQ-6 Hillsher House West	4/01/93	7.70	290	22	9	262	-1	54	14	55	3.5	.9	.80	4.50	-.005	-.01	.37	-.01	-.01
GWQ-6 Hillsher House West	4/01/93	7.70	304	22	10	322	0	49	14	53	3.1	1.1	.84	5.05	-.005	.03	.36	-.02	.03
GWQ-12	8/09/83	7.90	350	14	30							2.2	1.00	-.10		-.05	-.05		
GWQ-12	11/27/84	7.80	340	14	37							2.3	1.00	-.10		-.05	-.05		
PALOMAS BETWEEN ANIMAS AND PERCHA CREEK																			
PW-3	1/27/76	8.00	243	24	0	158	0	23	3	44	5.1	2.6	.64						
PW-3	8/14/81	8.20	300	66	31	139	0	16	1	87		.8	2.50	.31	-.010	-.05			.19
MW-5	9/19/75	7.70	260	30	26	157	0	26	3	54	4.1	-.5	.61						
PW-1	12/23/75	7.80	217	16	10	145	0	22		38	4.5	3.5	.46						
PW-1	12/23/75	7.80	217	16	10	145	0	22	3	38	4.5	3.5	.46						
PW-1	8/14/81	8.10	250	32	24	171	0	28	4	53		.7	.90	.20	-.010	-.05			-.05
PW-2	1/15/76	8.10	257	17	0	153	0	21	3	39	4.3	3.5	.66						
PW-2	11/27/84	7.90	470	20	125							1.7	.60	-.10		-.05	-.05		
MW-6	1/01/75	7.60	367	66	38	146	0	19	1	90	7.3	4.3	3.40						
MW-8	1/01/75	7.70	293	10	21	222	0	34	10	45	6.2	15.4	.86						
MW-2	5/07/75	7.90	327	8	40	209	0	9	0	89	5.3		2.30						
MW-1	1/01/75	8.10	433	10	73	215	0	28	1	85	10.6	6.1	.70						
PERCHA BOX																			
PC-2	1/01/01	7.77	336	9	64	218	0	55	11	39	3.0	-1.0	2.10	-.05	-.005	-.03	-.03	-.03	-.05
PC-4	1/01/01	7.81	368	9	63	244	0	66	11	38	3.0	-1.0	2.20	-.05	-.005	-.03	-.03	-.03	-.05
PC-6	1/01/01	7.62	406	11	71	270	0	65	10	56	3.6	-1.0	3.70	-.05	-.005	-.03	-.03	-.03	-.05

" - " Indicates concentration is below given detection limit

Sample Location	Date	pH	Tds	Cl	SO4	HCO3	CO3	Ca	Mg	Na	K	NO3	F	Fe	As	Cu	Mn	Cr	Zn
PERCHA CREEK																			
16.5.20.243	5/03/74	8.10		4	29	194	0	46	5										
16.5.22.313	5/03/74	8.10		5	33	181	0	39	4	34	2.1	.3	.60	.02					
16.5.22.412	7/10/74	8.70		7	32	174		29	3	47	3.2	.4	1.00	.08			.01		
16.7.16.111	7/02/74	8.00		7	57	259		79	7	28	1.5	.9	.40	.03			.04		
RIO GRANDE																			
Rio Grande R. @ El Paso	1/01/58		721	87	260	92		87	17	116									
Rio Grande R. @ El Paso	1/01/64		1,058	199	340	113		96	22	224									
Rio Grande R. @ El Paso	1/01/75		846	124	275	119		92	19	159									
Rio Grande R. @ El Paso	12/30/75		809		129	265		88	19	151									
WARM SPRING CANYON																			
Warm Sp.	4/02/93	8.50	1,370	52	351	774	18	28	3	457	22.0	0.0	22.20	.09	-.005	.01	.02	-.02	-.01

" - " Indicates concentration is below given detection limit

Sample Location	Pb	Mo	Co	Ni	Ag	Cd	Hg	Se	Ba	Al	SiO2	B	HS	CN
ANIMAS/SECO CREEK														
15.5.22.122											36.00			
15.5.27.333											30.00			
15.5.27.413											33.00	.12		
15.5.27.442											31.00			
15.5.27.443											30.00	.21		
15.5.29.424											33.00	.06		
15.5.30.213											47.00			
LAC-1	-.01	-.05	-.05	-.05	-.03	-.001	-.0010		-.10	-.05		-.10		
MW-9	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
MW-10	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
MW-11	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
CABALLO RESEVOIR														
CF-Caballo	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		.14		
MINE AREA														
Tailings Decant										-.50				
Alluvium Decant														
Acid Rock Drainage										3720.00				
GWQ-2 McCravey/Dutch Gulch	-.02	-.05	-.01	-.05	-.02	-.005	.0013	-.005	-.20	-.01		-.10		-.01
McCravey-Greyback	-.02	-.02	-.05	-.01	-.01	-.020	-.0010	-.005	-.50	-.10		.04	-.10	-.01
GWQ-8 Greer Windmill	-.05	-.10	-.05	-.05	-.02	-.010	-.0010	.004	-1.00	-.25		.08		-.05
GWQ-8 Greer Windmill	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.10		.03	-.10	-.01
GWQ-8 Greer Windmill	-.02	-.02	-.01	-.02	-.01	-.001	-.0002	-.005	.04	-.05		-.10	-1.00	
NP-4		-.05				-.005	-.0010	-.005						-.01
NP-4		-.05				-.005	-.0010	-.005						-.01
NP-4														
NP-4														
NP-4														
NP-4														
NP-4														
NP-4														
NP-4	-.02	-.02	-.05	-.01	-.01	-.002	.0090	-.005	-.50	.30		.04	2.80	-.01
GWQ-10	-.05	-.10	-.05	-.05	-.02	-.010	-.0010	-.002	-1.00	10.20		.02		-.05
GWQ-10	-.02	-.05	-.02	-.05	-.02	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
GWQ-10	-.05	-.10	-.05	-.02	-.02	-.010	-.0010	-.002	-1.00	-.25		.77		-.05
GWQ-10		-.05				-.005	-.0010	-.005						-.01
GWQ-10		-.05				-.005	-.0010	-.005						-.01
GWQ-10														
GWQ-10														
GWQ-10														
GWQ-10														
GWQ-10														
GWQ-10	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.10		.04	-.10	-.01
GWQ-10		-.05				-.005	-.0010	-.005						-.01
NP-3	-.05	-.10	-.05	-.05	-.02	-.010	-.0010	.005	-1.00	-.25		.19		-.05
NP-3	-.02	.16	-.02	-.05	-.02	-.005	-.0010	-.005	.20	-.01		-.10		-.01
NP-3	-.05	-.10	-.05	-.02	-.02	-.010	-.0010	-.005	-1.00	-.25		.29		-.05
NP-3		-.10												-.01
NP-3		-.05				-.005	-.0010	-.005						-.01
NP-3		-.05				-.005	-.0010	-.005						-.01
NP-3														
NP-3														
NP-3														
NP-3														
NP-3														
NP-3	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	.10		.02	-.10	-.01
GQW94-20	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		.11		

" - " Indicates concentration is below given detection limit

Sample Location	Pb	Mo	Co	Ni	Ag	Cd	Hg	Se	Ba	Al	SiO2	B	HS	CN
MINE AREA														
GWQ-1 N. Inspiration											35.00			
GWQ-1 N. Inspiration														
GWQ-1 N. Inspiration	-.02	-.05	-.05	-.05	-.02	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
GWQ-1 N. Inspiration	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.10		.03	-.10	-.01
GWQ-9 S.Inspiration;IDW-1														
GWQ-9 S.Inspiration;IDW-1	.03													-.01
GWQ-9 S.Inspiration;IDW-1	-.05	-.10	-.05	-.05	-.02	-.010	-.0010	-.002	-1.00	-.25		.04		-.05
GWQ-9 S.Inspiration;IDW-1		-.05				-.005	-.0010	-.005						-.05
GWQ-9 S.Inspiration;IDW-1		-.05				-.005	-.0010	-.005						-.05
GQW94-17	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
GQW94-21A	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
GQW94-21B	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
GWQ-11	-.05	-.10	-.05	-.05	-.02	-.010	-.0010	.006	-1.00	-.25		.09		-.05
GWQ-11	-.02	-.05	-.02	-.05	-.02	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
GWQ-11	-.05	-.10	-.05	-.02	-.02	-.010	-.0010	.011	-1.00	-.25		.55		-.05
GWQ-11		-.05				-.005	-.0010	-.005						-.01
GWQ-11		-.05				-.005	-.0010	-.005						-.01
GWQ-11		-.05				-.005	-.0010	-.005						-.01
GWQ-11														
GWQ-11														
GWQ-11														
GWQ-11														
GWQ-11	-.02	-.02	-.05	-.01	-.01	-.020	-.0010	-.005	-.50	.20		.04	-.10	-.01
GQW94-13	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
GQW94-16	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
NP-5	-.02	-.05	-.02	-.05	-.02	-.005	-.0010	-.005	-.20	.01		-.10		-.01
NP-5		-.10				-.005	-.0010	-.005						-.01
NP-5		-.05				-.005	-.0010	-.005						-.01
NP-5		-.05				-.005	-.0010	-.005						-.01
NP-5														
NP-5														
NP-5														
NP-5														
NP-5														
NP-5	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	.20		.04	-.10	-.01
NP-2	-.05	-.10	-.05	-.05	-.02	-.010	-.0010	-.002	-1.00	-.25		.08		-.05
NP-2		-.10				-.005	-.0010	-.005						-.01
NP-2		-.05				-.005	-.0010	-.005						-.01
NP-2		-.05				-.005	-.0010	-.005						-.01
NP-2						-.005	-.0010	-.005						-.01
NP-2														
NP-2														
NP-2														
NP-2														
NP-2	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	.005	.60	.50		.10	-.10	-.01
NP-1	-.05	-.10	-.05	-.05	-.02	-.005	-.0010	.003	-1.00	-.25		-.00		-.05
NP-1		-.05				-.005	-.0010	-.005						
NP-1		-.05				-.005	-.0010	-.005						-.05
NP-1														
NP-1														
NP-1														
NP-1														
NP-1	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.10		.03	-.10	-.01
NP-1		-.05				-.005	-.0010	-.005						-.01
GQW94-14	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
GQW94-15	-.01	-.05	-.05	-.05	-.03	-.005	-.0010	-.005	-.10	-.05		-.10		
GWQ-7 Old Office														
GWQ-7 Old Office	-.02													-.01

" - " Indicates concentration is below given detection limit

Sample Location	Pb	Mo	Co	Ni	Ag	Cd	Hg	Se	Ba	Al	SiO2	B	HS	CN
MINE AREA														
GWQ-7 Old Office	-.02	-.05	-.02	-.05	-.02	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
GWQ-7 Old Office		-.05				-.005	-.0010	-.005						-.01
GWQ-7 Old Office						-.005	-.0010	-.005						-.10
GWQ-7 Old Office	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.10		.04	-.10	-.01
MW-4														
GWQ-3 Shale/Shack Well	.07	-.05	-.05	-.05	-.02	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
GWQ-3 Shale/Shack Well		-.05				-.005	-.0010	-.005						-.01
GWQ-3 Shale/Shack Well		-.05				-.005	-.0010	-.005						-.01
BG-2 Sp.	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	.60	-.10		.03	-.10	-.01
Pit-Shore	.01				.03	.035	.0004	-.001	0.00					
Pit-Shore	.01				-.02	.015	-.0020	-.001	0.00					
Pit-Shore														
Pit-Shore														
Pit-Shore														
Pit-Shore														
Pit-Shore	-.10	-.10	.10	-.10	-.10	-.100	-.0050	-.005	-.50	2.00	15.20	-.10		
Pit-40 ft.	-.02	-.02	-.05	.03	-.01	.030	-.0010	-.005	-.50	.70		.06	-.10	-.01
Pit-10 ft.	-.02	-.02	-.05	.03	-.01	.030	-.0010	-.005	-.50	.70		.09	-.10	-.01
CF-Pit2	-.01	-.05	-.05	-.05	-.03	.017	-.0010	-.005	-.10	-.05		-.10		
CF-Pit	-.01	-.05	-.05	-.05	-.03	.017	-.0010	-.005	-.10	-.05		-.10		
Big Sp.	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	1.20	-.10		.02	-.10	-.01
SWQ-1														
SWQ-1	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.10		.02	-.10	-.01
GWQ-4 Cunningham	-.02	-.05	-.05	-.05	-.02	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
GWQ-4 Cunningham	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	1.00	-.10		.02	-.10	-.01
SWQ-2														
SWQ-2	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	.008	-.50	-.10		.08	-.10	-.01
GWQ-5 Rock Lined	-.02	-.05	-.05	-.05	-.02	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
SWQ-3														
SWQ-3														
SWQ-3														
SWQ-3	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.10		.06	-.10	-.01
GWQ-6 Hillsher House West	-.02	-.02	-.05	-.05	-.01	-.005	-.0010	-.005	-.20	-.01		-.10		-.01
GWQ-6 Hillsher House West	-.00	-.02	-.01	-.02	-.01	-.001	-.0002	-.005	.14	-.05		-.10	-1.00	
GWQ-6 Hillsher House West	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	.60	-.10		.09	-.10	-.01
GWQ-12		-.05				-.005	-.0010	-.005						-.01
GWQ-12		-.05				-.005	-.0010	-.005						-.01
PALOMAS BETWEEN ANIMAS AND PERCHA CREEK														
PW-3														
PW-3	-.02													-.01
MW-5														
PW-1														
PW-1														
PW-1	-.02													-.01
PW-2														
PW-2						-.005	-.0010	-.005						-.01
MW-6														
MW-8														
MW-2														
MW-1														
PERCHA BOX														
PC-2	-.01	-.05	-.05	-.05	-.03	-.001	-.0010		-.10	-.05		-.10		
PC-4	-.01	-.05	-.05	-.05	-.03	-.001	-.0010		-.10	-.05		-.10		
PC-6	-.01	-.05	-.05	-.05	-.03	-.001	-.0010		-.10	-.05		-.10		

" - " Indicates concentration is below given detection limit

Sample Location	Pb	Mo	Co	Ni	Ag	Cd	Hg	Se	Ba	Al	SiO2	B	HS	CN
PERCHA CREEK														
16.5.20.243														
16.5.22.313											34.00	.05		
16.5.22.412											31.00			
16.7.16.111											34.00			
RIO GRANDE														
Rio Grande R. @ El Paso														
Rio Grande R. @ El Paso														
Rio Grande R. @ El Paso														
Rio Grande R. @ El Paso														
WARM SPRING CANYON														
Warm Sp.	-.02	-.02	-.05	-.01	-.01	-.002	-.0010	-.005	-.50	-.01		.15	-.10	-.01

Source: Davie & Spiegel 1967; Murray 1959; Newcomer et al. 1993; Watson et al. 1993; SRK 1995.

