United States Department of Interior
Bureau of Land Management

Battle Mountain District
Shoshone-Eureka Resource Area, Battle Mounatin, NV

July 1994

CORTEZ PIPELINE GOLD DEPOSIT

DRAFT

Environmental Impact Statement

MISSION STATEMENT

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife, wilderness, air and scenic, scientific and cultural values.

BLM/BM/PL-94/017+1793

United States Department of the Interior

TAKE PRIDE IN AMERICA

BUREAU OF LAND MANAGEMENT
Nevada State Office
850 Harvard Way
P.O. Box 12000
Reno, Nevada 89520-0006

IN REPLY REFER TO:

N64-93-001P
1793 \ 3809
(NV-064.3)
(NV-930.1)

JUN 17 1994

Dear Interested Party:

Enclosed for your review and comment is the Cortez Pipeline Gold Deposit Draft Environmental Impact Statement (DEIS).

This DEIS presents an analysis of the projected impacts of Cortez Gold Mine's proposed 1,880-acre open pit mine project and associated dewatering of the project's open pit. In addition to the proposed action, the No Action Alternative has been analyzed in this DEIS.

The Bureau of Land Management (BLM) has worked closely with Cortez in developing the Pipeline Proposal. Based on the environmental protection measures that have resulted from this coordination, the BLM has selected the "Proposed Action" as its preferred alternative.

You may contact Dave Davis, Pipeline Project EIS Team Leader at the following address should you have any questions or concerns about this project: Bureau of Land Management, Battle Mountain District Office, 50 Bastian Way, P. O. Box 1420, Battle Mountain, Nevada, 89820, Attn: Dave Davis. Comments on the DEIS should also be sent to the Battle Mountain address. Two meetings are to be held in order to provide the interested public an opportunity to comment on the DEIS. Meeting dates, times, and places will be announced in the "Federal Register" and through public news releases in the local media.

You may reach Dave Davis at (702) 635-4000 should you have questions related to the project or these documents.

Sincerely,

For Thomas V. Leshendok

Ronald B. Wenker
Acting State Director, Nevada

1 Enclosure
Encl. 1 - Cortez Pipeline Gold Deposit DEIS

COVER SHEET

CORTEZ PIPELINE GOLD DEPOSIT
ENVIRONMENTAL IMPACT STATEMENT

(X) Draft | ( ) Supplemental Draft

Lead Agency: U.S. Department of the Interior
Bureau of Land Management

Cooperating Agencies: None

Project Location: Lander County, Nevada

For Further Information Contact: Dave Davis, EIS Coordinator
Telephone (702) 635-4000

Direct Correspondence to: Bureau of Land Management
Attn: Dave Davis
50 Bastian Road
P.O. Box 1420
Battle Mountain, NV 89820

Abstract: The Cortez Gold Pipeline Project is a proposed 1,880 acre development. The project includes a new open-pit mine with associated dewatering system and waste dumps, a combined heap leach/tailing impoundment facility, a 5,000 ton/day ore-processing facility, and continued exploration drilling.

Pursuant to other numerous regulations and laws, this document's review has been coordinated with U.S. Fish and Wildlife Service; Army Corps of Engineers; Nevada Division of Environmental Protection, Mining and Air Quality Bureaus; Nevada State Historic Preservation Office; U.S. Environmental Protection Agency; U.S. Bureau of Mines, and National Park Service.

Date Draft EIS Issued: July 22, 1994

Date Comments must be Postmarked: September 20, 1994

Responsible Official for EIS:

[signature] For **Ronald B. Wenker**
Acting State Director, Nevada

6-17-94
Date

Cortez Gold Mines (Cortez) proposes to develop and operate a new gold mine and processing facility located approximately 7 miles northwest of the existing Cortez facilities in north-central Nevada. The orebody that would be developed is called the Pipeline deposit, named for the presence of a nearby pipeline. The proposed development is described in a 1992 Plan of Operations (Proposed Action) that has been submitted by Cortez to the Battle Mountain District office of the Bureau of Land Management (BLM) in compliance with the BLM Surface Management of Public Lands Regulations 43 CFR 3809. The site of the Proposed Action is located within Crescent Valley, south of Battle Mountain. Several other mining operations (mining primarily precious metals) are located in the general vicinity. The Proposed Action includes developing a new open-pit mine with associated dewatering system and waste dumps, constructing a new combined heap leach/tailing impoundment facility, constructing a new ore processing facility complete with appurtenant facilities and continuing exploration drilling. Mining activities are proposed in Lander County, Nevada on unpatented mining claims or privately owned property. A total of approximately 1,880 acres would be affected by the Proposed Action.

The reserves to be mined include both mill-grade and heap-leach-grade ore. Portions of the ore would be processed at the proposed milling and heap leach facilities and other portions of the ore would be hauled to the existing Cortez mill for processing. Overburden from the pit area would be hauled to waste rock dumps near the pit. Exploration activities would generally consist of limited road building and exploration drilling near the project site.

PURPOSE AND NEED TO WHICH THE BLM IS RESPONDING

The Proposed Action would allow Cortez to develop the new Pipeline gold deposit, discovered and evaluated in 1991 and 1992. This new discovery contains sufficient ore reserves to allow continuous operation of a new mine and processing plant for at least 12 years after plant commissioning. It represents an increase in the annual mining and production rates, and represents a significant increase in the total Cortez workforce.

The BLM has reviewed the Proposed Action and has determined that preparation of an Environmental Impact Statement (EIS) is necessary. The BLM is serving as the lead agency for preparation of an EIS in compliance with the National Environmental Policy Act (NEPA). This EIS has been prepared in compliance with NEPA and BLM Handbook H-1790-1. The EIS describes the Proposed Action components, reasonable alternatives, potential environmental consequences of the project and alternatives, and design measures or mitigation measures capable of eliminating or reducing potential significant impacts.

DESCRIPTION OF THE PROPOSED ACTION

The Proposed Action includes developing a new open-pit mine with an associated dewatering system and waste rock dump; constructing a new combined heap leach/tailing impoundment facility; constructing a new 5,000-ton-per-day ore processing facility complete with all support facilities such as shops, warehouses, offices, changehouses, and laboratories; and concurrent mineral exploration in the project area. In order to mine and process the ore in the Pipeline deposit, a total of approximately 1,880 acres would be disturbed. Development of the open-pit mine would create disturbance of 241 acres. This disturbance at the open-pit mine would include 52 acres that were already disturbed during previous heap leach and milling activities. The largest areas of disturbance would be 586 acres for the waste rock dump area and 440 acres for the heap leach/tailings facility.

The Proposed Action includes reclamation of all proposed disturbance in accordance with BLM surface management regulations and Nevada Department of Environmental Protection regulations. Reclamation would result in an additional 81 acres of disturbance around the waste dump area and would be designed to provide a post-mining condition that would support land uses identified in the Shoshone-Eureka Resource Management Plan.

ALTERNATIVES

Alternatives to the Proposed Action include various options for location and operation of project components. Project alternatives considered include:

- Construct new 5,000-ton-per-day mill at the present Cortez millsite instead of adjacent to the new open-pit mine

- Refurbish present 2,000-ton-per-day Cortez mill and expand to 5,000-ton-per-day mill

- Refurbish present 2,000-ton-per-day Cortez mill

- Refurbish present 2,000-ton-per-day Cortez mill and add 3,000-ton-per-day heap leach operation

- Develop an underground mine (instead of open-pit mine) to feed refurbished 2,000-ton-per-day Cortez mill

- Re-inject pumped water into bedrock along the Shoshone range front

- Re-inject pumped water into alluvial deposits via a wellfield

- Discharge pumped water to surface water

- Discharge pumped water via a ditch/canal to an area considered suitable for agricultural development

- Discharge pumped water via a ditch/canal to an area considered suitable for development of a wetlands area

The range of alternatives considered consists primarily of operational alternatives for project components rather than location alternatives for the entire project because the feasibility of the project depends upon processing facilities being located relatively close to the orebody. In the alternative evaluation, the following factors were considered: public or agency issues/concerns, technical and economic feasibility, potential environmental advantage, and ability to meet the purpose and need stated by the applicant. Based on the screening of project alternatives, no feasible alternatives were retained for detailed analysis.

In accordance with the National Environmental Policy Act, the No Action Alternative is addressed in the EIS. Under the No Action Alternative, Cortez would not develop the Pipeline orebody as presently defined. Cortez would continue to mine gold at the Cortez and

Gold Acres minesites until those orebodies were exhausted. For the purposes of this EIS, the No Action Alternative would result from the BLM's disapproval of Cortez' 1992 Plan of Operations. However, other circumstances, such as a drop in gold prices or the application of some future legislation, could also potentially result in mine closure.

SUMMARY OF IMPACTS

Detailed information on project impacts is provided in Section 4.0 of the EIS. The summary below highlights potential impacts from the Proposed Action. Impacts associated with the No Action Alternative are only discussed if they would be greater or substantially different from the Proposed Action. In most cases, the No Action Alternative would not result in additional impacts beyond those anticipated by the Proposed Action.

Air Quality

The Proposed Action would result in fugitive dust emissions from construction activities, blasting in the open-pit mine, operation of haul roads, and exploration. Estimates for fugitive dust emissions would not violate state or federal ambient standards. The Proposed Action would also result in point source emissions from the proposed ore-processing facility. There would not be significant increases to maximum 24-hour or annual standards for PM_{10} or the 8-hour standards for mercury and arsenic. If the 8-hour standard for crystalline silica were exceeded during operation of the ore processing facility, a wet scrubber would be used to control these emissions. There would not be significant contributions to cumulative 24-hour or annual emissions in the Crescent Valley Air Basin.

Geology, Minerals, and Paleontology

Open-pit walls, waste rock dumps, and the heap leach/tailings impoundment facility would be designed to prevent significant structural damage or sediment transport caused by seismic or storm events. No paleontological resources have been identified within the project area.

Soils and Topography

Approximately 1,880 acres of soil disturbance would result from development of facilities and reclamation activities, including growth-medium stockpiles and roads. Approximately 52 of the acres proposed for disturbance have been disturbed during previous mining activities. Sedimentation in perennial water courses is not expected. Reclamation should be carefully monitored to determine if additional measures need to be taken to provide reclamation success. The Proposed Action would contribute approximately 16 percent of the total soils disturbance estimated for the existing, proposed and reasonably foreseeable projects considered in the cumulative impacts analysis. The cumulative long term disturbance represents 0.8 percent of the study area and is not considered significant.

Water Resources

Water Quantity

Hydrogeologic modelling was performed to predict the amount and extent of drawdown after 10 years of mine operation and pit dewatering. Potential impacts to groundwater uses and surface water features within the area affected by drawdown were evaluated based on this modelling. Modelling results for three pumping rates (25,600, 32,700, and 56,500 gpm) show that significant water table drawdowns (in excess of 20 feet) are limited to an area within 5 to 7 miles of the project site. These three pumping rates represent three scenarios for dewatering the mine pit: a rate less than the anticipated maximum pumping rate of 30,000 gpm, slightly greater, and nearly twice (worst case). The potential for impacts from pit dewatering would be lessened substantially by a reinfiltration system designed to return an estimated 90 percent or more of the pumped water to the groundwater system.