" - " Indicates concentration is below given detection limit

APPENDIX B

GENERAL WILDLIFE SPECIES LIST

COPPER FLAT MINE AREA

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
CREOSOTE ROLLING UPLAND	AMPHIBIA	BUFO COGNATUS	TOAD GREAT PLAINS
		BUFO DEBILIS	TOAD GREEN
		BUFO SPECIOSUS	TOAD TEXAS
		BUFO WOODHOUSEI	TOAD WOODHOUSES
		SCAPHIOPUS COUCHI	SPADEFOOT COUCHS
		SCAPHIOPUS HAMMONDI	WESTERN SPADEFOOT
	AVES	SELAPHORUS RUFUS	HUMMINGBIRD RUFOUS
		CHORDEILES ACUTIPENNIS	NIGHTHAWK LESSER
		CHORDEILES MINOR	NIGHTHAWK COMMON
		CHARADRIUS VOCIFERUS	KILLDEER
		ZENAIDURA MACROURA	DOVE MOURNING
		GEOCOCCYX CALIFORNIANUS	ROADRUNNER GREATER
		ACCIPITER COOPERII	HAWK COOPERS
		ACCIPITER STRIATUS	HAWK SHARP-SHINNED
		AQUILA CHRYSAETOS	EAGLE GOLDEN
		BUTEO JAMAICENSIS	HAWK RED-TAILED
		CATHARTES AURA	VULTURE TURKEY
		FALCO MEXICANUS	FALCON PRAIRIE
		FALCO SPARVERIUS	FALCON AM KESTREL
		CALLIPEPLA SQUAMATA	QUAIL SCALED
		LOPHORTYX GAMBELII	QUAIL GAMBELS
		EREMOPHILA ALPESTRIS	LARK HORNED
		CORVUS CORAX	RAVEN COMMON
		CORVUS CRYPTOLEUCUS	RAVEN WHITE-NECKED
		AMPHISPIZA BELLI	SPARROW SAGE
		AMPHISPIZA BILINEATA	SPARROW BLK-THROATED
		CALAMOSPIZA MELANOCORYS	BUNTING LARK
		CARPODACUS MEXICANUS	FINCH HOUSE
		CHONDESTES GRAMMACUS	SPARROW LARK
		GUIRACA CAERULEA	GROSBEAK BLUE
		PIPILO FUSCUS	TOWHEE BROWN
		POOECETES GRAMINEUS	SPARROW VESPER
		SPIZELLA BREWERI	SPARROW BREWERS
		SPIZELLA PASSERINA	SPARROW CHIPPING
		SPIZELLA PUSILLA	FIELD SPARROW
		ZONOTRICHIA LEUCOPHRYS	SPARROW PUGET SND WHTCND
		ICTERUS GALBULA	ORIOLE NORTHERN
		ICTERUS PARISORUM	ORIOLE SCOTTS
		LANIUS LUDOVICIANUS	SHRIKE LOGGERHEAD
		MIMUS POLYGLOTTOS	MOCKINGBIRD NORTHERN
		TOXOSTOMA CURVIROSTRE	THRASHER CURVE-BILLED
		TOXOSTOMA DORSALE	THRASHER CRISSAL
		AURIPARUS FLAVICEPS	VERDIN
		POLIOPTILA MELANURA	GNATCATCHER BLK-TAILED
		CAMPYLORHYNCHUS BRUNNEICAPILLUS	WREN CACTUS
		SALPINCTES OBSOLETUS	WREN ROCK
		MYIARCHUS CINERASCENS	FLYCATCHER ASHTHROATED
		SAYORNIS SAYA	PHOEBE SAYS
		TYRANNUS VERTICALIS	KINGBIRD WESTERN
		COLAPTES CAFER	FLICKER RED-SHAFTED
		DENDROCOPOS SCALARIS	WOODPECKER LADDER-BACKED
		SPEOTYTO CUNICULARIA	OWL BURROWING
	MAMMALIA	ODOCOILEUS HEMIONUS	DEER MULE
		CANIS LATRANS	COYOTE
		VULPES MACROTIS	FOX KIT
		FELIS RUFUS	BOBCAT
		CONEPATUS MESOLEUCUS	SKUNK HOG-NOSED
		SPILOGALE GRACILIS	SKUNK SPOTTED WESTERN
		TAXIDEA TAXUS	BADGER
		MEPHITIS MEPHITIS	SKUNK STRIPED
		BASSARISCUS ASTUTUS	RINGTAIL
		PROCYON LOTOR	RACCOON
		TADARIDA BRASILIENSIS	BAT FREE-TAILED BRAZILAN
		ANTROZOUS PALLIDUS	BAT PALLID
		MYOTIS CALIFORNICUS	BAT MYOTIS CALIFORNIA
		MYOTIS THYSANODES	BAT MYOTIS FRINGE-TAILED
		MYOTIS YUMANENSIS	BAT MYOTIS YUMA
		NOTIOSOREX CRAWFORDI	SHREW DESERT
		LEPUS CALIFORNICUS	BLACK-TAILED JACKRABBIT
		SYLVILAGUS AUDUBONII	COTTONTAIL DESERT
		NEOTOMA ALBIGULA	WOODRAT WHITE-THROATED
		ONYCHOMYS LEUCOGASTER	MOUSE N GRASSHOPPER
		ONYCHOMYS TORRIDUS	MOUSE SO GRASSHOPPER
		PEROMYSCUS EREMICUS	MOUSE CACTUS
		PEROMYSCUS LEUCOPUS	MOUSE WHT FOOTED
		PEROMYSCUS MANICULATUS	MOUSE DEER
		REITHRODONTOMYS MEGALOTIS	MOUSE W HARVEST
		ERETHIZON DORSATUM	PORCUPINE
		THOMOMYS BOTTAE	GOPHER POCKET BOTTAS
		DIPODOMYS MERRIAMI	RAT KANGAROO MERRIAM.S

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		DIPODOMYS ORDII	RAT KANGAROO ORDS
		PEROGNATHUS FLAVUS	MOUSE POCKET SILKY
		PEROGNATHUS INTERMEDIUS	MOUSE POCKET ROCK
		AMMOSPERMOPHILUS INTERPRES	ANTLPE GRD SQURL TEXAS
		MARMOTA FLAVIVENTRIS	MARMOT YELLOW-BELLIED
		SPERMOPHILUS SPILOSOMA	SQUIRREL GROUND SPOTTED
		SPERMOPHILUS VARIEGATUS	SQUIRREL ROCK
	REPTILIA	TERRAPENE ORNATA	TURTLE BOX WESTERN
		COPHASAURUS TEXANA	LIZARD GREATER EARLESS
		CROTAPHYTUS COLLARIS	LIZARD COLLARED
		GAMBELIA WISLIZENI	LIZARD LONGNOSED LEOPARD
		HOLBROOKIA MACULATA	LIZARD EARLESS LESSER
		PHRYNOSOMA CORNUTUM	LIZARD HORNED TEXAS
		PHRYNOSOMA MODESTUM	LIZARD HORNED RD-TAILED
		SCELOPORUS MAGISTER	LIZARD SPINY DESERT
		SCELOPORUS POINSETTI	LIZARD SPINY CREVICE
		SCELOPORUS UNDULATUS	LIZARD FENCE EASTERN
		UROSAURUS ORNATUS	LIZARD TREE
		UTA STANSBURIANA	LIZARD SIDE-BLOTCHED
		CNEMIDOPHORUS NEOMEXICANUS	WHIPTAIL NEW MEX
		CNEMIDOPHORUS TESSELATUS	WHIPTAIL COLO CHECKERED
		CNEMIDOPHORUS TIGRIS	WHIPTAIL WESTERN
		ARIZONA ELEGANS	SNAKE GLOSSY
		GYALOPION CANUM	SNAKE WESTERN HOOKNOSED
		HETERODON NASICUS	SNAKE HOGNOSE WESTERN
		HYPSIGLENA TORQUATA	SNAKE NIGHT
		MASTICOPHIS TAENIATUS	SNAKE STRIPED WHIP
		PITUOPHIS MELANOLEUCUS	SNAKE GOPHER
		SONORA SEMIANNULATA	SNAKE GROUND WESTERN
		TANTILLA NIGRICEPS	SNAKE BLACKHEADED PLAINS
		CROTALUS ATROX	SNAKE RATTLE W DIA BACK
		CROTALUS VIRIDIS	SNAKE RATTLE WESTERN
GRASS MOUNTIAN	AMPHIBIA	BUFO WOODHOUSEI	TOAD WOODHOUSES
	AVES	ZENAIDURA MACROURA	DOVE MOURNING
		GEOCOCCYX CALIFORNIANUS	ROADRUNNER GREATER
		AQUILA CHRYSAETOS	EAGLE GOLDEN
		BUTEO JAMAICENSIS	HAWK RED-TAILED
		CATHARTES AURA	VULTURE TURKEY
		FALCO MEXICANUS	FALCON PRAIRIE
		FALCO SPARVERIUS	FALCON AM KESTREL
		CALLIPEPLA SQUAMATA	QUAIL SCALED
		EREMOPHILA ALPESTRIS	LARK HORNED
		APHELOCOMA COERULESCENS	JAY SCRUB
		CORVUS CORAX	RAVEN COMMON
		GYMNORHINUS CYANOCEPHALUS	JAY PINON
		AIMOPHILA RUFICEPS	SPARROW RUFOUS CROWNED
		AMPHISPIZA BELLI	SPARROW SAGE
		AMPHISPIZA BILINEATA	SPARROW BLK-THROATED
		CALAMOSPIZA MELANOCORYS	BUNTING LARK
		CARPODACUS MEXICANUS	FINCH HOUSE
		CHLORURA CHLORURA	TOWHEE GREEN TAILED
		CHONDESTES GRAMMACUS	SPARROW LARK
		PIPILO FUSCUS	TOWHEE BROWN
		POOECETES GRAMINEUS	SPARROW VESPER
		SPIZELLA PASSERINA	SPARROW CHIPPING
		ZONOTRICHIA GAMBELI	SPARROW GAMBELS WHTCND
		STURNELLA NEGLECTA	MEADOWLARK WESTERN
		LANIUS LUDOVICIANUS	SHRIKE LOGGERHEAD
		MIMUS POLYGLOTTOS	MOCKINGBIRD NORTHERN
		PARUS GAMBELI	CHICKADEE MOUNTAIN
		PHAINOPEPLA NITENS	PHAINOPEPLA
		CAMPYLORHYNCHUS BRUNNEICAPILLUS	WREN CACTUS
		CATHERPES MEXICANUS	WREN CANON
		SALPINCTES OBSOLETUS	WREN ROCK
		MYADESTES TOWNSENDI	SOLITAIRE TOWNSENDS
		SIALIA CURRUCOIDES	BLUEBIRD MOUNTAIN
		SIALIA MEXICANA	BLUEBIRD WESTERN
		SAYORNIS SAYA	PHOEBE SAYS
		COLAPTES CAFER	FLICKER RED-SHAFTED
		DENDROCOPOS SCALARIS	WOODPECKER LADDER-BACKED
		ASIO OTUS	OWL LONG-EARED
	MAMMALIA	ANTILOCAPRA AMERICANA	PRONGHORN
		ODOCOILEUS HEMIONUS	DEER MULE
		CANIS LATRANS	COYOTE
		UROCYON CINEREOARGENTEUS	FOX GRAY
		FELIS RUFUS	BOBCAT
		CONEPATUS MESOLEUCUS	SKUNK HOG-NOSED
		SPILOGALE GRACILIS	SKUNK SPOTTED WESTERN
		MEPHITIS MEPHITIS	SKUNK STRIPED
		BASSARISCUS ASTUTUS	RINGTAIL