Primary impacts remaining after implementation of the reinfiltration system include the following:

- Of the 20 wells present in the drawdown zone, only 2 may be significantly impacted. If monitoring shows significant impacts, operational controls would be implemented or reinfiltration sites would be added or relocated.

- The existing Cortez mine groundwater remediation system could be significantly impacted if a hydraulic gradient is induced, thereby causing poor-quality ground-water to migrate away from the existing mine towards the center of Crescent Valley. If this were to occur, reinfiltration sites would be added or relocated.

- The potential for flow in the Humboldt River to be impacted by the proposed pit dewatering is considered negligible.

- Surface water flow in Cooks Creek near Rocky Pass may infiltrate over a shorter distance than presently. Of the approximately 30 springs in the drawdown zone, only those near Rocky Pass (3 springs) and those present in alluvium along the flank of the Cortez Range (8 springs) have potential for flow reduction. If monitoring committed by the applicant shows flow reduction, reinfiltration sites would be enhanced and/or relocated.

- Evaporative losses from the pit lake (about 300-380 gpm) would be small in comparison to certified consumptive use (2,000 gpm), but they are considered significant because they would persist for the life of the pit lake. Anticipated losses would be offset somewhat by precipitation and runoff, but a net loss to the basin would still occur. There are no feasible mitigation measures to reduce remaining unavoidable impacts.

- There is potential for subsidence of the land surface as groundwater is removed and the underlying aquifer undergoes compression. This subsidence could result in loss of aquifer productivity. This potential is considered low, and no mitigation is proposed.

Water Quality

Construction and operation of new waste rock dumps, heap leach and tailing facilities, and stockpiled ore areas have the potential to affect surface water and groundwater quality through acid rock drainage and/or release of contaminants such as weak acid dissociable (WAD) cyanide. Metals or other compounds that leak could impact groundwater quality by infiltrating through surface soils or surface water.

Potential impacts requiring design measures/monitoring, and in some cases additional mitigation, include the following:

- There is a low potential for surface water quality and groundwater quality degradation in the pit, waste rock storage, heap, and tailing areas due to acid rock drainage. Monitoring of surface water and groundwater, the leachate detection system, and assessment of chemical stability of mined materials will be part of operating and discharge permits. If monitoring detects contaminants in excess of applicable standards, a remediation plan would be implemented (e.g., similar to the pumpback system at the existing Cortez facility). This system would be designed to reduce impacts to less than significant levels — i.e., below cleanup goals stipulated by the Nevada Department of Environmental Protection.

- Although some interflow between the groundwater system and pit lake is expected, samples from the proposed pit area have low acid-producing potential, moderate to high neutralization potential, and low metals-leaching potential. Therefore no adverse impacts to groundwater quality or pit lake water are expected. Samples of pit lake and groundwater samples from monitoring wells around the pit lake would be analyzed for NDEP Profile 1 parameters.

- The potential for impacts to groundwater quality in reinfiltration areas is low because reinfiltration water quality is expected to be good. If monitoring shows exceedance of an applicable standard (e.g., total dissolved solids), mitigation measures such as pretreatement or alternative reinfiltration sites would be implemented. This would reduce impacts to less than significant levels.

- Spills of contaminants, lubricants, and fuels into drainages, soils, or groundwater are likely to occur over the life of the Proposed Action. Prevention and containment would be detailed in the spill prevention and containment plan prepared for the Proposed Action. Disposal or treatment of contaminated soil or groundwater to applicable cleanup standards (e.g., 10 times drinking water standards) would apply to all spills.

- Applicant-committed design measures would reduce potential impacts from erosion, sedimentation, and flooding of drainages or pit dewatering reinfiltration facilities to less than significant levels.

Vegetation

No threatened or endangered species would be impacted.

Standard revegetation efforts would be monitored to determine if additional measures are required.

There would be no impacts to riparian areas or wetlands directly or indirectly due to the drawdown of the aquifers. The proposed infiltration system would provide for the continuation of the plant communities associated with surface waters or high groundwater tables. There may be short-term impacts due to the time required for detection and adjustment of infiltration to sustain surface discharges, but this should not permanently damage riparian areas or wetlands.

Wildlife Resources

Removal of moderate- to low-quality wildlife habitat and indirect impacts due to traffic, noise, and human presence are not considered significant. Contribution of the Proposed Action to the cumulative impact would not be considered significant. No critical wildlife habitat or threatened and endangered species would be affected.

Acute toxicity in the tailing impoundment is not likely. Chronic toxicity could be significant at the proposed tailing impoundment or could be cumulatively significant due to multiple exposures from other projects in the region.

Recreation and Wilderness

The Proposed Action would have a moderate, incremental impact on dispersed and developed recreational resources. Feasible mitigation, including applicant-sponsored environmental educational training for off-road vehicle use, firearms safety, developed recreation site use and dispersed recreation ethics, could reduce impacts to less than significant levels.

Visual Resources

The Proposed Action is located on VRM Class IV lands, where changes to the characteristic landscape can be high and be the major focus of viewer attention. Although the proposed activity involves expansion of existing mining sites, as well as the construction of new facilities, the additive increase in visual contrast would not draw significant visual attention. Visual impacts would be similar to those which already exist from past and ongoing mining activities. These modifications would be additive to the existing mining disturbance within and adjacent to the Proposed Action. The pit development would create a negligible increase in visual change over the exiting mine pit disturbance.

Although visual resources would not be significantly impacted, several mitigations are available which would further reduce visual impacts. For reducing visual contrast, repetition of the basic landscape elements (form, line, color, and texture) would minimize visual change. Additionally, the use of surrounding landscape colors and native plant materials are appropriate means of reducing visual contrast.

Social and Economic Values

The Proposed Action would result in an increase of an average of 70 direct and 52 indirect jobs in the project area. Most of these new employees would reside in Elko and Battle Mountain and would create an additional demand for housing, schools, and law enforcement. In a cumulative sense, the Proposed Action would contribute to a significant regional impact on schools and infrastructure, particularly in Elko, Nevada.

Additional revenues from net proceeds from mines, sales, and property taxes would be generated for Lander, Eureka, and Elko counties because of an increase in assessed valuation and payroll.

Land Use/Livestock Grazing

No significant impacts are anticipated.

Cultural Resources

An EIS for the expansion of the existing Cortez mine was published in December 1992. The Cortez Expansion EIS Native American consultation identified no areas of traditional or religious importance to Native Americans that would be significantly affected. The Proposed Action falls within the same area as that analyzed for the Expansion EIS; therefore, the findings with regard to Native American concerns remain the same. The Proposed Action would not significantly contribute to cumulative losses of historic or prehistoric resources.

No Action Alternative

The objective of the No Action Alternative impact analysis is to describe environmental consequences that would result if the Proposed Action is not implemented in order to provide a comparison to the consequences of the Proposed Action. In general, the No Action Alternative would result in continuation of impacts associated with expansion of an existing open pit mine and waste rock dumps, construction of new heap leach facilities, rock dumps, construction of new heap leach facilities, waste rock dumps, and exploration drilling discussed in the Cortez Expansion EIS. In contrast to the No Action Alternative, the Proposed Action would have potential new impacts associated with development of a new open pit mine with associated dewatering system and waste dumps, construction of a new combined heap leach/tailing impoundment facility and construction of a 5,000-ton-per-day ore-processing facility complete with appurtenant facilities. It is anticipated that activities associated with the Proposed Action would continue for at least 12 years after plant commissioning.

New disturbance from the Proposed Action (e.g., to soils, vegetation, and wildlife habitat) would total approximately 1,880 acres. This would not occur with the No Action Alternative.

Reclamation requirements would be greater with the Proposed Action because of the additional disturbance and need for additional topsoil. In addition, reclamation of haul roads and other sites of ancillary facilities could occur earlier with the No Action Alternative than with the Proposed Action.

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1.0
INTRODUCTION AND PURPOSE AND NEED

1.1 INTRODUCTION

Cortez Gold Mines proposes to develop and operate a new gold mine and processing facility located approximately 7 miles northwest of the existing Cortez facilities in north-central Nevada. The orebody that would be developed is called the Pipeline deposit, named for the presence of a nearby pipeline.

A 1992 Plan of Operations for development of the Pipeline gold deposit has been submitted by Cortez Gold Mines (Cortez) to the Battle Mountain District Office of the Bureau of Land Management (BLM) in compliance with the BLM Surface Management of Public Lands Regulations 43 CFR 3809. In this Plan, Cortez proposes to develop and process the newly discovered Pipeline gold deposit. The project proposed by Cortez and all its ancillary facilities are referred to hereinafter as the Proposed Action. The Proposed Action is located in north-central Nevada, within Crescent Valley, south of Battle Mountain (Figures 1.1-1 and 1.1-2). Several other mining operations (mining primarily precious metals) are located in the general vicinity.

The Proposed Action represents a continuation of Cortez Gold Mines' gold mining and processing operations which were most recently analyzed in an EIS for the Cortez Gold Mine Expansion Project (Expansion EIS). To the extent possible, information that is common to the Expansion EIS and the Proposed Action will be incorporated in the new EIS by tiering to the Expansion EIS (including the Plan of Operations). These documents are available for public review in the BLM District Office, Battle Mountain, Nevada.

The Proposed Action includes developing a new open-pit mine with associated dewatering system and waste dumps, constructing a new combined heap leach/tailing impoundment facility, and constructing a new 5,000-ton-per-day ore processing facility complete with appurtenant facilities. Mining and related activities would be confined to the project site and immediately surrounding area, all within Lander County, Nevada, and all on unpatented mining claims or privately owned property. The total number of acres that would be affected by the Proposed Action is approximately 1,880 acres.

The reserves to be mined include both mill-grade and heap-leach-grade ore. Portions of the ore would be hauled to the existing Cortez mill for processing, and portions of the ore would be processed at the proposed heap leach facilities. Overburden from the pit area would be hauled to waste rock dumps near the pit. Exploration activities would generally consist of limited road building and exploration drilling near the project site.

1.2 PURPOSE AND NEED TO WHICH THE BLM IS RESPONDING

The Proposed Action would allow Cortez Gold Mines to develop the new Pipeline gold deposit, discovered and evaluated in 1991 and 1992. This new discovery contains sufficient ore reserves to allow continuous operation of a new mine and processing plant for at least 12 years after plant commissioning. It represents an increase in the annual mining and production rates, and represents a significant increase in the total Cortez Gold Mines workforce. Until current ore reserves to be processed at the present Cortez mill are exhausted, the new project and existing operations would overlap. During the overlap period, the new operation may share some of the management resources with the present Cortez operations, but the Proposed Action would be a stand-alone operation in terms of mining equipment and processing facilities. However, the Pipeline orebody contains carbonaceous gold ores suitable for processing in the existing Cortez roasting plant. This ore is scheduled to be hauled from the Pipeline deposit for processing. In addition, oxide ores may be processed in the Cortez mill, depending on the availability of ore for both the Cortez mill and the proposed Pipeline mill.

The BLM has reviewed the Proposed Action and has determined that preparation of an Environmental Impact Statement (EIS) is necessary. The BLM is serving as the lead agency for preparation of an EIS in compliance with the National Environment Policy Act (NEPA). This EIS has been prepared in compliance with NEPA and BLM Handbook H-1790-1. The EIS describes the Proposed Action components, reasonable alternatives, potential environmental consequences of the project and alternatives, and design measures or mitigation measures capable of eliminating or reducing potential significant impacts.

The Pipeline Plan of Operations has been reviewed for compliance with BLM/NDEP policies, plans and programs. The proposal is in conformance with the minerals decisions in the Record of Decision, Shoshone-Eureka Resource Area, Resource Management Plan (RMP), approved in 1986. The final use of the area described in the Reclamation Plan will conform to the Shoshone-Eureka RMP Amendment, dated November 1987.

1.3 LAND USE PLAN CONFORMANCE

The Proposed Action conforms with the Shoshone-Eureka Resource Management Plan (RMP) dated March 1986. Specifically, on page 29 in the Record of Decision of the RMP, under the heading "Minerals" subtitled "Objectives" number 1:

> "Make available and encourage development of mineral resources to meet national, regional, and local needs consistent with national objectives for an adequate supply of minerals."

Under "Management Decisions," "Locatable Materials," page 29, number 1:

> "All public lands in the planning areas will be open for mining and prospecting unless withdrawn or restricted from mineral entry."

Under "Management Decisions," number 5, Current Mineral Production Areas:

> "Recognize these areas as having a highest and best use for mineral production and encourage mining with minimum environmental disturbance..."

1.4 PUBLIC PARTICIPATION

Federal regulations mandate an early and open process for determining the scope of issues to be addressed and significant issues related to the proposed action. To begin this process, a scoping announcement was developed, letters and news releases were mailed, a Federal Register notice was published, and scoping meetings were held in Elko, Nevada, on December 8, 1992, and Reno, Nevada, on December 9, 1992.

The scope of this EIS reflects input received from the public during the scoping process. Key issue areas identified by the BLM and the public during this process include:

- Dewatering and its potential effects on local/regional aquifers
- Water rights issues
- Potential effects from reintroduction of water into local aquifers
- Water quality issues related to pit water, reinfiltration pond water and groundwater
- Evaporation of open pit water after closure
- Socioeconomics
- Surface disturbance associated with project of this size
- Proper reclamation of disturbed areas
- Cumulative impacts

The Draft EIS has been sent to governmental agencies and several designated groups and individuals for formal review and comment. Two public hearings, announced in the Federal Register and by news release, will be held. All comments received will be carefully considered as revisions are made for the Final EIS.

Public involvement techniques to be employed include news releases to the mass media; publication of notices in the Federal Register; letters to governmental agencies, organizations, and individuals; individual or small group meetings; briefings; and distribution of the EIS and technical appendices to public libraries and BLM offices.

1.5 AUTHORIZING ACTIONS

In addition to this EIS, approval of the Proposed Action would require authorizing actions from other federal, state or local agencies with jurisdiction over the project. Authorizing actions include land use and environmental permits, licenses and approvals. In conjunction with past and ongoing mining and mineral processing activities in the Cortez-Gold Acres district, Cortez has already obtained several permits and approvals. Table 1.5-1 summarizes the principal authorizing actions required for the Proposed Action including those already obtained.

TABLE 1.5-1

**SUMMARY OF PERMITS AND APPROVALS
REQUIRED FOR A MINING PROJECT IN NEVADA**

(Page 1 of 4)

Agency	Permit/Approval	Facet of Project	Time Requirements	Comments
FEDERAL				
U.S. Bureau of Land Management (BLM)	1. Approval of Plan of Operations (Requires EA or EIS).	All activities on unpatented mining claims or involving right-of-way on Federal land.	120-180 days	If EIS required, could take 365 days or longer. Public notice required.
	2. Right-of-Way Permits	Road and Powerline access on Federal land.	30-180 days	Data in Plan of Operations and EA can be used for this application.
U.S. Environmental Protection Agency (EPA)	Review of State Water and Air Permits	Surface and groundwater discharge permits; Air Quality Permit.	30-60 days review	Review capacity.
U.S. Army Corps of Engineers	Section 404 permit	Any filling or dredging of wetland/riparian areas.	90-180 days	If nationwide permit acceptable. Individual permit could take 365 days or longer.
STATE				
Nevada Division of Environmental Protection (NDEP)	Air Quality Permits			
	1. Air Quality Permit to Construct (ATC).	All aspects, including construction, that produce air contaminants, i.e., particulates, hydrocarbons, sulfur dioxide, etc.	Up to 95 days	Requires plans and specifications for air pollution control facility. Public notice/hearing required.

TABLE 1.5-1

SUMMARY OF PERMITS AND APPROVALS REQUIRED FOR A MINING PROJECT IN NEVADA

(Page 2 of 4)

Agency	Permit/Approval	Facet of Project	Time Requirements	Comments
	2. Air Quality Permit to Operate (ATO).	All aspects, including construction, that produce air contaminants, i.e., particulates, hydrocarbons, sulfur dioxide, etc.	180 days to demonstrate compliance after start-up.	No public notice required.
	Water Quality Permits			
	1. Water Pollution Control Discharge Permit.	Mine, tailings, heap leach operation; review discharge and seepage potential.	Minimum of 165 days.	Review of geotechnical design criteria to verify zero-discharge operation. Public notice required.
	2. National Pollution Discharge Elimination System (NPDES).	Any discharge of wastewater to surface water (i.e., sediment control facilities).	180 days	Review of geotechnical design; Public notice required.
	3. National Pollution Discharge Elimination System (NPDES) - Storm water.	Coverage by general mining storm water permit at each site.	30 days	Review of site plan. No public notice required.
	Solid Waste Disposal	Disposal of solid, non-toxic waste, i.e., garbage, construction waste, etc.	14-90 days; prior to construction	Site location, design and operation plan.
	Reclamation Permit for a Mining Operation	Any surface-disturbing aspect of the project.		

TABLE 1.5-1

SUMMARY OF PERMITS AND APPROVALS REQUIRED FOR A MINING PROJECT IN NEVADA

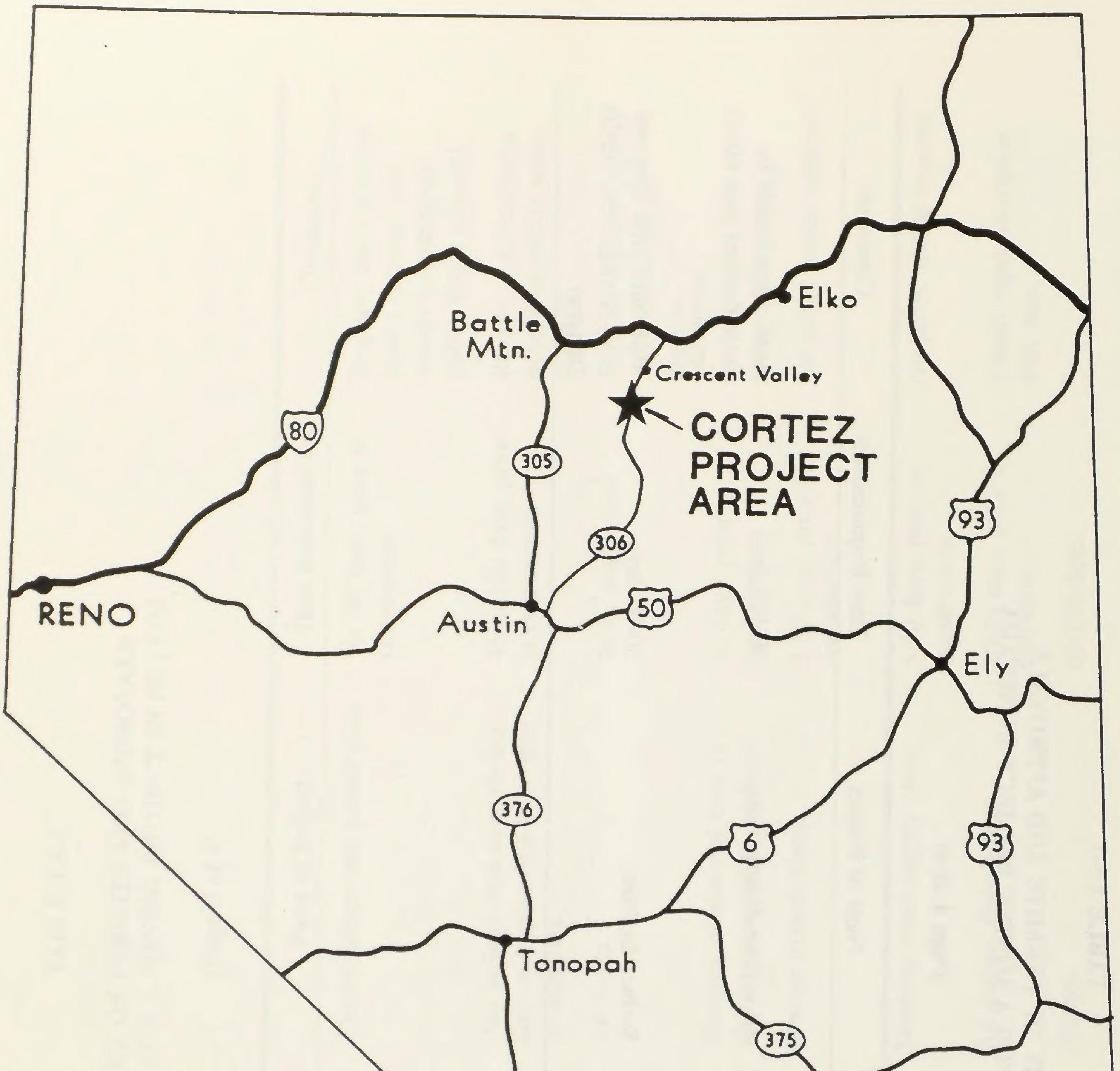
Agency	Permit/Approval	Facet of Project	Time Requirements	Comments
Nevada Division of Water Resources (NDWR)	1. Permit to Appropriate the Public Water.	Use of surface and groundwater.	90-180 days; prior to construction	Requires data regarding source of water and annual consumption; public notice required.
	2. Permit to Construct Tailings Dam.	Any tailings dam over 10-feet high or impounding more than 10 acre-feet.	45 to 120 days; prior to construction	Review of geotechnical design; no public notice required.
Nevada Department of Wildlife (NDOW)	1. Industrial Artificial Pond Permit.	All facets.	To be determined	Regulate wildlife impacts and cyanide-related impacts.
	2. Dredging Permit.	Removal of material from or placing material in wetlands.	10 days; prior to operation.	In conjunction with Army Corps of Engineers.
Nevada Division of Health/Consumer Protection Services	1. Sewage Disposal Plans.	Sewage system plans.	5-30 days; prior to construction.	No public notice required.
	2. Drinking Water Supply.	Drinking water supply plans.	5-30 days; prior to construction.	No public notice required.
Nevada Division of Historic Preservation	Review project to determine impact on cultural resources.	All surface disturbances.	30-90 days; prior to operation.	Submit legal description with map.
State Inspection of Mines	Notification of Opening or Closing of Mines	Mining.	60-120 days.	