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		PROCYON LOTOR	RACCOON
		ANTROZOUS PALLIDUS	BAT PALLID
		MYOTIS LEIBII	BAT MYOTIS SMALL-FOOTED
		MYOTIS THYSANODES	BAT MYOTIS FRINGE-TAILED
		PIPISTRELLUS HESPERUS	PIPISTREL WESTERN
		PLECOTUS TOWNSENDII	BAT TOWNSENDS BIG-EARED
		NOTIOSOREX CRAWFORDI	SHREW DESERT
		LEPUS CALIFORNICUS	BLACK-TAILED JACKRABBIT
		SYLVILAGUS AUDUBONII	COTTONTAIL DESERT
		NEOTOMA ALBIGULA	WOODRAT WHITE-THROATED
		PEROMYSCUS EREMICUS	MOUSE CACTUS
		PEROMYSCUS MANICULATUS	MOUSE DEER
		PEROMYSCUS TRUEI	MOUSE PINYON
		REITHRODONTOMYS MEGALOTIS	MOUSE W HARVEST
		SIGMODON HISPIDUS	RAT COTTON HISPID
		ERETHIZON DORSATUM	PORCUPINE
		THOMOMYS BOTTAE	GOPHER POCKET BOTTAS
		DIPODOMYS MERRIAMI	RAT KANGAROO MERRIAM.S
		PEROGNATHUS FLAVUS	MOUSE POCKET SILKY
		PEROGNATHUS INTERMEDIUS	MOUSE POCKET ROCK
		AMMOSPERMOPHILUS INTERPRES	ANTLPE GRD SQURL TEXAS
		SPERMOPHILUS VARIEGATUS	SQUIRREL ROCK
	REPTILIA	COPHASAURUS TEXANA	LIZARD GREATER EARLESS
		CROTAPHYTUS COLLARIS	LIZARD COLLARED
		SCELOPORUS UNDULATUS	LIZARD FENCE EASTERN
		UROSAURUS ORNATUS	LIZARD TREE
		EUMECES OBSOLETUS	SKINK GREAT PLAINS
		CNEMIDOPHORUS EXSANGUIS	WHIPTAIL CHIHUAHUA SPOTT
		CNEMIDOPHORUS INORNATUS	WHIPTAIL LITTLE STRIPED
		GYALOPION CANUM	SNAKE WESTERN HOOKNOSED
		MASTICOPHIS TAENIATUS	SNAKE STRIPED WHIP
		PITUOPHIS MELANOLEUCUS	SNAKE GOPHER
		CROTALUS ATROX	SNAKE RATTLE W DIA BACK
		CROTALUS LEPIDUS	SNAKE RATTLE ROCK
		CROTALUS MOLOSSUS	SNAKE RATTLE BLK-TAILED
PINON JUNIPER GRASS MOUNTIAN	AVES	AERONAUTES SAXATALIS	SWIFT WHITE-THROATED
		SELAPHORUS PLATYCERCUS	HUMMINGBIRD BROADTAILED
		PHALAENOPTILUS NUTTALLII	POOR-WILL COMMON
		ZENAIDURA MACROURA	DOVE MOURNING
		ACCIPITER COOPERII	HAWK COOPERS
		ACCIPITER STRIATUS	HAWK SHARP-SHINNED
		AQUILA CHRYSAETOS	EAGLE GOLDEN
		BUTEO JAMAICENSIS	HAWK RED-TAILED
		BUTEO REGALIS	HAWK FERRUGINOUS
		CIRCUS CYANEUS	HAWK MARSH
		CATHARTES AURA	VULTURE TURKEY
		FALCO COLUMBARIUS	MERLIN
		FALCO MEXICANUS	FALCON PRAIRIE
		FALCO SPARVERIUS	FALCON AM KESTREL
		MELEAGRIS GALLOPAVO	TURKEY
		CALLIPEPLA SQUAMATA	QUAIL SCALED
		CYRTONYX MONTEZUMAE	QUAIL MEARNS
		LOPHORTYX GAMBELII	QUAIL GAMBELS
		BOMBYCILLA CEDRORUM	WAXWING CEDAR
		CERTHIA FAMILIARIS	CREEPER BROWN
		APHELOCOMA COERULESCENS	JAY SCRUB
		CORVUS CORAX	RAVEN COMMON
		CYANOCITTA STELLERI	JAY STELLARS
		GYMNORHINUS CYANOCEPHALUS	JAY PINON
		AIMOPHILA RUFICEPS	SPARROW RUFOUS CROWNED
		AMPHISPIZA BILINEATA	SPARROW BLK-THROATED
		CARPODACUS CASSINII	FINCH CASSINS
		CARPODACUS MEXICANUS	FINCH HOUSE
		CARPODACUS PURPUREUS	FINCH PURPLE
		CHLORURA CHLORURA	TOWHEE GREEN TAILED
		CHONDESTES GRAMMACUS	SPARROW LARK
		HESPERIPHONA VESPERTINA	GROSBEAK EVENING
		JUNCO CANICEPS	JUNCO GRAY-HEADED
		JUNCO HYEMALIS	JUNCO SLATE-COLORED
		PASSERCULUS SANDWICHENSIS	SPARROW SAVANNAH
		PHEUCTICUS MELANOCEPHALUS	GROSBEAK BLACK-HEADED
		PIPILO ERYTHROPHTHALMUS	TOWHEE RUFOUS SIDED
		PIPILO FUSCUS	TOWHEE BROWN
		PIRANGA FLAVA	TANAGER HEPATIC
		PIRANGA LUDOVICIANA	TANAGER WESTERN
		POOECETES GRAMINEUS	SPARROW VESPER
		PYRRHULOXIA SINUATA	PYRRHULOXIA
		SPINUS PSALTRIA	GOLDFINCH LESSER
		SPINUS TRISTIS	GOLDFINCH AMERICAN
		SPIZELLA ATROGULARIS	SPARROW BLACK-CHINNED

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		SPIZELLA PASSERINA	SPARROW CHIPPING
		IRIDOPROCNE BICOLOR	SWALLOW TREE
		TACHYCINETA THALASSINA	SWALLOW VIOLET-GREEN
		ICTERUS GALBULA	ORIOLE NORTHERN
		ICTERUS PARISORUM	ORIOLE SCOTTS
		MOLOTHRUS ATER	COWBIRD BROWNHEADED
		LANIUS LUDOVICIANUS	SHRIKE LOGGERHEAD
		MIMUS POLYGLOTTOS	MOCKINGBIRD NORTHERN
		OREOSCOPTES MONTANUS	THRASHER SAGE
		TOXOSTOMA CURVIROSTRE	THRASHER CURVE-BILLED
		TOXOSTOMA DORSALE	THRASHER CRISSAL
		PARUS GAMBELI	CHICKADEE MOUNTAIN
		PARUS INORNATUS	TITMOUSE PLAIN
		PARUS WOLLWEBERI	TITMOUSE BRIDLED
		PSALTRIPARUS MINIMUS	BUSHTIT
		DENDROCIA AUDUBONI	WARBLER AUDUBONS
		DENDROCIA PETECHIA	WARBLER YELLOW
		VERMIVORA CELATA	WARBLER ORANGE-CROWNED
		VERMIVORA VIRGINIAE	WARBLER VIRGINIAS
		WILSONIA PUSILLA	WARBLER WILSONS
		PHAINOPEPLA NITENS	PHAINOPEPLA
		SITTA CAROLINENSIS	NUTHATCH WHTBREASTED
		SITTA PYGMAEA	PYGMY NUTHATCH
		STURNUS VULGARIS	STARLING
		POLIOPTILA CAERULEA	GNATCATCHER BLUE-GRAY
		REGULUS CALENDULA	KINGLET RUBY-CROWNED
		CAMPYLORHYNCHUS BRUNNEICAPILLUS	WREN CACTUS
		CATHERPES MEXICANUS	WREN CANON
		SALPINCTES OBSOLETUS	WREN ROCK
		THRYOMANES BEWICKII	WREN BEWICKS
		HYLOCHICHLA GUTTATA	THRUSH HERMIT
		MYADESTES TOWNSENDI	SOLITAIRE TOWNSENDS
		SIALIA CURRUCOIDES	BLUEBIRD MOUNTAIN
		SIALIA MEXICANA	BLUEBIRD WESTERN
		TURDUS MIGATORIUS	ROBIN AMERICAN
		CONTOPUS SORDIDULUS	PEWEE WESTERN WOOD
		EMPIDONAX DIFFICILIS	FLYCATCHER WESTERN
		MYIARCHUS CINERASCENS	FLYCATCHER ASHTHROATED
		SAYORNIS SAYA	PHOEBE SAYS
		TYRANNUS VERTICALIS	KINGBIRD WESTERN
		TYRANNUS VOCIFERANS	KINGBIRD CASSINS
		VIREO BELLII	VIREO BELLS
		VIREO SOLITARIUS	VIREO SOLITARY
		VIREO VICINIOR	VIREO GRAY
		ASYNDESMUS LEWIS	WOODPECKER LEWIS
		COLAPTES AURATUS	FLICKER YELLOW-SHAFTED
		DENDROCOPOS PUBESCENS	WOODPECKER DOWNY
		DENDROCOPOS SCALARIS	WOODPECKER LADDER-BACKED
		DENDROCOPOS VILLOSUS	WOODPECKER HAIRY
		MELANERPES FORMICIVORUS	WOODPECKER ACORN
		SPHYRAPICUS VARIUS	SAPSUCKER YELLOW-BELLIED
		AEGOLIUS ACADICUS	OWL SAW-WHET
		ASIO OTUS	OWL LONG-EARED
		BUBO VIRGINIANUS	OWL GREAT HORNED
		OTUS ASIO	OWL SCREECH COMMON
	MAMMALIA	ODOCOILEUS HEMIONUS	DEER MULE
		ODOCOILEUS VIRGINIANUS	DEER WHITE-TAILED
		CANIS LATRANS	COYOTE
		UROCYON CINEREOARGENTEUS	FOX GRAY
		VULPES VULPES	FOX RED
		FELIS CONCOLOR	LION MOUNTAIN
		FELIS RUFUS	BOBCAT
		CONEPATUS MESOLEUCUS	SKUNK HOG-NOSED
		MUSTELA FRENATA	WEASEL LONG-TAILED
		SPILOGALE GRACILIS	SKUNK SPOTTED WESTERN
		MEPHITIS MEPHITIS	SKUNK STRIPED
		BASSARISCUS ASTUTUS	RINGTAIL
		PROCYON LOTOR	RACCOON
		URSUS AMERICANUS	BEAR BLACK
		EUDERMA MACULATUM	BAT SPOTTED
		EPTESUCUS FUSCUS	BAT BIG BROWN
		IDIONYCTERIS PHYLLOTIS	BAT BIG-EARED ALLEN.S
		MYOTIS AURICULUS	BAT MYOTIS SOUTHWESTERN
		MYOTIS CALIFORNICUS	BAT MYOTIS CALIFORNIA
		MYOTIS LEIBII	BAT MYOTIS SMALL-FOOTED
		MYOTIS THYSANODES	BAT MYOTIS FRINGE-TAILED
		MYOTIS VOLANS	BAT MYOTIS LONG-LEGGED
		PLECOTUS TOWNSENDII	BAT TOWNSENDS BIG-EARED
		NOTIOSOREX CRAWFORDI	SHREW DESERT
		SOREX VAGRANS	SHREW VAGRANT

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		LEPUS CALIFORNICUS	BLACK-TAILED JACKRABBIT
		SYLVILAGUS AUDUBONII	COTTONTAIL DESERT
		NEOTOMA ALBIGULA	WOODRAT WHITE-THROATED
		NEOTOMA MEXICANA	WOODRAT STEPHEN S
		PEROMYSCUS BOYLII	MOUSE BRUSH
		PEROMYSCUS DIFFICILIS	MOUSE ROCK
		PEROMYSCUS EREMICUS	MOUSE CACTUS
		PEROMYSCUS LEUCOPUS	MOUSE WHT FOOTED
		PEROMYSCUS MANICULATUS	MOUSE DEER
		PEROMYSCUS TRUEI	MOUSE PINYON
		REITHRODONTOMYS MEGALOTIS	MOUSE W HARVEST
		ERETHIZON DORSATUM	PORCUPINE
		THOMOMYS BOTTAE	GOPHER POCKET BOTTAS
		PEROGNATHUS FLAVUS	MOUSE POCKET SILKY
		PEROGNATHUS INTERMEDIUS	MOUSE POCKET ROCK
		AMMOSPERMOPHILUS INTERPRES	ANTLPE GRD SQURL TEXAS
		EUTAMIAS DORSALIS	CHIPMUNK CLIFF
		SPERMOPHILUS VARIEGATUS	SQUIRREL ROCK
	REPTILIA	CROTAPHYTUS COLLARIS	LIZARD COLLARED
		PHRYNOSOMA CORONATUM	LIZARD COAST HORNED
		PHRYNOSOMA DOUGLASSI	LIZARD HORNED SHORT
		SCELOPORUS CLARKI	LIZARD SPINY CLARKS
		SCELOPORUS UNDULATUS	LIZARD FENCE EASTERN
		UROSAURUS ORNATUS	LIZARD TREE
		EUMECES OBSOLETUS	SKINK GREAT PLAINS
		CNEMIDOPHORUS EXSANGUIS	WHIPTAIL CHIHUAHUA SPOTT
		CNEMIDOPHORUS TESSELATUS	WHIPTAIL COLO CHECKERED
		CNEMIDOPHORUS TIGRIS	WHIPTAIL WESTERN
		CNEMIDOPHORUS VELOX	WHIPTAIL PLATEAU
		DIADOPHIS PUNCTATUS	SNAKE RINGNECK
		GYALOPION CANUM	SNAKE WESTERN HOOKNOSED
		LAMPROPELTIS GETULUS	SNAKE KING COMMON
		MASTICOPHIS TAENIATUS	SNAKE STRIPED WHIP
		PITUOPHIS MELANOLEUCUS	SNAKE GOPHER
		SALVADORA GRAHAMIAE	SNAKE PATCH-NOSED MTN
		THAMNOPHIS CYRTOPSIS	SNAKE GARTER BLACKNECKED
		THAMNOPHIS ELEGANS	SNK GARTER W TERRESTRIAL
		CROTALUS LEPIDUS	SNAKE RATTLE ROCK
		CROTALUS MOLOSSUS	SNAKE RATTLE BLK-TAILED
PSEUDORIPARIAN	AMPHIBIA	BUFO PUNCTATUS	TOAD RED-SPOTTED
		BUFO SPECIOSUS	TOAD TEXAS
		BUFO WOODHOUSEI	TOAD WOODHOUSES
		SCAPHIOPUS BOMBIFRONS	SPADEFOOT PLAINS
		SCAPHIOPUS COUCHI	SPADEFOOT COUCHS
		SCAPHIOPUS HAMMONDI	WESTERN SPADEFOOT
	AVES	ARCHILOCHUS ALEXANDRI	HUMMINGBIRD BLKCHINNED
			NIGHTHAWK LESSER
		CHORDEILES MINOR	NIGHTHAWK COMMON
		PHALAENOPTILUS NUTTALLII	POOR-WILL COMMON
		CHARADRIUS VOCIFERUS	KILLDEER
		ARDEA HERODIAS	HERON GREAT BLUE
		COLUMBA FASCIATA	PIGEON BAND-TAILED
		COLUMBIGALLINA PASSERINA	DOVE COMMON GROUND
		ZENAIDA ASIATICA	DOVE WHITE-WINGED
		ZENAIDURA MACROURA	DOVE MOURNING
		GEOCOCCYX CALIFORNIANUS	ROADRUNNER GREATER
		ACCIPITER COOPERII	HAWK COOPERS
		ACCIPITER STRIATUS	HAWK SHARP-SHINNED
		AQUILA CHRYSAETOS	EAGLE GOLDEN
		BUTEO JAMAICENSIS	HAWK RED-TAILED
		CIRCUS CYANEUS	HAWK MARSH
		FALCO SPARVERIUS	FALCON AM KESTREL
		CALLIPEPLA SQUAMATA	QUAIL SCALED
		LOPHORTYX GAMBELII	QUAIL GAMBELS
		APHELOCOMA COERULESCENS	JAY SCRUB
		CORVUS CORAX	RAVEN COMMON
		CORVUS CRYPTOLEUCUS	RAVEN WHITE-NECKED
		AIMOPHILA CASSINII	SPARROW CASSINS
		AIMOPHILA RUFICEPS	SPARROW RUFOUS CROWNED
		AMPHISPIZA BELLI	SPARROW SAGE
		AMPHISPIZA BILINEATA	SPARROW BLK-THROATED
		CALAMOSPIZA MELANOCORYS	BUNTING LARK
		CARPODACUS CASSINII	FINCH CASSINS
		CARPODACUS MEXICANUS	FINCH HOUSE
		CHLORURA CHLORURA	TOWHEE GREEN TAILED
		CHONDESTES GRAMMACUS	SPARROW LARK
		GUIRACA CAERULEA	GROSBEAK BLUE
		HESPERIPHONA VESPERTINA	GROSBEAK EVENING
		JUNCO CANICEPS	JUNCO GRAY-HEADED
		PIPILO FUSCUS	TOWHEE BROWN

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		PIRANGA LUDOVICIANA	TANAGER WESTERN
		SPINUS PSALTRIA	GOLDFINCH LESSER
		SPIZELLA PALLIDA	SPARROW CLAYCOLORED
		ZONOTRICHIA ALBICOLLIS	SPARROW WHTTHROATED
		ZONOTRICHIA GAMBELI	SPARROW GAMBELS WHTCND
		HIRUNDO RUSTICA	SWALLOW BARN
		PETROCHELIDON PYRRHONOTA	SWALLOW CLIFF
		STELGIDOPTERYX RUFICOLLIS	SWALLOW ROUGH-WINGED
		AGELAIUS PHOENICEUS	BLACKBIRD REDWINGED
		ICTERUS GALBULA	ORIOLE NORTHERN
		ICTERUS PARISORUM	ORIOLE SCOTTS
		MOLOTHRUS ATER	COWBIRD BROWNHEADED
		STURNELLA NEGLECTA	MEADOWLARK WESTERN
		LANIUS LUDOVICIANUS	SHRIKE LOGGERHEAD
		MIMUS POLYGLOTTOS	MOCKINGBIRD NORTHERN
		OREOSCOPTES MONTANUS	THRASHER SAGE
		TOXOSTOMA CURVIROSTRE	THRASHER CURVE-BILLED
		TOXOSTOMA DORSALE	THRASHER CRISSAL
		AURIPARUS FLAVICEPS	VERDIN
		PSALTRIPARUS MINIMUS	BUSHTIT
		DENDROCIA AUDUBONI	WARBLER AUDUBONS
		DENDROCIA GRACIAE	WARBLER GRACES
		DENDROCIA NIGRESCENS	WARBLER BLKTHROATED GRAY
		DENDROCIA PETECHIA	WARBLER YELLOW
		DENDROCIA TOWNSENDI	WARBLER TOWNSENDS
		DENDROCIA VIRENS	WARBLER BLKTHROATED GRN
		ICTERIA VIRENS	CHAT YLWBREASTED
		MNIOTILTA VARIA	WARBLER BLK AND WHT
		OPORORNIS TOLMIEI	WARBLER MACGILLIVRAYS
		PARULA AMERICANA	WARBLER NO PARULA
		PROTONOTARIA CITREA	WARBLER PROTHONOTARY
		SEIURUS NOVEBORACENSIS	WATERTHRUSH NO
		VERMIVORA CELATA	WARBLER ORANGE-CROWNED
		VERMIVORA LUCIAE	WARBLER LUCYS
		VERMIVORA PEREGRINA	WARBLER TENNESSEE
		VERMIVORA RUFICAPILLA	WARBLER NASHVILLE
		VERMIVORA VIRGINIAE	WARBLER VIRGINIAS
		PASSER DOMESTICUS	SPARROW HOUSE OR ENGLISH
		SITTA CAROLINENSIS	NUTHATCH WHTBREASTED
		POLIOPTILA MELANURA	GNATCATCHER BLK-TAILED
		REGULUS CALENDULA	KINGLET RUBY-CROWNED
		CAMPYLORHYNCHUS BRUNNEICAPILLUS	WREN CACTUS
		CATHERPES MEXICANUS	WREN CANON
		SALPINCTES OBSOLETUS	WREN ROCK
		THRYOMANES BEWICKII	WREN BEWICKS
		HYLOCHICHLA GUTTATA	THRUSH HERMIT
		MYIARCHUS CINERASCENS	FLYCATCHER ASHTHROATED
		SAYORNIS SAYA	PHOEBE SAYS
		TYRANNUS VERTICALIS	KINGBIRD WESTERN
		TYRANNUS VOCIFERANS	KINGBIRD CASSINS
		VIREO BELLII	VIREO BELLS
		VIREO SOLITARIUS	VIREO SOLITARY
		VIREO VICINIOR	VIREO GRAY
		COLAPTES CAFER	FLICKER RED-SHAFTED
		DENDROCOPOS SCALARIS	WOODPECKER LADDER-BACKED
		SPHYRAPICUS VARIUS	SAPSUCKER YELLOW-BELLIED
		ASIO OTUS	OWL LONG-EARED
		BUBO VIRGINIANUS	OWL GREAT HORNED
		TYTO ALBA	OWL BARN
	MAMMALIA	ANTILOCAPRA AMERICANA	PRONGHORN
		ODOCOILEUS HEMIONUS	DEER MULE
		CANIS LATRANS	COYOTE
		FELIS RUFUS	BOBCAT
		CONEPATUS MESOLEUCUS	SKUNK HOG-NOSED
		SPILOGALE GRACILIS	SKUNK SPOTTED WESTERN
		TAXIDEA TAXUS	BADGER
		MEPHITIS MEPHITIS	SKUNK STRIPED
		TADARIDA BRASILIENSIS	BAT FREE-TAILED BRAZILAN
		TADARIDA MACROTIS	BAT FREE-TAILED BIG
		ANTROZOUS PALLIDUS	BAT PALLID
		MYOTIS CALIFORNICUS	BAT MYOTIS CALIFORNIA
		MYOTIS THYSANODES	BAT MYOTIS FRINGE-TAILED
		MYOTIS YUMANENSIS	BAT MYOTIS YUMA
		NOTIOSOREX CRAWFORDI	SHREW DESERT
		LEPUS CALIFORNICUS	BLACK-TAILED JACKRABBIT
		SYLVILAGUS AUDUBONII	COTTONTAIL DESERT
		NEOTOMA ALBIGULA	WOODRAT WHITE-THROATED
		ONYCHOMYS LEUCOGASTER	MOUSE N GRASSHOPPER
		PEROMYSCUS BOYLII	MOUSE BRUSH
		PEROMYSCUS EREMICUS	MOUSE CACTUS

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		PEROMYSCUS LEUCOPUS	MOUSE WHT FOOTED
		PEROMYSCUS MANICULATUS	MOUSE DEER
		REITHRODONTOMYS MEGALOTIS	MOUSE W HARVEST
		ERETHIZON DORSATUM	PORCUPINE
		DIPODOMYS MERRIAMI	RAT KANGAROO MERRIAM S
		DIPODOMYS ORDII	RAT KANGAROO ORDS
		PEROGNATHUS FLAVUS	MOUSE POCKET SILKY
		PEROGNATHUS INTERMEDIUS	MOUSE POCKET ROCK
		SPERMOPHILUS SPILOSOMA	SOUIRREL GROUND SPOTTED
		SPERMOPHILUS VARIEGATUS	SQUIRREL ROCK
	REPTILIA	COPHASAURUS TEXANA	LIZARD GREATER EARLESS
		CROTAPHYTUS COLLARIS	LIZARD COLLARED
		GAMBELIA WISLIZENI	LIZARD LONGNOSED LEOPARD
		HOLBROOKIA MACULATA	LIZARD EARLESS LESSER
		PHRYNOSOMA CORNUTUM	LIZARD HORNED TEXAS
		PHRYNOSOMA DOUGLASSI	LIZARD HORNED SHORT
		PHRYNOSOMA MODESTUM	LIZARD HORNED RD-TAILED
		SCELOPORUS CLARKI	LIZARD SPINY CLARKS
		SCELOPORUS MAGISTER	LIZARD SPINY DESERT
		SCELOPORUS POINSETTI	LIZARD SPINY CREVICE
		SCELOPORUS UNDULATUS	LIZARD FENCE EASTERN
		UROSAURUS ORNATUS	LIZARD TREE
		UTA STANSBURIANA	LIZARD SIDE-BLOTCHED
		EUMECES OBSOLETUS	SKINK GREAT PLAINS
		CNEMIDOPHORUS EXSANGUIS	WHIPTAIL CHIHUAHUA SPOTT
		CNEMIDOPHORUS INORNATUS	WHIPTAIL LITTLE STRIPED
		CNEMIDOPHORUS TESSELATUS	WHIPTAIL COLO CHECKERED
		CNEMIDOPHORUS TIGRIS	WHIPTAIL WESTERN
		CNEMIDOPHORUS UNIPARENS	WHPTAIL DESERT GRASSLAND
		CNEMIDOPHORUS VELOX	WHIPTAIL PLATEAU
		ARIZONA ELEGANS	SNAKE GLOSSY
		DIADOPHIS PUNCTATUS	SNAKE RINGNECK
		ELAPHE SUBOCULARIS	SNAKE RAT TRANS-PECOS
		HETERODON NASICUS	SNAKE HOGNOSE WESTERN
		LAMPROPELTIS GETULUS	SNAKE KING COMMON
		LEPTOTYPHLOPS DULCIS	SNAKE BLIND TEXAS
		LEPTOTYPHLOPS HUMILIS	SNAKE BLIND WESTERN
		MASTICOPHIS FLAGELLUM	SNAKE COACHWHIP
		MASTICOPHIS TAENIATUS	SNAKE STRIPED WHIP
		PITUOPHIS MELANOLEUCUS	SNAKE GOPHER
		RHINOCHEILUS LECONTEI	SNAKE LONG-NOSED
		SALVADORA HEXALEPIS	SNAKE PATCH-NOSED W
		SONORA SEMIANNULATA	SNAKE GROUND WESTERN
		TANTILLA NIGRICEPS	SNAKE BLACKHEADED PLAINS
		TANTILLA PLANICEPS	SNAKE BLACKHEADED W
		THAMNOPHIS CYRTOPSIS	SNAKE GARTER BLACKNECKED
		THAMNOPHIS ELEGANS	SNK GARTER W TERRESTRIAL
		TRIMORPHODON BISCUTATUS	SNAKE LYRE
		CROTALUS ATROX	SNAKE RATTLE W DIA BACK
		CROTALUS VIRIDIS	SNAKE RATTLE WESTERN
		SISTRURUS CATENATUS	MASSASAUGA
RIPARIAN	AMPHIBIA	AMBYSTOMA TIGRINUM	SALAMANDER TIGER
		BUFO COGNATUS	TOAD GREAT PLAINS
		BUFO DEBILIS	TOAD GREEN
		BUFO PUNCTATUS	TOAD RED-SPOTTED
		BUFO SPECIOSUS	TOAD TEXAS
		BUFO WOODHOUSEI	TOAD WOODHOUSES
		HYLA ARENICOLOR	FROG TREE CANYON
		RANA CATESBEIANA	FROG BULL
		RANA PIPIENS	FROG NO LEOPARD
		SCAPHIOPUS BOMBIFRONS	SPADEFOOT PLAINS
		SCAPHIOPUS COUCHI	SPADEFOOT COUCHS
		SCAPHIOPUS HAMMONDI	WESTERN SPADEFOOT
	AVES	ACCIPITER COOPERII	HAWK COOPERS
		ACCIPITER STRIATUS	HAWK SHARP-SHINNED
		AECHMOPHORUS OCCIDENTALIS	GREBE WESTERN
		AEGOLIUS ACADICUS	OWL SAW-WHET
		AERONAUTES SAXATALIS	SWIFT WHITE-THROATED
		AGELAIUS PHOENICEUS	BLACKBIRD REDWINGED
		AIMOPHILA RUFICEPS	SPARROW RUFOUS CROWNED
		AIX SPONSA	DUCK WOOD
		AMPHISPIZA BELLI	SPARROW SAGE
		AMPHISPIZA BILINEATA	SPARROW BLK-THROATED
		ANAS ACUTA	DUCK PINTAIL COMMON
		ANAS CAROLINENSIS	TEAL AMERICAN GRNWING
		ANAS CYANOPTERA	TEAL CINNAMON
		ANAS DIAZI	DUCK MEXICAN
		ANAS PLATYRHYNCHOS	DUCK MALLARD
		ANAS STREPERA	DUCK GADWALL
		ANHINGA ANHINGA	ANHINGA