TABLE 1.5-1

SUMMARY OF PERMITS AND APPROVALS REQUIRED FOR A MINING PROJECT IN NEVADA

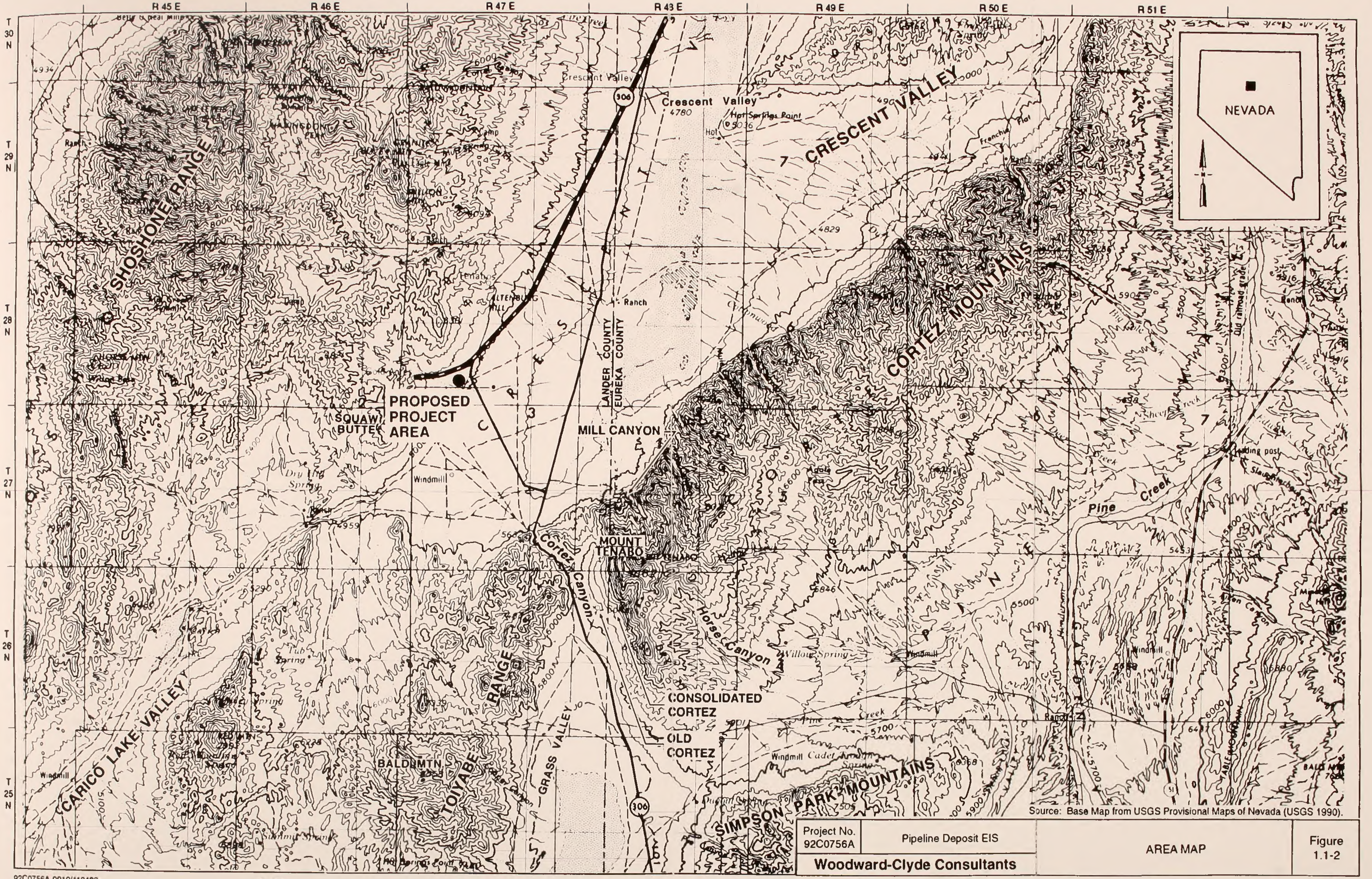
(Page 4 of 4)

Agency	Permit/Approval	Facet of Project	Time Requirements	Comments
COUNTY				
Planning Commission (varies from County to County)	Special Use Permit	All surface disturbances.	60-120 days	Application should include detailed plan of operations.
	Building Permit	Surface facilities.	30-60 days	Must have prior approval from Nevada State Health Division



Project No. 92C0756A	Pipeline Deposit EIS	LOCATION MAP	Figure 1.1-1

92C0756A-0010/110493



Project No. 92C0756A	Pipeline Deposit EIS	AREA MAP	Figure 1.1-2
Woodward-Clyde Consultants			

2.0
ALTERNATIVES INCLUDING THE PROPOSED ACTION

The action proposed by Cortez in its Plan of Operations and the range of alternatives evaluated for this EIS are described in this section. Input from the public scoping process as well as from affected agencies and the BLM has been considered in order to identify alternatives to the Proposed Action. As required by NEPA, the No Action alternative is also evaluated. The applicant's existing facilities and operations are described to establish the context for the description of the Proposed Action. Section 2.0 concludes with a summary and comparison of impacts associated with the proposed action and alternatives.

The era of modern mining at the Cortez Gold Mine began in 1969. In 1990 Cortez prepared a Plan of Operations to expand its existing facilities at the Cortez and Gold Acres areas. Known as the Cortez Gold Mine Expansion Project, the effects of the proposed activity were analyzed in the 1990 Cortez Gold Mine Expansion EIS (Expansion EIS). Cortez now proposes to develop and operate a new gold mine and processing facility at its newly discovered Pipeline gold deposit near the Gold Acres area (Proposed Action).

Activities associated with existing operations and already approved under existing Plans of Operations including the recent Expansion EIS are not the subject of this EIS except for their consideration as part of the cumulative impact assessment. Existing operations are described below in Section 2.1. A discussion of the Proposed Action follows in Section 2.2. To the extent possible, information that is common to the Expansion EIS and the current EIS will be incorporated into the present EIS by tiering to the Expansion EIS. Reasonably foreseeable mining projects (proposed by the applicant or other interests) considered in the cumulative impact analysis are identified and evaluated in Section 5.0.

Cortez's Plan of Operations for the Proposed Action and the technology associated with modern gold mining is very complex and sometimes difficult to understand. A glossary of mining terminology and other technical terms is included to assist the reader/reviewer of this EIS (see Section 9.0). Terms or processes used for the first time in the EIS will be in **bold type**, to direct the reader to the glossary for a definition of that term or process. Refer to

Figure 2.0-1 for a simplified diagram showing steps involved in the processes used in gold production.

The Expansion EIS prepared for the Cortez Gold Mine Expansion addressed the expansion of existing facilities, while the currently Proposed Action, the Pipeline Deposit development, was referred to in the Expansion EIS as a "reasonably foreseeable disturbance" (RFD). Technical aspects of the Proposed Action have been previously explained in the Expansion EIS. Rather than repeat explanation of such processes as Carbon-In-Leach (CIL) circuits in the current EIS, it will be tiered to the Expansion EIS where a more detailed discussion is provided.

2.1 EXISTING FACILITIES AND OPERATIONS

In addition to the existing facilities described below in Section 2.1.1, the developments described in the Expansion EIS are assumed to be in place at the time the Proposed Action would begin. These developments include expanding an existing open-pit mine and waste rock dumps; constructing new heap leach facilities, tailings disposal facilities, and waste rock dumps; and continuing exploration drilling. These developments would encompass approximately 428 acres.

2.1.1 Location of Existing Facilities and Land Ownership

Cortez's existing gold mining operations are located in north central Nevada in Eureka and Lander counties, approximately 78 miles southwest of Elko, Nevada (Figure 1.1-1). The mining operations are reached from Elko by traveling approximately 40 miles west on Interstate 80, and then approximately 38 miles south on Nevada State Route 306 (Figure 1.1-1). The Cortez Gold Mines company is based in Cortez, Nevada in Lander County where the administrative offices, mill site, and ancillary facilities are situated. A landing strip for small aircraft is located in Crescent Valley, approximately 2.5 miles west of the mill site and is usually serviceable all year.

Existing Cortez mining and processing facilities are located in three main areas, Cortez, Gold Acres and Horse Canyon. The Cortez area lies on the east side of Crescent Valley on the western flank of the Cortez Mountains in Lander County approximately 6 miles west of

Horse Canyon. The Gold Acres area lies on the southwest side of Crescent Valley in the Shoshone Range in Lander County, approximately 8 miles northwest of the Cortez area. It contains the Gold Acres and London Extension open-pit mines. The Horse Canyon area is approximately 2 miles east of Mt. Tenabo in the Cortez Mountains in Eureka County. It encompasses the Horse Canyon open-pit mine and an associated deposit to the south, the South Silicified Zone. The facilities addressed in the Plan of Operations for the Cortez Gold Mine Expansion Project and the Expansion EIS were located at the Cortez and Gold Acres areas. The Proposed Action is located in the Gold Acres area.

The applicant controls approximately 44,000 acres of **unpatented mining claims** and 3,200 acres of **patented mining claims** in the vicinity of existing mining operations.

2.1.2 History of Mining in the Proposed Action Area

Mining in the Cortez-Gold Acres district began with the discovery of mineralization in 1862 when high-grade silver ores were exploited from underground mines located approximately 4.5 miles southeast of the present Cortez mill site. An 8-**stamp mill** was erected in Mill Canyon in the 1860s to process the silver ore. The Garrison and Arctic tunnels provided the bulk of this silver production between 1864 and 1895, with a lower level of mining and milling activity continuing throughout the Cortez-Mill Canyon area until 1930. A small **cyanidation** process was operated for a short time in lower Mill Canyon, and a portion of this structure remains today.

Gold mining in the Gold Acres area began in 1935. It was the largest gold producer in the Bullion mining district. Underground methods were used initially, with open-pit methods introduced later on. A mill using cyanidation processing techniques was constructed in the area. Gold Acres was one of the few U.S. gold mines which operated through World War II, and was one of the largest gold producers in Nevada in the 1950s.