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		ANSER CAERULESCENS	GOOSE GREATER SNOW
		ANTHUS SPINOLETTA	PIPIT WATER
		APHELOCOMA COERULESCENS	JAY SCRUB
		AQUILA CHRYSAETOS	EAGLE GOLDEN
		ARCHILOCHUS ALEXANDRI	HUMMINGBIRD BLKCHINNED
		ARDEA HERODIAS	HERON GREAT BLUE
		ASIO OTUS	OWL LONG-EARED
		ASYNDESMUS LEWIS	WOODPECKER LEWIS
		AYTHYA AFFINIS	DUCK SCAUP LESSER
		AYTHYA AMERICANA	DUCK REDHEAD
		AYTHYA COLLARIS	DUCK RING-NECKED
		AYTHYA VALISINERIA	DUCK CANVASBACK
		BOMBYCILLA CEDRORUM	WAXWING CEDAR
		BOTARUS LENTIGINOSUS	BITTERN AMERICAN
		BRANTA CANADENSIS	GOOSE CANADA
		BUBO VIRGINIANUS	OWL GREAT HORNED
		BUBULCUS IBIS	EGRET CATTLE
		BUCEPHALA ALBEOLA	DUCK BUFFLEHEAD
		BUCEPHALA CLANGULA	DUCK GOLDENEYE COMMON
		BUTEO JAMAICENSIS	HAWK RED-TAILED
		BUTEO SWAINSONI	HAWK SWAINSONS
		BUTEOGALLUS ANTHRACINUS	HAWK BLACK
		CALIDRIS ALBA	SAUNDERLING
		CALLIPEPLA SQUAMATA	QUAIL SCALED
		CAMPYLORHYNCHUS BRUNNEICAPILLUS	WREN CACTUS
		CAPELLA GALLINAGO	SNIPE COMMON
		CARDELLINA RUBRIFRONS	WARBLER RED-FACED
		CARPODACUS CASSINII	FINCH CASSINS
		CARPODACUS MEXICANUS	FINCH HOUSE
		CARPODACUS PURPUREUS	FINCH PURPLE
		CATHARTES AURA	VULTURE TURKEY
		CATHERPES MEXICANUS	WREN CANON
		CERTHIA FAMILIARIS	CREEPER BROWN
		CHARADRIUS VOCIFERUS	KILLDEER
		CHLORURA CHLORURA	TOWHEE GREEN TAILED
		CHORDEILES ACUTIPENNIS	NIGHTHAWK LESSER
		CINCLUS MEXICANUS	DIPPER AMERICAN
		CIRCUS CYANEUS	HAWK MARSH
		COCCYZUS AMERICANUS	CUCKOO YELLOW-BILLED
		COLAPTES CAFER	FLICKER RED-SHAFTED
		COLUMBIGALLINA PASSERINA	DOVE COMMON GROUND
		CONTOPUS SORDIDULUS	PEWEE WESTERN WOOD
		CORVUS CORAX	RAVEN COMMON
		CORVUS CRYPTOLEUCUS	RAVEN WHITE-NECKED
		CYANOCITTA STELLERI	JAY STELLARS
		DENDROCIA AUDUBONI	WARBLER AUDUBONS
		DENDROCIA GRACIAE	WARBLER GRACES
		DENDROCIA NIGRESCENS	WARBLER BLKTHROATED GRAY
		DENDROCIA PETECHIA	WARBLER YELLOW
		DENDROCIA TOWNSENDI	WARBLER TOWNSENDS
		DENDROCOPOS PUBESCENS	WOODPECKER DOWNY
		DENDROCOPOS SCALARIS	WOODPECKER LADDER-BACKED
		DENDROCOPOS VILLOSUS	WOODPECKER HAIRY
		EGRETTA THULA	EGRET SNOWY
		EMPIDONAX DIFFICILIS	FLYCATCHER WESTERN
		EMPIDONAX HAMMOND II	FLYCATCHER HAMMONDS
		EMPIDONAX OBERHOLSERI	FLYCATCHER DUSKY
		EMPIDONAX TRAILLII	FLYCATCHER WILLOW
		EUPHAGUS CYANOCEPHALUS	BLACKBIRD BREWERS
		FALCO COLUMBARIUS	MERLIN
		FALCO PEREGRINUS	FALCON PEREGRINE
		FALCO SPARVERIUS	FALCON AM KESTREL
		FLORIDA CAERULEA	HERON LITTLE BLUE
		FREGATA MAGNIFICENS	FRIGATEBIRD MAGNIFICENT
		FULICA AMERICANA	COOT AMERICAN
		GALLINULA CHLOROPUS	GALLINULE COMMON
		GAVIA IMMER	LOON COMMON
		GEOCOCCYX CALIFORNIANUS	ROADRUNNER GREATER
		GEOTHYLPIS TRICHAS	YELLOWTHROAT COMMON
		GLAUCIDIUM GNOMA	OWL PYGMY NORTHERN
		GRUS AMERICANA	CRANE WHOOPING
		GRUS CANADENSIS	CRANE SANDHILL
		GUIRACA CAERULEA	GROSBEAK BLUE
		GYMNORHINUS CYANOCEPHALUS	JAY PINON
		HALIAEETUS LEUCOCEPHALUS	EAGLE BALD
		HESPERIPHONA VESPERTINA	GROSBEAK EVENING
		HIRUNDO RUSTICA	SWALLOW BARN
		HYLOCHICHLA GUTTATA	THRUSH HERMIT
		HYLOCHICHLA USTULATA	THRUSH SWAINSONS
		ICTERIA VIRENS	CHAT YLWBREASTED

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		ICTERUS CUCULLATUS	ORIOLE HOODED
		ICTERUS GALBULA	ORIOLE NORTHERN
		ICTERUS PARISORUM	ORIOLE SCOTTS
		ICTINIA MISISIPPIENSIS	KITE MISSISSIPPI
		IRIDOPROCNE BICOLOR	SWALLOW TREE
		IXOBRYCHUS EXILIS	BITTERN LEAST
		JUNCO HYEMALIS	JUNCO SLATE-COLORED
		LAMPORNIS CLEMENCIAE	HUMMINGBIRD BLUETHROATED
		LANIUS LUDOVICIANUS	SHRIKE LOGGERHEAD
		LOBIPES LOBATUS	PHALAROPE NORTHERN
		LOPHORTYX GAMBELII	QUAIL GAMBELS
		MARCEA AMERICANA	DUCK WIDGEON AMERICAN
		MEGACERYLE ALCYON	KINGFISHER BELTED
		MELANERPES FORMICIVORUS	WOODPECKER ACORN
		MELEAGRIS GALLOPAVO	TURKEY
		MELOSPIZA LICOLNII	SPARROW LINCOLNS
		MELOSPIZA MELODIA	SPARROW SONG
		MERGUS CUCULLATUS	MERGANSER HOODED
		MERGUS MERGANSER	MERGANSER COMMON
		MIMUS POLYGLOTTOS	MOCKINGBIRD NORTHERN
		MNIOTILTA VARIA	WARBLER BLK AND WHT
		MOLOTHRUS ATER	COWBIRD BROWNHEADED
		MYCTERIA AMERICANA	STORK WOOD
		MYIARCHUS CINERASCENS	FLYCATCHER ASHTHROATED
		NUMENIUS AMERICANUS	CURLEW LONG-BILLED
		NYCTICORAX NYCTICORAX	HERON BLKCRWND NIGHT
		OLOR COLUMBIANUS	SWAN WHISTLING
		OPORORNIS TOLMIEI	WARBLER MACGILLIVRAYS
		OTUS ASIO	OWL SCREECH COMMON
		OXYURA JAMAICENSIS	DUCK RUDDY
		PANDION HALIAETUS	OSPREY
		PARULA AMERICANA	WARBLER NO PARULA
		PARUS GAMBELI	CHICKADEE MOUNTAIN
		PARUS INORNATUS	TITMOUSE PLAIN
		PARUS WOLLWEBERI	TITMOUSE BRIDLED
		PASSERCULUS SANDWICHENSIS	SPARROW SAVANNAH
		PELECANUS ERYTHRORHYNCHOS	PELICAN WHITE
		PETROCHELIDON PYRRHONOTA	SWALLOW CLIFF
		PHAINOPEPLA NITENS	PHAINOPEPLA
		PHALACROCORAX AURITUS	CORMORANT DBL CRESTED
		PHALACROCORAX OLIVACEUS	CORMORANT OLIVACEOUS
		PHALAENOPTILUS NUTTALLII	POOR-WILL COMMON
		PHEUCTICUS LUDOVICIANUS	GROSBEAK ROSE-BREASTED
		PHEUCTICUS MELANOCEPHALUS	GROSBEAK BLACK-HEADED
		PIPILO ERYTHROPHTHALMUS	TOWHEE RUFOUS SIDED
		PIPILO FUSCUS	TOWHEE BROWN
		PIRANGA FLAVA	TANAGER HEPATIC
		PIRANGA LUDOVICIANA	TANAGER WESTERN
		PIRANGA RUBRA	TANAGER SUMMER
		PLEGADIS CHIHI	IBIS WHITE-FACED
		PODICEPS AURITUS	GREBE HORNED
		PODICEPS CASPICUS	GREBE EARED
		PODILYMBUS PODICEPS	GREBE PIED-BILLED
		POLIOPTILA CAERULEA	GNATCATCHER BLUE-GRAY
		PORZANA CAROLINA	SORA
		PROTONOTARIA CITREA	WARBLER PROTHONOTARY
		PSALTRIPARUS MINIMUS	BUSHTIT
		PYRRHULOXIA SINUATA	PYRRHULOXIA
		RALLUS LIMICOLA	RAIL VIRGINIA
		RECURVIROSTRA AMERICANA	AVOCET AMERICAN
		REGULUS CALENDULA	KINGLET RUBY-CROWNED
		RIPARIA RIPARIA	SWALLOW BANK
		SALPINCTES OBSOLETUS	WREN ROCK
		SAYORNIS NIGRICANS	PHOEBE BLACK
		SAYORNIS SAYA	PHOEBE SAYS
		SEIURUS NOVEBORACENSIS	WATERTHRUSH NO
		SELAPHORUS PLATYCERCUS	HUMMINGBIRD BROADTAILED
		SELAPHORUS RUFUS	HUMMINGBIRD RUFOUS
		SETOPHAGA RUTICILLA	REDSTART AMERICAN
		SIALIA MEXICANA	BLUEBIRD WESTERN
		SITTA CANADENSIS	NUTHATCH REDBREASTED
		SITTA CAROLINENSIS	NUTHATCH WHTBREASTED
		SITTA PYGMAEA	PYGMY NUTHATCH
		SPATULA CLYPEATA	DUCK NORTHERN SHOVELER
		SPHYRAPICUS THYROIDEUS	SAPSUCKER WILLIAMSONS
		SPHYRAPICUS VARIUS	SAPSUCKER YELLOW-BELLIED
		SPINUS PSALTRIA	GOLDFINCH LESSER
		SPINUS TRISTIS	GOLDFINCH AMERICAN
		SPIZELLA PASSERINA	SPARROW CHIPPING
		STEGANOPUS TRICOLOR	PHALAROPE WILSONS