Regional geochemical studies undertaken by the U.S. Geological Survey in the Cortez Canyon area during the early 1960s indicated gold mineralization which eventually led to the discovery of the Cortez gold deposit by Placer Amex (now Placer Dome U.S.).

2.1.3 History of Cortez's Mining Operations

Since the discovery of the Cortez deposit, Cortez and the Cortez Joint Venture have developed several mines in the Proposed Action area. Cortez operated a **cyanide leach countercurrent decantation** (CCD) recovery mill from January 1969 to February 1976. The mill ran initially from 1969 to 1973, processing 1,700 tons per day of **oxidized ore** from the Cortez ore body. Starting in 1973, the mill was operated at 2,300 tons per day on softer, less oxidized, high-clay ore from Gold Acres. At the same time, **heap leaching** of the lower grade portion of the ore was practiced at both Cortez and Gold Acres to supplement the milling operation. In February 1976, the oxidized portion of the ore body at Gold Acres was depleted, the mobile equipment was auctioned off, and the mill ceased operation. Leaching of the ore heaps continued through 1979. In early 1980, heap leaching was started on low-grade oxidized dump material left from the earlier Cortez operation. The mill was converted from CCD, a process using zinc to recover gold, to one using activated carbon (charcoal) to recover gold, called **Carbon-in-Leach** or CIL. Modifications were completed in February 1981, and at that time, processing of the Gold Acres London Extension dump material commenced. The Horse Canyon Project commenced in early 1983 supplying the mill with ore for another 4 years. This project was permitted under case file N64-81-001P by the BLM.

Following operations at Horse Canyon, mining of the first stage of the Gold Acres London Extension pit area began in 1988 (Plan of Operations N64-86-001P). This stage was designed to recover the remaining oxide reserves in order to sustain the 2,000-ton-per-day mill until a **circulating fluid bed roaster** (CFB) modification could be completed. The CFB roaster was necessary because the mill was able to treat oxide or easily treatable ore only and was unable to extract gold from the remaining ores containing carbon and sulfide minerals. The carbon and sulfide minerals have an affinity for the gold that does not allow separation by chemicals in the CIL mill. The CFB roaster breaks down the bond between the gold and carbon/sulfide minerals by an oxidation process of raising temperatures to over 700°C or 1,300°F. The CFB process does not increase mill throughput. The roaster and mill are located on privately owned lands.

2.1.4 Existing Mining Operations

To sustain the current mill production, oxide ore is being mined from the East Pit at Cortez and the London Extension Pit at Gold Acres. Low-grade oxide ore is also produced at the East Pit and stacked on pads for heap leaching. Operations at the East Pit are approved under permit N64-81-001P. Feed is supplied to the roaster from stockpiles located at Horse Canyon and Gold Acres. Cortez's 1990 Plan of Operations was recently approved. An expansion south of the London Extension Pit mine in the Gold Acres area was included in this plan. In addition to these operations, Cortez is continuing to remove waste rock with uneconomic gold content from three of four stages at the Gold Acres London Extension Pit in order to uncover mixed **carbonaceous/oxide ore**.

Minable reserves in the Northwest Pit (above the water table), adjacent to the Cortez East Pit, are being developed to supply oxidized ore for processing at Cortez.

A portion of the current oxide stockpiles located at Gold Acres are in consideration for processing at the Cortez heap leach pads provided the economics are favorable.

2.1.5 Summary of Existing Plans of Operation and Rights-of-Way

Existing Plans of Operations and Rights-of-Way approved by the BLM for previous Cortez development and exploration in the Proposed Action area are summarized in Table 2.1-1.

2.1.6 Existing Processing Facilities

Existing mill processing facilities include ore processing facilities (i.e., the crushing and grinding circuits, the CFB roaster, the CIL mill and a tailings impoundment). Refer to Figure 2.0-1 for a diagram showing the steps involved in these processes. Heap leaching facilities are also used to recover gold from mined ore. These existing facilities are located on patented land primarily in the Cortez area. Heap leaching, crushing and grinding, tailings, and the CIL mill are described in more detail under the Proposed Action (Section 2.2.3). The CFB roasting process description is provided below.

Roasting Circuit

As mining and development progressed in the Cortez-Gold Acres district, ore bodies with increasing amounts of carbon and sulfide minerals were encountered. Gold recoveries from these ores is very poor by the existing CIL process scheme. The CFB roaster has the capability to raise the temperature of the ore and thereby oxidize the difficult minerals and free the gold for extraction by subsequent chemical means. Ore is roasted at temperatures near 700 °C or 1,300°F. Exhaust gases from the roaster flow through a gas cleaning plant where dust, sulfur dioxide, and mercury are removed prior to discharge from a stack.

2.1.7 Ancillary Facilities, Equipment, and Workforce

Power

Sierra Pacific Power Company provides electrical service to the minesite through a 60-kV line from the Battle Mountain area. Cortez owns the transformer substation located at the mill.

Water Source and Supply

The primary consumptive use of water occurs in the Cortez plantsite area due to evaporative losses. Water used for mining and milling purposes at Cortez is supplied by groundwater wells in the Gold Acres area, Horse Canyon area and Cortez plantsite area.

Cortez is currently conducting groundwater remediation under the direction of the NDEP to remove cyanide from a localized area of shallow groundwater. A system of pollution control wells recovers shallow groundwater and provides makeup for the process solution circuit. By using shallow, poor quality groundwater for the process solution makeup, the consumptive use of higher quality fresh water is minimized.

Two production wells are available at the Cortez plantsite to supply the demand for fresh water. Gold Acres area and Horse Canyon area are served by one production well each. Water from these areas is primarily used for dust control purposes.

Access Roads and Internal Mine Roads

The Cortez-Gold Acres mine area is accessed via Nevada State Highway 306, which extends southward off U.S. Interstate 80, both of which are paved. The last few miles of road to the plantsite is a Lander county road. Internal mine roads consist of a 14-mile haul road from Horse Canyon pit area intersection to the Cortez plantsite intersection, an 8-mile haul road from Gold Acres to the millsite, and a 1-mile haul road from Cortez to the millsite. The haul road from Gold Acres will be rerouted according to the 1990 Plan of Operations.

Surface Water Diversions and Drainage Control

The areas surrounding existing facilities contain numerous channels and washes that flow only during times of intense precipitation and snowmelt. These facilities are protected from surface runoff and storm events by berms and diversion ditches. Use of natural drainage courses are maximized as much as possible to reroute runoff. Springs and surface flow are controlled by channelling flow around the facilities. Diversion ditches protect Proposed Action facilities from being inundated by surface runoff.

Fuel Storage

Diesel fuel for mine equipment and power generators are transported to the Proposed Action site by commercial tanker trucks. Average use is approximately 100,000 gallons of fuel per month.

Fuel is stored in existing tanks located in the Horse Canyon, Cortez, and Gold Acres areas. Above ground tanks are surrounded by lined berms sized to contain the contents of the largest tank in case of spillage or tank rupture.

Sanitary and Solid Waste Disposal

All sanitary wastes are disposed of in the existing on-site, state-approved leach field. All trash and refuse is hauled to an approved landfill facility. All refuse is handled in accordance with applicable federal, state, and county laws.

Fencing and Security

To prevent interference to mining and to protect the general public from harm, the pad, pond, and process areas are surrounded by a 5-foot-high fence. Appropriate warning signs are placed on this fence at 200-foot intervals. All access roads to these areas have gates with locking capability to provide vehicular access control. In addition, the mine security department makes routine inspections to ensure that the access gates are properly maintained and that entrance by the public does not occur.

Support Facilities

Support facilities include an administrative office, assay lab, and first aid station located in buildings in the Cortez mill area. There is also an office and maintenance facility located in each of the Horse Canyon and the Gold Acres areas.

Other mine site facilities consist of the existing mobile equipment ready line, maintenance shop, explosives magazine, mine office and fuel and lube-oil storage facilities. In addition to the facilities located in the Cortez mine area, both the Horse Canyon and Gold Acres mine areas have subordinate maintenance-related facilities.

Fire Protection

Adequate fire protection equipment and a fire protection plan have already been established for the existing operations at the Proposed Action site. These procedures comply with all regulations imposed by the Mine Safety and Health Administration (MSHA) and applicable state and county building codes and regulations.

Chemical Reagent Requirements and Storage

Reagents are required for the milling and heap leach operations. Currently, sodium cyanide is received as a liquid. Caustic is obtained in commercially available forms when needed. Lime is stored on site in a silo as a solid and added either as a solid or as milk-of-lime for pH control in the mill. The working inventory of reagents is kept as low as feasible.

The following safety measures are currently followed and would be continued for the Proposed Action:

- All chemicals are stored within fenced or restricted access areas. Sodium cyanide and acid are stored separately.

- Sufficient calcium hypochlorite and/or hydrogen peroxide are maintained on site to neutralize any unforeseen spills.

- Sodium cyanide is typically received as a liquid solution containing 30 percent sodium cyanide. The solution is buffered with caustic to a pH of 13 to prevent the formation of hydrogen cyanide gas. Liquid cyanide is stored in a tank which is surrounded by a concrete containment berm sufficient to contain 110 percent of the tank's capacity.

  An inventory of sodium cyanide briquettes is also maintained in reserve should liquid cyanide shipments be interrupted. Sodium cyanide briquettes are received in drums. When emptied, drums are triple-rinsed and disposed of in accordance with applicable regulations.

- All employees are indoctrinated in the safe use of chemicals. Proper safety training is given to those employees involved in handling chemicals. Adequate personal protection equipment is worn by all employees during the handling of chemicals. State-certified trained first responders provide emergency medical treatment.

- Face shields or goggles, rubber aprons, rubber gloves, and respirators are worn when handling chemicals. This safety equipment, plus earplugs, are used at all appropriate times and meet MSHA requirements.

- Hard hats, safety glasses, and steel-toed boots are worn by all personnel on site as appropriate to the work area.

- Cyanide antidote kits, oxygen bottles, first aid kits, fresh water showers, and eye wash stations are located in the mill area. An additional cyanide antidote kit, oxygen bottle, first aid kit, and trauma kit are located in the office or at the security gate. All employees are instructed in their use.

- At least two people are present when sodium cyanide is being mixed.

- At least one person is on site continuously during operational shutdowns.

- Cortez has developed a detailed sodium cyanide spill prevention and response plan to mitigate potential impact of such spills in the Proposed Action area. This plan requires immediate control of the source of the spill and immediate notification of the shift foreman. The shift foreman would immediately investigate the spill and take those actions which are both appropriate and safe to stop the discharge at source and contain the spill to minimize its impact. The shift foreman would notify the mill superintendent and/or other company official as soon as possible, who would in turn notify the appropriate agencies as required. Spilled product would be retrieved for reuse as practical. Spilled sodium cyanide solution not suitable for reuse would be neutralized with calcium hypochlorite. Contaminated materials not suitable for reuse would be excavated to the depth of apparent contamination and placed in the lined heap leach pad and reclaimed as part of this facility. The excavated area would be sampled and tested for total cyanide concentration. Areas where the total cyanide concentration exceeds 10 mg/kg of soil would be further excavated until the entire impacted area is remedied.

Workforce

The present operation employs 175 people. Approximately 75 employees work in ore processing which includes the CFB roaster, CIL mill, and heap leach facilities. About 50 employees are involved with mining operations, and about 50 people are employed for administrative work.

2.1.8 Existing Reclamation

Reclamation practices on the Cortez Joint Venture property have evolved over the years. Waste rock dump sloping was started in the mid 1970s at the Cortez and Gold Acres areas. These dumps remained inactive until 1980 at which time an investigation revealed some of the dumps located at Cortez could be heap leached economically. In addition to this, plans were made to convert the mill which made milling of low grade dumps at Gold Acres feasible. The converted mill was commissioned in 1981 and operated on these low grade dumps until 1983.

Mining activities in these areas redisturbed much of the reclaimed land. However, remnants of the reclaimed areas do remain and are indicative of what reshaping dumps can do in assisting reclamation.

Natural revegetation was successful to some degree at both areas but more so at Gold Acres. The reason for this is that the waste rock at Gold Acres contains more fines and holds moisture better than some of the waste rock at Cortez.

In the 1980s, an emphasis was placed on establishing reclamation procedures. This resulted in several test programs which were intended to evaluate seed mixtures for different areas, particularly for the Horse Canyon area. Seeding was attempted around the Horse Canyon pit based on mixtures recommended from the BLM, Soil Conservation Service, consulting services and other mining companies. These areas are being monitored today in order to establish a successful program for the future.

A test plot area selected at both the Cortez and Gold Acres areas in the spring of 1989 intends to evaluate other revegetation parameters including mulching, fertilizing and spreading of topsoil.

More recently, emphasis has been placed on the reclamation of exploration roads while simultaneously monitoring the reclaimed dump areas. Current procedures for reclaiming exploration roads start with replacing the cut area with the fill portion of the road. The last part of the fill placed on the road is typically topsoil, the first part of the road excavated. Again, the seeding placed on the road is dependent on the area. The BLM has recently prescribed a mixture for the different areas. Recent reclamation of two dumps at the Cortez area included reshaping, application of topsoil and seeding. Over 100 acres of roads and dumps have been reclaimed by Cortez. All of this reclamation has been observed or inspected by the BLM.

The waste rock dumps at Cortez and Gold Acres are built with reclamation in mind. The tier design is used wherever feasible to minimize the amount of fill to be rehandled and to provide more breaks in the slope. Where practical, soil is stockpiled for future spreading.

The BLM has provided guidelines for prevention of unnecessary and undue degradation of public lands. In general, these include proper location and construction of roads (i.e., water bars, percent grade, water course approach, and topsoil stockpiling), plugging of exploration drill holes and construction and location of waste rock dumps (north facing slopes, tier design, etc.).

Current mine practices reflect the requirements of the Environmental Assessments and the Environmental Impact Statement for the existing Plans of Operations per the BLM specifications.

2.2 PROPOSED ACTION

The Proposed Action would allow Cortez Gold Mines to develop the new Pipeline gold deposit, discovered and evaluated in 1991 and 1992. The deposit name refers to a water pipeline which crosses the area and supplies the Gold Acres operation. This new discovery contains sufficient ore reserves to allow continuous operation of a new mine and processing plant for at least 12 years after plant commissioning. It would result in an increase in the annual mining and production rates, and the total Cortez Gold Mines workforce.

The Proposed Action includes developing a new open-pit mine with an associated dewatering system and waste rock dump; constructing a new combined heap leach/tailing impoundment facility; constructing a new 5,000-ton-per-day ore processing facility complete with all support facilities such as shops, warehouses, offices, changehouses, and laboratories; and concurrent mineral exploration in the project area (Figure 2.2-1). The Proposed Action would be located in Lander County, on unpatented mining claims on Federal land or on privately owned property.

2.2.1 Surface Disturbance in the Proposed Mining Area

The surface disturbance that would result from mining and processing of ore is summarized in Table 2.2-1 and Figure 2.2-2. Surface disturbance would result primarily from construction of the open-pit mine, heap leach/tailings impoundment, waste rock dump, and processing facility. A discussion of the proposed mining operations and processing facilities is presented in Section 2.2.2.

In order to mine and process the ore in the Pipeline deposit, a total of approximately 1,880 acres would be disturbed. Development of the open-pit mine would create disturbance to 241 acres. Of this disturbance, 52 acres consists of an inactive heap leach facility operated in 1972-1976 and a valley-fill deposit of mill tailing from operations during 1935-1960. Other major areas of disturbance would include 586 acres for the waste rock dump area and 440 acres for the leach/heap tailings impoundments. The total disturbed acreage estimate includes 81 acres that would be disturbed to accomplish reclamation of the waste dump area.

The inactive heap leach facility above is known as the Old Gold Acres Heap Leach Material. This material consists of tailings and heap leach material from the historic operations described above. As part of the NDEP Water Pollution Control Permit Application for the Proposed Action, the Old Gold Acres Material was chemically characterized for acid rock drainage potential by meteoric water mobility testing. The purpose of the testing is to provide characterization of the materials that will be excavated during the mining for the Proposed Action and to evaluate the level of materials handling required based on that testing.

A total of 16 MWMP tests were performed on material type composite samples from 122 test pit samples distributed across the Old Gold Acres tailing and heap leach material including pond and pad liners and underlying soils. The MWMP results are summarized on Table 2.2-X. The testing results show that the material is generally of fair quality for which special material handling requirements would not be necessary. The 7 tailings wash material and underlying soil samples have only elevated iron levels with an average of 11 mg/L, which exceeds the 3 mg/L NDEP MWMP limit. The 3 heap leach material samples results show slightly elevated arsenic concentrations of up to 0.625 mg/L (MWP limit = 0.5 mg/L), with an average level of 0.3 mg/L. The 5 MWP composite sample results on the heap leach pad and pond liner materials showed slightly elevated arsenic, iron, and mercury concentrations. One sample collected from the pregnant solution pond (MWMP sample GAL-SP2) reported significantly elevated arsenic values of 2.87 mg/L and also has elevated iron and mercury concentrations.

The results of the MWMP testing shows that the Old Gold Acres tailing material is not toxic. However, to be conservative, the Proposed Action design calls for isolation of the material in the pit mined material waste rock dump to minimize the potential for leaching due to contact with percolating water or runoff. Because the material is not toxic, the material need not be placed into an engineered containment. The Old Gold Acres Heap Leach Material will not be managed in a special manner. The Old Gold Acres solution pond liners do have potentially significant levels of arsenic, iron and mercury; therefore, that material will be placed in the Proposed Action tailing containment facility to prevent possible leaching of contaminants into the groundwater.

2.2.2 Proposed Mining Operations

Open Pit Configuration and Stability

Initial engineering indicated that the pit would have maximum pit wall slopes between 38 and 60 degrees, varying by rock type and geotechnical considerations. The ultimate crest of the pit would be at 5,150 feet above sea level and the pit would be approximately 1,000 feet deep, with the bottom of the pit at 4,120 feet above sea level.

Pit high wall configuration would be controlled by several parameters, some of which are geologic and geotechnical controls, equipment constraints or safe operating practices. Pit bench heights and widths would be designed according to sound engineering practice. Bench heights are determined by the mining equipment limitations and the characteristics of the gold mineralization. High wall slopes are a function of the geometry of the ore body and are based on slope stability analyses.

As mining progressed, an ongoing geotechnical program would confirm the assumptions made and the validity of the slope design. The geologic and geotechnical characteristics of the materials exposed during mining would be monitored regularly. Geologic structure mapping and interpretation, groundwater monitoring, and slope stability analyses would be the basis elements of this geotechnical program. Slope movement monitoring would be instituted to evaluate the safety of pit high walls. In addition, operational procedures for controlling blasting and bench scaling would be instituted to facilitate mining of stable pit walls.

Drilling and Blasting

Ore would be mined by conventional open-pit methods involving drilling, blasting, loading and hauling. Most of the overburden and ore would require drilling and blasting. Blasting would be performed only during daylight hours and under strict safety procedures as required by the Mine Safety and Health Administration (MSHA). Approximately 650 tons of explosives would be delivered monthly by licensed haulers and stored on site in approved storage facilities. Scaled distance formulas would be used to establish safe seismic disturbances and air blast limits.

Dewatering of the Open-Pit Mine

The mine dewatering plan has been developed with the aim of providing relatively dry pit conditions according to the mining schedule. A maximum pumping rate of 30,000 gpm (49,000 acre-feet/yr) is expected to be reached within the first 2 years of dewatering operations and would be maintained through the course of the mining schedule. However, the actual pumping rate from deep wells during the latter stage of mining could be significantly reduced if groundwater is effectively intercepted by shallower wells.

Dry open-pit conditions would be accomplished using specific well types designed for completion within the main water-bearing zones through which pit inflow must be controlled. Complete depressurization of the pit walls should also be possible in most areas, although rapid dewatering could result in temporary localized perched water conditions. Vertical or inclined borings would be installed to drain zones of persisting saturation and relieve pore pressure.

In coordination with the mining schedule, implementation of the majority of the dewatering system must occur within the period of prestripping and the first year of production. The dewatering schedule would be implemented with two main objectives: (1) to dewater the saturated alluvium in the east pit wall, preventing slope failure; and (2) to progressively dewater the bedrock in the pit to a level below the pit floor and subsequently maintain the water table below the bottom of the pit.

For pit wall stability, the water level in the alluvium must be kept below the lowest point at which the gravel/bedrock interface occurs in the wall (4,705 ft). In addition, a safety margin has to be designed into the system to allow for rebound in water levels in the event of power outage. A 20-foot vertical safety margin has been used during planning. The target water elevation for the alluvium in the east wall would be therefore 4,685 feet. To achieve this, it would be necessary to create a drawdown of 110 feet at the margin of the pit. To allow the pit to be worked in dry conditions, the groundwater heads within the bedrock would need to be ultimately lowered by over 700 feet to an elevation below 4,120 feet.

Four types of wells would be used for this scheme: (1) alluvial interception, (2) shallow bedrock, (3) deep bedrock, and (4) drains or ejectors. The planned approach is for 25 to 40 percent of the water to be pumped from alluvial wells, 45 to 50 percent to be pumped by shallow bedrock wells, and 15 to 25 percent to be pumped from deep bedrock wells. Drain holes and ejector wells would account for less than 1 percent of the overall pumping rate. For the Pipeline deposit, the interception well field approach offers reduced overall pumping head and avoids in-pit well locations.

Alluvial Wells. Fourteen alluvial wells would be necessary in the period of prestripping to dewater the saturated alluvium on the east of the pit. The average depth of these wells would be approximately 460 feet. These wells would serve two functions: (1) to lower the water level within the alluvium, and (2) to intercept a component of the water which would flow toward the mine and prevent it from reaching the bedrock.