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		STELGIDOPTERYX RUFICOLLIS	SWALLOW ROUGH-WINGED
		STELLULA CALLIOPE	HUMMINGBIRD CALLIOPE
		TACHYCINETA THALASSINA	SWALLOW VIOLET-GREEN
		TELMATODYTES PALUSTRIS	WREN MARSH LONG-BILLED
		THRYOMANES BEWICKII	WREN BEWICKS
		TOXOSTOMA RUFUM	THRASHER BROWN
		TROGLODYTES AEDON	WREN HOUSE
		TURDUS MIGATORIUS	ROBIN AMERICAN
		TYRANNUS VERTICALIS	KINGBIRD WESTERN
		TYRANNUS VOCIFERANS	KINGBIRD CASSINS
		VERMIVORA CELATA	WARBLER ORANGE-CROWNED
		VERMIVORA LUCIAE	WARBLER LUCYS
		VERMIVORA PEREGRINA	WARBLER TENNESSEE
		VERMIVORA RUFICAPILLA	WARBLER NASHVILLE
		VERMIVORA VIRGINIAE	WARBLER VIRGINIAS
		VIREO BELLII	VIREO BELLS
		VIREO GILVUS	VIREO WARBLING
		VIREO SOLITARIUS	VIREO SOLITARY
		VIREO VICINIOR	VIREO GRAY
		WILSONIA PUSILLA	WARBLER WILSONS
		XANTHOCEPHALUS XANTHOCEPHALUS	BLACKBIRD YLWHEADED
		ZENAIDA ASIATICA	DOVE WHITE-WINGED
		ZENAIDURA MACROURA	DOVE MOURNING
		ZONOTRICHIA ALBICOLLIS	SPARROW WHTTHROATED
		ZONOTRICHIA GAMBELI	SPARROW GAMBELS WHTCND
	MAMMALIA	ANTROZOUS PALLIDUS	BAT PALLID
		BASSARISCUS ASTUTUS	RINGTAIL
		CANIS LATRANS	COYOTE
		CASTOR CANADENSIS	BEAVERS
		CONEPATUS MESOLEUCUS	SKUNK HOG-NOSED
		EPTESUCUS FUSCUS	BAT BIG BROWN
		ERETHIZON DORSATUM	PORCUPINE
		EUDERMA MACULATUM	BAT SPOTTED
		EUMOPS PEROTIS	BAT WESTERN MASTIFF
		EUTAMIAS CINEREICOLLIS	CHIPMUNK GRAY-COLLARED
		FELIS CONCOLOR	LION MOUNTAIN
		FELIS RUFUS	BOBCAT
		IDIONYCTERIS PHYLLOTIS	BAT BIG-EARED ALLEN S
		LASIURUS BOREALIS	BAT RED
		LASIURUS CINEREUS	BAT HOARY
		MEPHITIS MEPHITIS	SKUNK STRIPED
		MUSTELA FRENATA	WEASEL LONG-TAILED
		MYOTIS AURICULUS	BAT MYOTIS SOUTHWESTERN
		MYOTIS CALIFORNICUS	BAT MYOTIS CALIFORNIA
		MYOTIS LEIBII	BAT MYOTIS SMALL-FOOTED
		MYOTIS LUCIFUGUS	BAT MYOTIS LITTLE BROWN
		MYOTIS THYSANODES	BAT MYOTIS FRINGE-TAILED
		MYOTIS VOLANS	BAT MYOTIS LONG-LEGGED
		MYOTIS YUMANENSIS	BAT MYOTIS YUMA
		NEOTOMA ALBIGULA	WOODRAT WHITE-THROATED
		NEOTOMA MEXICANA	WOODRAT STEPHEN S
		NOTIOSOREX CRAWFORDI	SHREW DESERT
		ODOCOILEUS HEMIONUS	DEER MULE
		ONDATRA ZIBETHICUS	MUSKRAT
		PEROGNATHUS INTERMEDIUS	MOUSE POCKET ROCK
		PEROMYSCUS BOYLII	MOUSE BRUSH
		PEROMYSCUS EREMICUS	MOUSE CACTUS
		PEROMYSCUS LEUCOPUS	MOUSE WHT FOOTED
		PEROMYSCUS MANICULATUS	MOUSE DEER
		PIPISTRELLUS HESPERUS	PIPISTREL WESTERN
		PLECOTUS TOWNSENDII	BAT TOWNSENDS BIG-EARED
		PROCYON LOTOR	RACCOON
		REITHRODONTOMYS MEGALOTIS	MOUSE W HARVEST
		SCIURUS ABERTI	SQUIRREL ABERTS
		SIGMODON HISPIDUS	RAT COTTON HISPID
		SOREX VAGRANS	SHREW VAGRANT
		SPERMOPHILUS SPILOSOMA	SQUIRREL GROUND SPOTTED
		SPERMOPHILUS VARIEGATUS	SQUIRREL ROCK
		SPILOGALE GRACILIS	SKUNK SPOTTED WESTERN
		SYLVILAGUS AUDUBONII	COTTONTAIL DESERT
		TADARIDA BRASILIENSIS	BAT FREE-TAILED BRAZILAN
		URSUS AMERICANUS	BEAR BLACK
	REPTILIA	CHRYSEMYS PICTA	TURTLE PAINTED
		CHRYSEMYS SCRIPTA	TURTLE SLIDER
		CNEMIDOPHORUS EXSANGUIS	WHIPTAIL CHIHUAHUA SPOTT
		CNEMIDOPHORUS TIGRIS	WHIPTAIL WESTERN
		CNEMIDOPHORUS VELOX	WHIPTAIL PLATEAU
		COPHASAURUS TEXANA	LIZARD GREATER EARLESS
		CROTALUS ATROX	SNAKE RATTLE W DIA BACK
		CROTALUS MOLOSSUS	SNAKE RATTLE BLK-TAILED

STANDARD HABITAT SITE NAME	CLASS	SCIENTIFIC NAME	COMMON NAME
		CROTALUS VIRIDIS	SNAKE RATTLE WESTERN
		CROTAPHYTUS COLLARIS	LIZARD COLLARED
		DIADOPHIS PUNCTATUS	SNAKE RINGNECK
		ELAPHE SUBOCULARIS	SNAKE RAT TRANS-PECOS
		EUMECES OBSOLETUS	SKINK GREAT PLAINS
		HETERODON NASICUS	SNAKE HOGNOSE WESTERN
		HOLBROOKIA MACULATA	LIZARD EARLESS LESSER
		KINOSTERNON FLAVESCENS	TURTLE YELLOW MUD
		LAMPROPELTIS GETULUS	SNAKE KING COMMON
		LEPTOTYPHLOPS DULCIS	SNAKE BLIND TEXAS
		LEPTOTYPHLOPS HUMILIS	SNAKE BLIND WESTERN
		MASTICOPHIS TAENIATUS	SNAKE STRIPED WHIP
		PITUOPHIS MELANOLEUCUS	SNAKE GOPHER
		SALVADORA GRAHAMIAE	SNAKE PATCH-NOSED MTN
		SCELOPORUS CLARKI	LIZARD SPINY CLARKS
		SCELOPORUS MAGISTER	LIZARD SPINY DESERT
		SCELOPORUS POINSETTI	LIZARD SPINY CREVICE
		SCELOPORUS UNDULATUS	LIZARD FENCE EASTERN
		SISTRURUS CATENATUS	MASSASAUGA
		SONORA SEMIANNULATA	SNAKE GROUND WESTERN
		THAMNOPHIS CYRTOPSIS	SNAKE GARTER BLACKNECKED
		THAMNOPHIS ELEGANS	SNK GARTER W TERRESTRIAL
		THAMNOPHIS MARCIANUS	SNAKE GARTER CHECKERED
		THAMNOPHIS SIRTALIS	SNAKE GARTER COMMON
		TRIONYX SPINIFERUS	TURTLE SPINY
		UROSAURUS ORNATUS	LIZARD TREE
		UTA STANSBURIANA	LIZARD SIDE-BLOTCHED

APPENDIX C

KEY OBSERVATION POINT WORKSHEETS

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: August 10, 1995
District: Las Cruces
Resource Area: Caballo
Activity (program):

SECTION A. PROJECT INFORMATION

1. Project Name: Copper Flat Mine
2. Key Observation Point: 1
3. VRM Class: III
4. Location: Township 15S, Range 5W, Section 14
5. Location Sketch

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	flat to rugged Mine: small, narrow strip	uniform to patchy	none
LINE	undulating to jagged	horizontal, smooth	none
COLOR	brown Mine: tan	tan, green, black	none
TEXTURE	smooth to coarse	fine and dense, sparse	none

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	flat to rugged Mine: angular, asymmetrical	uniform to patchy	not visible
LINE	undulating to jagged	horizontal, smooth	not visible
COLOR	tan, brown	tan, green, black	not visible
TEXTURE	smooth to coarse	fine and dense, sparse	not visible

SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

ELEMENTS	LAND/WATER BODY (1) Strong	Moderate	Weak	None	VEGETATION (2) Strong	Moderate	Weak	None	STRUCTURES (3) Strong	Moderate	Weak	None
Form			X					X				X
Line				X				X				X
Color				X				X				X
Texture				X				X				X

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: R. P. Rasmussen
Date: August 10, 1995

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date August 10, 1995

District Las Cruces

Resource Area Caballo

Activity (program)

SECTION A. PROJECT INFORMATION

1. Project Name Copper Flat Mine
2. Key Observation Point 2
3. VRM Class III

4. Location
Township 15S
Range 6W
Section 32

5. Location Sketch

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	prominant pyramidal, flat to rolling. Ore: flattened strip	uniform to patchy	conical, rectangular
LINE	irregular, undulating	horizontal, smooth	parallel, horizontal, short vertical
COLOR	reddish brown, grey, tan, brown, white	tan, medium olive green, dark grey	white, light green, tan
TEXTURE	smooth to rough	medium to sparse	scattered

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	Ore: prominant symmetrical benches. Dam: rhomboid	none to patchy	conical, rectangular
LINE	irregular, undulating, bold horizontal	none	short vertical, horizontal, parallel
COLOR	reddish brown, tan, white	medium olive green	light green, tan
TEXTURE	medium to rough	even/ordered	scattered

SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

ELEMENTS	Land/Water Body (1) Strong	Moderate	Weak	None	Vegetation (2) Strong	Moderate	Weak	None	Structures (3) Strong	Moderate	Weak	None
Form	X					X					X	
Line		X						X				X
Color			X				X					X
Texture			X			X						X

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☒ Yes ☐ No (Explain on reverse side)

Evaluator's Names: R. P. Rasmussen

Date: August 10, 1995

DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

AAQS: Ambient Air Quality Standards. The ambient air quality is the prevailing condition of the atmosphere at a given time; the outside air. Regulatory standards for concentration levels of a specified pollutant in the outside air over a specified averaging time period within a given area.

ABA: acid-base accounting.

ACEC: area of critical environmental concern.

ACHP: Advisory Council on Historic Preservation.

Acre-foot, acre-feet: A unit for measuring volume, equal to the quantity of water or other material required to cover 1 acre of land surface to a depth of 1 foot or a volume of 43,560 cubic feet or 325,851 gallons.

A.D.: Anno Domini (in the year of our Lord, in relation to dates).

ADT: Average Daily Traffic. The volume of traffic on a roadway, measured as a one-way trip between points (a round trip is two one-way trips).

Adit: Horizontal mine tunnel.

AIRFA: American Indian Religious Freedom Act of 1978.

Allotment: An area of land designated and managed for grazing of livestock.

Alluvial: Pertaining to material that is transported and deposited by running water.

Alluvium: A general term for all detrital deposits resulting from the operations of modern rivers, including the sediments laid down in riverbeds, floodplains, lakes, and fans at the foot of mountain slopes and estuaries.

Ambient (air): The surrounding atmospheric conditions.

AMD: Acid mine drainage.

Andesites: An extruded igneous (volcanic) rock.

Animal Unit (AU): Considered to be one mature cow (1,000 pounds) or its equivalent based upon average daily forage consumption of 26 pounds of dry matter per day.

ANSI: American National Standards Institute.

Anticline: A geologic unit of folded strata that is convex (flexed upward). In a simple anticline, beds forming the opposing limbs of the fold dip away from its axial plane.

Aquifer: A water-bearing layer of permeable rock, sand, or gravel. A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to conduct groundwater and yield large quantities of water to wells and springs.

Archaeology: The science that investigates the history of peoples by the remains belonging to the earlier periods of their existence.

Archival: Pertaining to or contained in documents or records preserved in evidence of something.

ARD: acid rock drainage.

ARPA: Archeological Resources Protection Act of 1979.

Arroyo Habitat: Intermittent drainages (arroyos) supporting a more varied vegetation composition than the surrounding upland areas.

Artifact: Any object showing human workmanship or modification especially from a prehistoric or historic culture.

ASTM: American Society for Testing and Materials.

Authorized Officer: Any person authorized by the Secretary of the Interior, or his representative, to administer Federal regulations.

AUMs: Animal unit months. The measurement of the privilege of grazing one animal for one month. The amount of forage needed to sustain one cow, one cow with a calf less than 6 months of age, one horse, five sheep, two elk, five deer, or nine antelope for a month. Generally considered to be 900 to 1,000 pounds of air dry forage.

Azurite: Deep-blue to violet-blue monoclinic copper carbonate mineral.

BA: Biological Assessment. An evaluation conducted in accordance with the legal requirements under Section 7 of the Endangered Species Act (16 U.S.C. 1 536[c]) for major Federal construction projects. The purpose of the assessment and resulting document is to determine whether the proposed action is likely to affect any threatened or endangered species.

Backfilling and grading: The operation of refilling an excavation and finishing the surface.

BACT: Best Available Control Technology.

Basin and range: Topography characterized by a series of tilted fault block mountain ranges and broad intervening basins.

Basin and Range physiographic province: A province in the southwestern United States characterized by a series of tilted fault blocks forming longitudinal ridges or mountains and broad intervening basin.

Bench face: The surface of an excavated area at some point between the material being mined and the original surface of the ground on which equipment can be set, moved, or operated.

Berm: An earthen structure, generally several feet high, which acts as a barrier to make it difficult for a vehicle to cross, or which redirects the flow of traffic or water. A mound of stable material placed at the outside bottom of a topsoil or material pile to help hold the pile in position.

B.C.: Before Christ (in relation to dates).

BISON-M: Biota Information System of New Mexico.

BLM: U.S. Department of the Interior, Bureau of Land Management.

BMP: Best Management Practices.

Bond release: Return of a performance bond to a mine operator after the regulatory agency has inspected and evaluated the completed reclamation operations and determined that all regulatory requirements have been satisfied.

Borrow areas or fill areas: Places where earth material is removed or added for construction purposes.

Borrow materials: Soil or rock dug from one location to provide fill at another location.

B.P.: Before present (in relation to dates).

Breccia: Large angular fragments forming a rock; may be of either volcanic or sedimentary origin.

Broadcast seeding: Scattering seed on the surface of the soil.

ca.: Circa, or about (in relation to time, or dates).

CAA: Clean Air Act of 1955, as amended.

Cauldron: Large, basin-shaped volcanic depression.

Candidate, Category 1 (C1): Taxa for which USFWS has substantial information on hand to support proposing the species for listing as threatened or endangered. Listing proposals are either being prepared or have been delayed by higher-priority listing work.

Candidate, Category 2 (C2): Taxa for which the USFWS has information to indicate that the listing as threatened or endangered is possibly appropriate. Additional information is being collected.

Candidate, Category 3 (C3): Taxa that were once being considered for listing as endangered and threatened but are no longer receiving such consideration.

Catchment: A reservoir or basin developed for flood or sediment control or for water management associated with livestock and/or wildlife.

CEQ: Council on Environmental Quality, Executive Office of the President. An advisory council to the President established by the National Environmental Policy Act of 1969. The Council reviews Federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act.

CFR: Code of Federal Regulations. A codification of Federal documents published by the Office of the *Federal Register*, National Archives and Records Administration.

cfs: Cubic feet per second.

Clean Water Act: Federal Water Pollution Control Act, as amended.

Contrast: The effect of a striking difference in the form, line, color, or texture of an area being viewed.

CO: carbon monoxide.

CO_2: carbon dioxide.

COE: U.S. Army Corps of Engineers.

Cretaceous: Span of time between 136 and 65 million years ago.

CRMD: Cultural Resources Management Division.

Crowned grading: Road or area smoothing that produces a peaked effect, where the center of the road or area is slightly higher than the surrounding area.

Cultural resources: Any site or artifact associated with cultural activities.

Cultural Resources Inventory Classes:

> **Class I** - Existing Data Inventory: an inventory study of a defined area designed to provide a narrative overview (cultural resource overview) derived from existing cultural resource information and to provide a compilation of existing cultural resource site record data on which to base the development of the BLM's site record system.
>
> **Class II** - Sampling Field Inventory: a sample-oriented field inventory designed to locate and record, from surface and exposed profile indications, all cultural resource sites within a portion of a defined area in a manner which will allow an objective estimate of the nature and distribution of cultural resources in the entire defined area. The Class Ii inventory is a tool utilized in management and planning activities as an accurate predictor of cultural resources in the area of consideration. The primary area of consideration for the implementation of Class II inventory is a planning unit. The secondary area is a specific project in which an intensive field inventory (Class III) is not practical or necessary.
>
> **Class III** - Intensive Field Inventory: an intensive field inventory designed to locate and record, from surface and exposed profile indications, all cultural resource sites within a specified area. Normally, upon completion of such inventories in an area, no further cultural resource inventory work is needed. A Class III inventory is appropriate on small project areas, all areas to be disturbed, and primary cultural resource areas.

$CuSO_4$: copper sulfate.

CWA: Clean Water Act of 1972.

dB: Decibel. A unit measure of sound.

dBA: Decibel measurement on the "A-weighting" scale. A decibel adjusted (weighted) to reflect the relative loudness of sounds most sensitive to human ears.

Distribution line: An electric power line operating at a voltage of less than 69 kilovolts.

Disturbed area: Surface acreage that would be actively disturbed by proposed mining or mining-related activities. An area where vegetation, topsoil, and/or overburden is removed, or, upon which topsoil, spoil, or waste is placed as a result of mining or mining-related activities.

DOI: U.S. Department of the Interior, Office of the Secretary.

Drainage basin: a part of the surface of the earth that is occupied by a draining system, which consists of a surface stream of a body of impounded surface water together with all tributary surface streams and bodies of impounded water.

E.: East (in relation to legal land-tract descriptions of property).

EA: Environmental Assessment.

Effluent limitations: Regulatory standards that apply to the discharge or outflow of water from ground or subsurface storage.

EIS: Environmental Impact Statement. An analytical document that portrays potential impacts to the human environment of a particular course of action and its reasonable alternatives as required by Section 102(2)(C) of the National Environmental Policy Act (NEPA).

Endangered species:

> **Federally Listed:** Any species in danger of extinction throughout all or a significant portion of its range. This definition excludes species of insects that the Secretary of the Interior determines to be pests and whose protection under the Endangered Species Act of 1973 would present an overwhelming and overriding risk to man.
>
> **State (Group I):** Species whose prospect of survival or recruitment in the State are in jeopardy in the foreseeable future.
>
> **State (Group II):** Species whose prospect of survival or recruitment within the State may become jeopardized in the foreseeable future.

Environment: The surrounding conditions, influences, or forces that affect or modify an organism or an ecological community and ultimately determine its form and survival.

EPA: Effective peak horizontal ground acceleration used when discussing earthquakes.

EPA: U.S. Environmental Protection Agency.

Ephemeral stream: A stream that flows only briefly in direct response to rainfall or snowmelt events, has no baseflow, and whose channel is, at all times, above the water table.

Erosion: The group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface.

Erosion control structures: Usually one large earthen, rock, wire, or cement structure used to hold large concentrated flows of water and release this water in small noneroding amounts.

ESA: Endangered Species Act.

ESD: Ecological Site Description.

Evaporation pond: An impoundment area where water is retained and allowed to evaporate.

Existing utility corridors: A parcel of land without fixed boundaries, limited only by terrain, land ownership, and environmental considerations.

Exploration holes: Boreholes drilled during the search for mineral deposits.

Eyrie: The nest of a bird, generally a raptor, on a cliff or mountain top.

°F: fahrenheit. A measure of temperature.

Fault: A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.

Fault scarp: Steep rock faces formed by shearing of rock.

Federal land(s): Any land, including mineral interests, owned by the United States [40 CFR 700.5].

FLPMA: Federal Land Policy and Management Act of 1976, as amended (Public Law 94-579). An Act which gives BLM legal authority to establish public land policy, to establish guidelines for administering such policy and to provide for the management, protection, development and enhancement of the public lands.

Floodplain: That portion of a river valley, adjacent to the river channel, built of sediments and inundated with water at least once every 100 years.

FONSI: finding of no significant impact.

Forb: Any herbaceous nonwoody plant that is not a grass or grass-like plant.

Formation: The primary unit of formal geologic mapping or description. Most formations possess certain distinctive or combinations of distinctive lithic features.

Front end loader: Heavy construction equipment similar to a bulldozer.

Froth flotation process: Method for floating minerals to surface of a liquid for removal during milling.

FS: USDA Forest Service.

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.

gpd/ft: gallons per day/foot.

gpm: gallons per minute.

Graben: Fault block valley; elongated, depressed crustal block bounded by faults on its long sides.

Groundwater: Subsurface water that is in the zone of saturation. The top surface of the groundwater is the "water table." The source of water for wells, seepage, and springs.

Groundwater, confined: Groundwater that is under pressure. The vertical flow of water is restricted and generally prohibited by geology. Its upper limit is the bottom of a bed of distinctly lower hydraulic conductivity than that of the material in which the confined water occurs.

Groundwater, perched: Unconfined groundwater separated from an underlying body of groundwater by an impervious, unsaturated zone.

Groundwater, unconfined: Groundwater that is not under pressure. Generally used to describe water that does not rise above the level at which it is first found, at the time it is found. Seasonal changes in both unconfined and confined water levels can occur as a result of variations in recharge and discharge.

Groundwater, 2-D Flow: Groundwater flow in a horizontal plane. No vertical water flow except for infiltration of rain water in the unconfined case. In the confined case there is no vertical water flow.

Groundwater, 3-D Flow: Groundwater flow in three dimensions, including vertically down and up.

Habitat: A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Habitat Management Plan (HMP): A written and officially approved plan for a specific geographical area of public land which identifies wildlife habitat and related objectives, establishes the sequence of actions for achieving objectives, and outlines procedures for evaluating accomplishments.

HCP: Habitat Conservation Plan. A written and officially approved plan for a specific geographic area which identifies wildlife habitat and related objectives, establishes the sequence of actions for achieving objectives and outlines procedures for evaluating accomplishments.

Horst: Elongated, uplifted crustal block bounded by faults on its long sides.

hp: horsepower.

HUD: U.S. Department of Housing and Urban Development.

Hydrology: The science that relates to the water of the earth.

Hypogene: When a mineral deposit or enrichment is formed by ascending solutions commonly at elevated temperatures.

IBLA: U.S. Department of the Interior, Board of Land Appeals.

Impact: A modification in the status of the environment brought about by the Proposed Action.

Intrusive rock: Igneous rock formed within surrounding rock as a result of magma intrusion.

Jurisdictional wetlands: Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

KOPs: key observation points.

kV: Kilovolt. A unit measure of electricity, equal to 1,000 volts.

Landform: A term used to describe the many types of land surfaces that exist as the result of geologic activity and weathering, e.g., plateaus, mountains, plains, and valleys.

Lithic: A stone or rock exhibiting modification by humans. It generally applies to projectile points, scrapers, and chips, rather than ground stone.

Lithic Scatter: A prehistoric cultural site type where flakes, cores, and stone tools are located through the manufacture or use of the tools.

L_{dn}: Day-night average sound level. The 24-hour, time-weighted annual average, or average dBA.

LOS: Level of service. A qualitative measure of traffic operations, defined in terms of six levels of driver comfort and delay ranging from LOS "A" (best) to LOS "F" (congested).

Magma: Naturally occurring mobile rock material from which igneous rocks are formed.

Magnitude: A quantity characteristic of the total energy released by an earthquake. Usually defined using the Richter magnitude scale.

Malachite: Bright-green monoclinic copper carbonate mineral.

Mantle: Zone of the earth below the crust and above the core with transition zone between.

mcy: million cubic yards.

$\mu g/m^3$: micrograms per cubic meter.

mg/l: milligrams per liter.

mg/m^3: micrograms per cubic meter.

MIBC: methyl isobutyl carbinol

Mine, the: The proposed Copper Flat Mine.

Mineralization: Process by which minerals are introduced into a rock, resulting in an economically valuable or potentially valuable deposit.

Mitigation: The lessening of a potential adverse effect by applying appropriate protective measures or adequate scientific study. Activities in the affected environment that avoid, minimize, reduce, eliminate, replace, or rectify the impact of a proposed action or practice.

MLRA: Major Land Resource Area.

MMPA: Mining and Mineral Policy Act of 1970.

Monocline: Stratum or geologic beds that dip for an indefinite or unknown length in one direction and that do not apparently form sides of ascertained anticlines or synclines.

mph: Miles per hour.

MSDS: Material Safety Data Sheet.

MSHA: Mine Safety and Health Administration.

MSL: mean sea level.

Mtmt: Million truck miles traveled.

MW: megawatt.

N.: North (in relation to legal land-tract descriptions of property).

NAAQS: National Ambient Air Quality Standards.

NAGPRA: Native American Graves Protection and Repatriation Act of 1990.

NaSH: sodium hydrosulfide.

NE: Northeast (in relation to legal land-tract descriptions of property).