Shallow bedrock wells would pump water out of fracture zones at shallower levels, thereby intercepting the water before it flowed downward into the main shear zone. It is probable that most of the shallow bedrock wells would be located mainly to the north and south, outside of the final pit. For the preliminary design, between six and nine shallow bedrock wells have been assumed. They would have to be drilled to an average depth of around 650 feet.

Deep bedrock wells would be necessary to lower the water table beneath the pit. To achieve full depressurization, they would require a component of groundwater inflow from below the level of the final pit floor. It would be necessary to drill the deep wells to an average depth of around 900 to 1,000 feet.

The current geologic interpretation suggests that there would be areas of low-permeability rock and clay gouge material occurring in the pit walls. In order to dissipate pore pressures, it could be necessary to install local drainage measures at various locations within the pit. If the rock which underlies the low-permeability material were already depressurized, drain holes could be installed. The objective of the drains would be to enhance vertical permeability. Water which was trapped within the low-permeability layers would flow laterally towards the drains. They would allow this water to flow downward into the depressurized zones. Should drains not be suitable in some areas, a system of ejector wells could be used. In-pit sumps could be required to facilitate collection and transfer of local pit wall drainage, floor seepage, and precipitation.

Dewatering System. The initial dewatering system would consist of 28 (increasing to 38) production dewatering wells, turbine pumps installed in each of the wells, power supply to the pumps, discharge lines from the individual wells, main discharge lines, conveyance line, and infiltration gallery. Collection and transfer of minor pit wall drainage and runoff would be accomplished with wet pit sump pumps and lift stations.

As dewatering operations proceeded, the actual number of production wells would depend on the total pumping rate required for dewatering. Alluvial wells would be completed with a 14-inch-diameter production casing string. Shallow bedrock wells would be completed with a 16-inch- to 18-inch-diameter casing string. Deep bedrock wells would be completed with an 18-inch-diameter casing string. High-efficiency well screen would be specified and completion intervals determined based on the formation conditions which were encountered during drilling.

Since no significant pumping lift would be required beyond well head discharge, the pumping system would be designed without breaks in pressure. The well pumps would therefore provide sufficient head to pump the water through a main discharge branch line to the outfall location. The discharge would break pressure at the outfall and be conveyed by gravity flow to the infiltration area.

Water Management. Water appropriation applications have been filed for a total of 67 cubic feet per second (approximately 30,000 gpm) to accommodate the displacement of groundwater for mine dewatering and provide for water supply. Of this total, an estimated consumptive use of 2,000 gpm is proposed for mining and milling. The remaining 28,000 gpm is proposed to be returned to the Crescent Valley groundwater basin.

Shallow infiltration which provides direct recharge to the Crescent Valley alluvial aquifer is the applicant-preferred option for discharge of the pumped water; the feasibility of this method has been demonstrated by test work. Infiltration of the dewatering discharge would minimize the area of pumping influence and reduce evaporative losses, but direct recycle of infiltrate to the pumping system must be avoided for efficient mine dewatering. Flexibility in the location of infiltration beds would permit directional control of excessive drawdown.

Small-scale infiltration tests conducted in shallow soil horizons within the Proposed Action area report vertical conductivities ranging from 2 to 50 feet/day. During pumping tests, 1,600 gpm and 2,300 gpm were discharged to a pilot-scale infiltration basin over a period of 6 weeks. An average infiltration rate of 7 feet/day (1,600 gpm/acre) was observed, suggesting that less than 20 acres would be sufficient to accommodate the proposed discharge rate of 28,000 gpm. However, a design area of 80 acres has been used to account for variability in infiltration capacity and ensure that sufficient area is available to avoid interruption of system discharge.

Infiltration ponds will be designed and constructed to put the water produced during pit dewatering activities back into the alluvial aquifer. The water will be conveyed to the ponds via open channels or pipelines, where it will percolate downward through the soil to the water table. Once the water reaches the water table, it will then flow laterally into the aquifer (known as aquifer recharge), where it will flow with the direction of groundwater movement in the vicinity of the infiltration ponds. Because the recharge is centered in a relatively small area compared to natural recharge which occurs regionally, the infiltrating water may not flow laterally as fast as it is recharged, resulting in a **groundwater mound**. Groundwater flow in the alluvium which will receive the recharge occurs from areas of higher hydraulic elevation (or **head**) to areas of lower hydraulic elevation (**head**). In the natural groundwater system in Crescent Valley, this is from the margins of the valley at the toes of the mountains toward the center of the valley and then northerly along the center of the valley toward the Humboldt River. The mound of groundwater which may be created beneath the infiltration ponds will result in a localized reversal of the groundwater flow direction (**hydraulic gradient**) because it creates an area of greater hydraulic head than the surrounding water table. This local reversal of the hydraulic gradient serves a useful purpose in several ways. First, it would reduce the lateral extent of the drawdown in the water table due to the pit dewatering activities. Second, by placing the infiltration ponds between the area of drawdown and spring, seep, and well locations, the potential effects to springs and seeps and well water users would be reduced. Groundwater mounding beneath infiltration ponds would also help prevent pulling water from the Cortez Mine area (about 5-7 miles to the east), thus limiting impacts on groundwater cleanup activities at the Cortez Mine.

Figure 2.2-3 indicates the proposed location of potential life-of-mine infiltration sites to fall within a 1-mile-wide band centered 3.5 miles from the Pipeline open-pit. The radial segment extends from the northeast (commencing at State Route 306) to the southwest (ending at County Road 225). Each infiltration site would be surrounded by a standard 4-strand barbed wire fence approved by the BLM. Figure 2.2-3 also indicates the general location of the conveyance corridor, the initial infiltration site located in the northeast sector of the radial segment (site A), and two private land parcels deeded to Cortez Gold Mines on which infiltration or water disposal could take place. An area of 126 acres would be required for conveyance channel or pipe(s), pond system, and access to conduct infiltration activity at site A. The system is sized to accommodate rotational operation. This method of operation requires sufficient infiltration area to allow individual basins to be temporarily taken out of service for reconditioning and silt removal.

Monitoring

Water quality monitoring of the dewatering system will include:

- Water quality of individual dewatering wells
- Composite mine discharge.
- Hydrochemical parameters for existing wells or springs that show a water level change of more than 10 feet in response to infiltration.

Waste Rock Dump Facilities

The proposed rock dump area would cover a total of approximately 586 acres, and would have a final capacity of approximately 233 million tons. The waste rock dump area would be located as close as possible to the pit in order to minimize haulage distance (Figure 2.2-2). In addition to the unmineralized rock that overlies the orebody, non-mineralized material (interburden) is locally interspersed within the ore. The overburden and interburden rock would be hauled by haul trucks to the waste rock dump area.

The waste rock dump area would be developed by end dumping at an angle of approximately 38 degrees. Wherever feasible, waste rock dump facilities would be designed and built as terraced structures to facilitate recontouring and reclamation. A 30 percent swell factor is assumed in the conceptual facility designs. The upslope portion of the disposal area would be sloped back into the hill to prevent runoff down the face of the disposal area. The downslope portion of the waste rock dump area would have a maximum height of 200 feet above grade. Engineered diversions would be installed as necessary to protect the waste rock dump area from being inundated by surface runoff. (It is anticipated that material segregation during dumping would promote natural drainage of the disposal facility.) No surface water features have been identified in waste rock dump areas.

Ore Stockpiles

At times, ore mining rates or the need to blend ore types may require construction of temporary ore stockpiles with a planned capacity of up to 100,000 tons of ore which would be located near or within the proposed pits. Additionally, ore stockpiles would be located at the crusher and could also be located near or within other components of the ore processing and roaster facilities.

If the final-stage ore is mined out at an elevated rate, a 5.1-million-ton stockpile would be constructed near the plantsite, as shown in Figure 2.2-2.

2.2.3 Proposed Processing Facilities

The Proposed Action would include the construction of a 5,000-ton-per-day milling circuit to be located in the plantsite area (Figure 2.2-1). A heap leaching facility would also be constructed to process low-grade ores. The milling and heap leaching facilities would be located on unpatented mining claims.

The Pipeline orebody contains carbonaceous gold ores suitable for processing in the existing Cortez roasting plant. This ore is scheduled to be hauled from the Pipeline deposit for processing. In addition, oxide ores may be processed in the Cortez mill, depending on the availability of ore for both the Cortez mill and the proposed Pipeline mill.

Crushing and Grinding

Ore would be fed from the ore bin to a jaw crusher and then conveyed to a 5,000-ton coarse-ore stockpile. The crushed ore would be reclaimed from the stockpile and fed to a **semi-autogenous grinding (SAG) mill**. The SAG mill is a large rotating drum that contains steel balls. The tumbling action of the balls and the ore particles causes the ore to grind to a fine powder. Oversize material from the SAG mill discharge would be further reduced in size by a cone crusher and then recycled through the SAG mill. The ore is further ground by a **ball mill**. The final ground product would be slurried (ore mixed with water) and fed to the CIL mill.

Carbon-In-Leach (CIL) Circuit

The slurried ore from the grinding process would be piped to a thickener, which is a large tank that allows the ore to settle from the slurry. Settled ore would be pumped to the eight carbon-in-leach (CIL) tanks where the gold would be dissolved by cyanide solution and adsorbed onto carbon (charcoal) granules.

Carbon-In-Column (CIC) Circuit

Some gold would also be dissolved in the thickener and the solution overflowing the thickener tank would be run through a series of carbon (charcoal) tanks or columns where gold was removed from the solution and onto carbon granules. Activated carbon would be used to extract the gold from a cyanide solution. The gold free solution from these columns would be recirculated to the grinding process.

Recovery and Refining Circuit

Gold-bearing carbon granules from the CIL and CIC circuits would be sent to the carbon stripping circuit, which is designed to remove gold from the carbon granules. In the stripping circuit, the gold-bearing carbon would be placed in a pressurized tank and a hot chemical solution containing sodium cyanide and sodium hydrochloride would be circulated through the carbon. The gold would be dissolved into this solution and this solution would be cooled and then passed through an electrical unit that causes gold to precipitate onto steel wool. The now gold-free carbon would be reactivated to an efficient state by thermal means and then reused in the circuit. The steel wool containing the gold would be mixed with **fluxes** and melted in a small furnace to produce gold ingots. Several ingots would be combined in a second melting furnace and poured into a bar mold. The bar would be removed from the mold and prepared for shipment.

Tailings Disposal Facilities

Once slurried ore from the mill has been treated and the gold recovered, the remaining slurried material called tailings, would be transported through a pipeline into the tailings disposal area proposed south of the plantsite. The solid portion of the tailing would settle in the pond while the liquid portion of the tailings would rise to the top. Once at the surface of the pond, the liquid would clarify as solids settled to the bottom of the pond and the clear liquid was allowed to drain to a pipe system that transported the solution back to the mill for reuse.