NEPA: National Environmental Policy Act of 1969, as amended. An act to establish a National policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes. It requires Federal agencies to carefully consider the environmental consequences of agency actions; document environmental analyses and subsequent decisions appropriately, efficiently, and cost-effectively; and involve interested individuals, organizations, and agencies in the decisionmaking process.

NHPA: National Historic Preservation Act of 1966, as amended.

NMDGF: New Mexico Department of Game and Fish.

NMDOT: State of New Mexico, Department of Transportation.

NMED: New Mexico Environmental Department.

NMHP: New Mexico Natural Heritage Program.

NMMD: New Mexico Department of Energy, Minerals, and Natural Resources-Mining and Minerals Division.

N-NW: north-northwesterly.

NNP: net neutralizing potential.

NO: nitric oxide.

O_x: nitrogen oxide.

NO_2: nitrogen dioxide.

NOAA: National Ocean and Atmospheric Administration.

NOI: Notice of Intent.

NP/AP: neutralizing potential/acid-generating potential.

NPDES: National Pollutant Discharge Elimination System.

NPS: National Park Service.

NRCS: Natural Resources Conservation Service, formerly the Soil Conservation Service.

NRHP: National Register of Historic Places.

NSPS: New Source Performance Standards.

NW: Northwest (in relation to legal land-tract descriptions of property).

NWI: National Wetland Inventory.

NW-SE: northwesterly-southeasterly.

OHV: off-highway vehicle.

One-hundred-year flood: A flood with a magnitude that may occur once every 100 years. A 1-in-100 chance of a certain area being inundated during any year.

ORV: Off-road vehicle. Any motorized vehicle capable of, or designed for, travel on or immediately over land, water, or other natural terrain.

OSHA: Occupational Safety and Health Administration.

Overburden: Material of any nature that overlies a mineral deposit, excluding topsoil.

PA: Programmatic Agreement.

Paleontology: The science that deals with the life of past geological ages through the study of the fossil remains of organisms.

Paleozoic: Span of time from end of Precambrian to beginning of Mesozoic ranging from about 570 million to 250 million years ago.

Particulate(s): Minute, separate particles, such as dust or other air pollutants.

Particulate emissions: Finely divided solid or liquid particles discharged into the air in the form of dust, smoke, fumes, mist, spray, or fog. Generally considered to be pollutants.

Passerine: The largest order of birds, including most songbirds, that perch.

Peak-hour-traffic: The morning and evening "rush" hours when traffic is at its heaviest, usually between 7 and 8 a.m. and 5 and 6 p.m.

Perennial stream: A stream that flows continuously throughout the year.

Petroglyph: a form of rock art manufactured by incising, scratching, or pecking designs into rock surfaces.

PDEIS: Preliminary Draft Environmental Impact Statement.

pH: The measure of acidity or basicity of a solution.

Physiographic province: Region in which all parts have similar geologic structure and climate and whose landforms differ significantly from those of other regions.

Placer: Deposits found in drainages, which are carried downstream through weathering.

PM_{10}: Particulate matter less than 10 microns in size. An air quality measurement standard.

POO: Plan of Operations; mine operation discussion.

Porphyry copper: Volcanic rock containing phenocysts in a fine-grained, sugary-textured groundmass.

Porphyry intrusion: Igneous rock containing phenocysts in a fine-grained, sugary-textured groundmass.

Postmining land use: The specific use or management-related activity to which a disturbed area is restored after completion of mining and reclamation.

Postmining topography: The relief and contour of the land that remains after mining has been completed.

Potentiometric surface: An imaginary surface representing the total head of ground water and defined by the level to which water will rise in a well. A water table is a potentiometric surface.

ppm: Parts per million. A unit of gaseous or liquid measurement, often used to identify the amount of particulates in air or water.

Precambrian: About 90 percent of geologic time more than 2.5 billion years old; precedes Paleozoic.

Private land(s): Any land, including mineral interests, under private ownership that does not have Federal or State interest.

PSD: Prevention of significant deterioration. The process incorporated in the Clean Air Act which places emission limitations on specified new or modified sources. PSD regulations are intended to limit deterioration of air quality that is currently cleaner than National ambient air quality standards.

Public land(s): Lands (surface and mineral estate) owned by the United States and administered by the Bureau of Land Management.

R.: Range (in relation to legal land-tract descriptions of property).

RA: Resource Area.

Rangeland: Land used for grazing by livestock and big game animals on which the vegetation is dominated by grasses, grass-like plants, forbs, or shrubs.

Rangeland Condition (Ecological): The present state of the vegetation on a range site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the climax plant community for the site. Rangeland condition is basically an ecological rating of the plant community.

Four classes are used to express the degree to which the composition of the present plant community reflects that of the climax.

Ecological Condition Class	Percentage of Present Plant Community that is Climax for the Range Site
Excellent	76 - 100
Good	51 - 75
Fair	26 - 50
Poor	0 -25

Raptors: Birds of prey with sharp talons and strongly curved beaks (e.g., hawks, owls, vultures, eagles).

Reagent: A substance, chemical, or solution used in the copper concentrating process to assist in removing copper from ore.

Region: A large tract of land generally recognized as having similar character types and physiographic types.

Revegetation: The reestablishment and development of self-sustaining plant cover following land disturbance. The enhancement of natural processes by human assistance through seedbed preparation, reseeding, and mulching.

Rhyolitic: Extrusive igneous rock with phenocrysts of quartz and alkali feldspar in a glassy groundmass.

Rift: A system of fractures (faults) in the earth's crust and the associated valley or depression.

Right-of-way: Strip of land over which the powerline, access road, or maintenance road would pass.

ROC: reactive organic compounds.

ROD: Record of Decision.

ROW: Right-of-way. The legal right for use, occupancy, or access across land or water areas for a specified purpose or purposes. Also, the lands covered by such a right.

Riparian area: A form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.

Ripping: The act of mechanically breaking compacted soils or rock into pieces small enough to be economically transported by other equipment, such as a scraper or dozer.

RLRS: New Mexico Department of Hazardous and Radioactive Bureau-Radiation Licensing and Registration Section.

RMP: Resource Management Plan. A written land use plan that outlines BLM decisions and strategies for management of the resources in a particular area, replacing the management framework plan in the BLM's planning system.

RUSLE: Revised Universal Soil Loss Equation.

RV: recreational vehicle.

S.: South (in relation to legal land-tract descriptions of property).

SAG: semi-autogenous.

SARA: Superfund Amendments and Reauthorization Act.

SE: Southeast (in relation to legal land-tract descriptions of property).

Sediment: Unconsolidated solid material that comes from weathering of rock and is carried by, suspended in, or deposited by water or wind.

Sedimentary rock: Rock resulting from consolidation of loose sediment that has accumulated in layers.

Seep: An extensive line or surface seam where water emerges from the ground, as contrasted with a spring where water emerges from a localized spot.

Seismicity: The likelihood of an area being subjected to earthquakes. The phenomenon of earth movements.

Shaft: Vertical mine tunnel.

SHPO: State Historic Preservation Officer. The official appointed by a given State's Governor to lead that State's historic preservation program and review all actions that affect the State's National Register Sites.

Silicated: When a rock is converted into or replaced by silicate minerals.

Sill: Igneous intrusion that parallels the structure of surrounding rock.

SMIO: State Mine Inspectors Office.

SO_2: sulfur dioxide.

Soil Horizon: A distinct layer of soil, approximately parallel to the land surface, and different from adjacent, genetically related layers in physical, chemical, and biological properties or characteristics.

Soil Series: A group of soils having genetic horizons (layers) that, except for texture of the surface layer, have similar characteristics and arrangement in the profile.

SPCC Plan: Spill Prevention Control and Countermeasure Plan.

Species: A group of individuals of common ancestry that closely resemble each other structurally and physiologically and in nature interbreed producing fertile offspring.

State land(s): Any lands, including mineral interests, owned by a given State.

Stock: Chimneylike ore body; igneous intrusion less than 40 square miles in surface exposure.

Stoping: Extraction of ore from an underground mine by working horizontally in a series of levels or steps.

Strata: A single sedimentary geologic bed or layer, of any thickness, that is made up of similar rock types.

Stratigraphy: Form, arrangement, geographic distribution, chronologic succession, classification, and relationships of rock strata.

Study area: A given geographical area delineated for specific research.

Substation: A facility in an electrical transmission system with the capacity to route and control electrical power and to transform power to a higher or lower voltage.

Supergene: When a mineral deposit or enrichment is formed by descending solutions by a process generally associated with weathering of rocks.

SW: Southwest (in relation to legal land-tract descriptions of property).

Syncline: A geologic unit of folded strata that is concave (flexed downward). In a simple syncline, beds forming the opposing limbs of the fold dip toward its axial plane.

T.: Township (in relation to legal land-tract descriptions of property).

Tailings: Mine waste that is left over following processing of ore.

TDS: Total dissolved solids. The dry weight of dissolved material, organic and inorganic, contained in liquid.

T&E: threatened and endangered.

Tertiary: Span of time between 65 and 3 to 2 million years ago.

Threatened species: Any species likely to become endangered within the foreseeable future throughout all or a significant part of its range.

Topsoil/subsoil stockpile: Soils that are removed prior to mining and gradually accumulated for reclamation and revegetation once mining is completed.

Ton: A unit measure of weight. A short or net ton is equal to 2,000 pounds; a long ton, or British ton, is 2,240 pounds; a metric ton is about 2,205 pounds. Short tons are avoirdupois weights pertaining to commodities sold by weight.

TPQ: Threshold Planning Quantity.

Transmission line: An electric power line operating at a voltage of 69 kilovolts or greater.

Trust land(s): Any lands within the State of New Mexico, including mineral interests, owned by the state.

TSP: Total suspended particulates. The dry weight of particulate material (dust, smoke, fumes, mist, spray, or fog) suspended in the air.

TSS: total suspended solids.

Tuffs: Compacted deposits of volcanic ash and dust that may contain up to 50 percent sediments, such as sand or clay.

Uplift: Structurally high area in the crust produced by an upthrust of rocks.

U.S.: United States.

USDI: United States Department of the Interior.

USDOT: United States Department of Transportation.

USEPA: United States Environmental Protection Agency.

USFS: United States Forest Service.

USFWS: U.S. Department of the Interior, Fish and Wildlife Service.

USGS: United States Geological Survey.

Visual Resources Management (VRM) Classes: VRM Classes are based on relative visual ratings of inventoried lands. Each class describes the different degree of modification allowed to the basic elements of the landscape. The following are the minimum management objectives for each class.

> **Class I:** Natural ecological changes and very limited management activity are allowed. Any contrast created within the characteristic landscape must not attract attention. This classification is applied to Visual Area of Critical Environmental Concern, wilderness areas, wild and scenic rivers, and other similar situations.
>
> **Class II:** Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the landscape. A contract may be seen but should not attract attention.
>
> **Class III:** Contrasts to the basic elements caused by a management activity may be evident and begin to attract attention in the landscape. The changes, however, should remain subordinate in the existing landscape.
>
> **Class IV:** Contrasts may attract attention and be a dominant feature in the landscape in terms of scale. However, the changes should repeat the basic elements of the landscape.

VLF: very low frequency.

VRM: Visual Resource Management. The systematic means to identify visual values, establish objectives which provide the standards for managing those values, and evaluate the visual impacts of proposed projects to ensure that objectives are met.

W.: West (in relation to legal land-tract descriptions of property).

Water table: The surface in a groundwater body where the water pressure is atmospheric. It is the level at which water stands in a well that penetrates the water body just far enough to hold standing water. (See groundwater.)

Wetlands: Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. BLM Manual 1737, *Riparian-Wetland Area Management*, includes marshes, shallow swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas as wetlands.

Wilderness: The definition contained in Section 2(c) of the Wilderness Act of 1964 is as follows: "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untammeled by man, where man himself is a visitor who does not remain." Wilderness is an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is a sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, educational, scenic, or historical value.

Wilderness area: An area formally designated by Congress as part of the National Wilderness Preservation System.

Wilderness characteristics: Those characteristics of wilderness as described in Section 2(c) of the Wilderness Act. These include size, naturalness, solitude, primitive and unconfined type of recreation, and supplemental values.

Wilderness inventory: An evaluation of the public land in the form of a written description and a map showing those lands that meet the wilderness criteria as established under Section 603(a) of the Federal Land Policy and Management Act and Section 2(c) of the Wilderness Act. The lands meeting the criteria will be referred to as Wilderness Study Areas (WSAs). Those lands identified as not meeting wilderness criteria will be released from further wilderness consideration.

Wildlife habitat: A geographical area that can provide for the key activities of wildlife. All elements of a wild animal's environment necessary for completion of its life cycle, including food, cover, water and living space.

WSA: Wilderness Study Area. A roadless block of public lands which BLM has determined may possess the wilderness qualities described in the Wilderness Act of 1964. WSAs were established in order to study the suitability of the areas for possible designation as wilderness by Congress. BLM protects each WSA's wilderness qualities until Congress decides whether or not the WSA will be designated as wilderness.

$\mu g/m^3$: Micrograms per cubic meter.

1H:1V: 1.0 horizontal: 1.0 vertical.

yd^3: cubic yard.

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BUREAU OF LAND MANAGEMENT
LAS CRUCES DISTRICT OFFICE
1800 MARQUESS STREET
LAS CRUCES, NEW MEXICO 88005