The tailings impoundment and heap leaching facilities would be integrated into one facility on approximately 420 acres of unpatented mining claims. Site assessment studies and geotechnical and groundwater investigations have been performed and the tailings disposal facility has been designed to meet or exceed NDEP containment specifications. As presently planned, this facility would consist of a tailings embankment; a lined, impervious impoundment area; lined solution storage ponds; and tailings slurry and water return pipelines. The facility would be a zero-discharge or closed system, and would not discharge process solutions to surface water or groundwater resources, in accordance with NDEP and BLM requirements. The facility would be built in phases to accommodate the 18 to 20 million tons of tailings that would be generated over the project life.

Concentrations of **weak acid dissociable (WAD) cyanide** in the tailings impoundment would be maintained well below 50 ppm, and generally below 20 ppm. These low concentrations would be maintained as a result of the low cyanide requirements in the leaching circuit and by washing the tailings with a solution which would be much lower in cyanide concentration prior to discharge to the tailings impoundment.

Heap Leach Facilities

In addition to the milling processes discussed in previous sections, an ore processing technique called heap leaching would be used to recover gold from low grade ores. A new heap leach facility would be constructed in conjunction with the tailing storage facility. The facility would be built in phases to accommodate the 16 to 20 million tones of heap leach material that would be produced over the mine life.

Heap leaching involves placing ore grade material on a prepared pad using mine haulage trucks. Ore would be placed in **lifts** 15 to 20 feet in height. Once a lift was completed, an array of sprinkler pipe would be moved onto the lift. Through the sprinkler system, a dilute solution of sodium cyanide would be sprayed on the ore. Due to the chemical reaction that would take place between the cyanide solution and the gold in the ore, the gold would be put into the solution and flow to solution collection ponds along the surface of the prepared pad. Solution would be then run through a **carbon adsorption circuit**, which would recover the gold from solution.

Each lift that was placed on the heap would be sprayed with cyanide solution for 90 to 160 days. Following the completion of heap construction and leaching, the heap would be allowed to drain, and then, sprayed with fresh water. Rinsing the heaps with fresh water will usually remove residual cyanide left in the heap to standards set by the Nevada Division of Environmental Protection. If rinsing of the heaps with fresh water did not reduce residual cyanide levels to acceptable standards, a solution of cyanide-destroying chemicals could be applied to the heap until neutralization standards were met.

The proposed heap leaching facility is designed as a closed-circuit, zero-discharge system both in terms of potential leakage and in terms of overflow. The solution collection ponds are designed to store process solutions and to contain runoff from a 100-year, 24-hour storm event. The proposed heap leach facility would be surrounded by containment berms. The berms would prevent surface runoff from entering the facility and causing erosion of structures or dilution of the **leach solution**. The berms would also prevent any possible escape of process solutions from the facility.

The heap leach solution ponds would be covered with 1-inch mesh netting and 8-foot-tall fencing to exclude avian and other wildlife from entering the ponds. Leach solution collection and conveyance ditches would also be covered with 1-inch mesh netting or covers to exclude wildlife.

Heap leach ore is not expected to contain clays or fines in sufficient quantities to cause pooling or ponding of cyanide solution on the tops of heaps. Were ponding to occur, ore underlying ponded areas would be scarified (broken or loosened) to enhance infiltration.

2.2.4 Exploration Activity

Exploration activities to identify and delineate satellite deposits would occur. Surface surveys and drilling programs are planned. Exploration disturbance would occur at about 12 acres per year during the early years of the project. Based on concurrent reclamation of the exploration disturbance, a maximum of 48 acres would be unreclaimed at any one time.

2.2.5 Ancillary Facilities, Equipment, and Workforce

Most ancillary facilities would remain as described in Section 2.1.7. The changes to existing operations are described below.

Power

Sierra Pacific Power Company would provide electrical service to the mine site through a new 120-kV transmission line from the Battle Mountain area. The new line would connect the Reese River substation in Battle Mountain to the Cortez Tap Switching Station in Whirlwind Valley (about 12 miles). It would then proceed 23 miles south to a new substation. This 12-15 MW Pipeline substation would be located at the beneficiation plant. An environmental assessment for an 80-foot right-of-way and the substation was prepared in December 1992 (BLM 1992a).

Water Supply and Source

The primary consumptive use of water would occur at the plant site due to evaporative losses. Water used for mining and milling purposes at Pipeline would be supplied from the mine dewatering program. Bottled water would be supplied to the mine site for drinking.

Site Layout and Support Facilities

The site layout for the Pipeline plant site is provided in Figure 2.2-1. It includes the following support facilities:

- Administration Office
- Safety/Change House, including a first aid station
- Mill Facility
- Assay Lab
- Shop/Warehouse
- Ready Line/Rite Shop
- Heavy Equipment Fuel Line
- Light Vehicle Fuel Line
- Diesel Storage Facility
- Gas Storage Facility
- Explosives Storage

Access Roads and Internal Mine Roads

The Proposed Action would use the existing Gold Acres haul road to move carbonaceous ore and oxide ore to supplement existing operations at the Cortez milling facility. The existing Gold Acres haul road would require widening from 50 feet to 120 feet to accommodate the larger 190-ton haul trucks. A ROW amendment would be required for this widening. In addition, a network of light vehicle access roads would be required to monitor highwall slopes, the dewatering/infiltration system, and the heap leach/tailings impoundment.

Cortez would use a dust suppressant to control fugitive dust on the haul road as needed to supplement routine use of water trucks. Magnesium chloride has been used in the past, and proved to be very effective in suppressing dust emissions from the Gold Acres haul road.

Fencing and Security

The applicant proposes to fence the plant site and all cyanide use areas prior to operations as required by BLM, NDEP, and NDOW. Infiltration sites and open channel corridors would also be fenced prior to use. Mining areas undergoing concurrent reclamation would be fenced as necessary to facilitate revegetation efforts. During final reclamation, the open pit crest area would be bermed and an outboard fence installed. A roving security patrol would provide access control for the entire site.

Fuel Storage

Diesel fuel for mine equipment and power generators would be transported to the Proposed Action site by commercial tanker trucks. The average use would be about 4.2 million gallons per year. Fuel would be stored in above-ground tanks that would be surrounded by lined berms sized to contain the contents of the largest tank in case of spillage or tank rupture.

Mine Equipment

Major mining equipment is listed in Table 2.2-2.

Chemical Reagent Requirements and Storage

Reagents required for the milling and heap leach operations are listed in Table 2.2-3. Several of these reagents as well as other materials that would be transported, stored, or used on-site are designated as hazardous materials or substances.

Definition of the term "hazardous materials" is found in 49 CFR 172.101. "Hazardous substances" are defined in 40 CFR 302.4 and SARA Title III. Hazardous materials and substances that are expected to be transported, stored, or used on-site in quantities greater than the Threshold Planning Quantity (TPQ) designated by SARA Title III for emergency planning include:

Substance	Annual Usage (lbs)	TPQ (lbs)
Sodium Cyanide	1,539,500	100
Lime	6,408,600	10,000
Hydrochloric Acid	927,500	10,000
Sodium Hydroxide	342,800	10,000
Flocculent	335,800	10,000
Descalent	247,000	10,000
Gasoline	650,000	10,000
Diesel Fuel	30,500,000	10,000
Ammonium Nitrate	15,600,000	10,000

The following hazardous materials and substances may be transported, stored, and used at the plant site in appreciable quantities, but less than the TPQ designated by SARA Title III for emergency planning:

Acetone
Ammonium Hydroxide
Calcium Hypochlorite
Ethyl Alcohol
Freon

Isopropyl Alcohol
Litharge (lead oxide)
Nitric Acid
Petroleum Solvents
Sodium Hypochlorite
Soda Ash
Sulfuric Acid

Small quantities of hazardous materials not included in the above list may be used as laboratory reagents, paints, office products, and maintenance products.

Hazardous Materials Management

Transportation and handling of chemical reagents would be by licensed carriers and properly trained workers. All vehicles and containers would carry the appropriate placards. Chemicals would be stored at the process plant area and protected from the elements. Petroleum fuels would be stored in above ground tanks or tank batteries surrounded with sufficient containment volume to accommodate 110 percent of the largest vessel.

Waste oil would be used as a heating fuel if acceptable, recycled, or disposed of by manifesting to a permitted off-site disposal facility. Where possible, solvents would be used which can be classified as non-hazardous waste upon disposal. Waste solvents which are classified as hazardous would be managed accordingly. Any wastes generate which are classified as hazardous would be managed in accordance with prevailing regulations and guidelines.

Hazardous Wastes

Operation of the Proposed Action may affect the Small Quantity Generator (RCRA) status now maintained by Cortez Gold Mines. The volume of used petroleum solvent would increase significantly. Lead bearing assay lab waste cupels and crucibles would also increase. The resulting quantity of wastes generated would possibly result in Large Quantity Generator status assigned to Cortez Gold Mines. Where acceptable, wastes would be recycled for product recovery. RCRA regulated hazardous wastes would be neutralized and managed on-site; or temporarily stored and manifested to an off-site TSD facility in accordance with RCRA/NDEP regulation.

<u>Workforce</u>

During the 1-year construction period, the combination of mine development workers and construction workers is expected to peak at about 375 during the height of the construction effort of the Proposed Action. The breakdown of these personnel is shown in Table 2.2-4. The mine development personnel would be a part of the permanent Proposed Action workforce. It is expected that the temporary construction workforce would be housed in the cities of Elko, Carlin, Battle Mountain, and Crescent Valley, and would be transported by bus to the site each day. There are no plans to build construction camp living facilities at or near the Proposed Action site.

Plant operations and mining would require a total operations workforce of about 265 long-term employees. Cortez currently employs about 195 persons. As the current operations are phased out, these 195 jobs at Cortez will be eliminated. The current employees will either move over to operate the new mine or move to other U.S. Placer Dome operations. Therefore, with the Proposed Action, there would be a net increase of about 70 additional employees at Cortez. Both the mine development and the plant operation personnel would be hired from the local area if possible.

2.2.6 Mine Production Schedule

The construction of the plant is expected to take 1 year. The mine life is expected to be at least 12 years after commissioning.

2.2.7 Proposed Reclamation Plan

The BLM surface management regulations in 43 CFR 3809 as well as the NDEP Bureau of Mining and Regulation/Reclamation regulations require that a mining company using public land for its operations must prevent undue and unnecessary degradation of the land and provide a plan for reclamation of the disturbances. The details of this general requirement have been expanded in various BLM Instruction Memorandums.

As part of its Reclamation Permit Application, Cortez Gold Mines has prepared a reclamation plan for the Proposed Action. The Cortez reclamation plan is intended to comply with the applicable BLM and NDEP regulations and policies and is generally designed to provide a post-mining condition of the affected land which would support the land uses identified in the BLM's Shoshone-Eureka Management Plan (RMP). The proposed post-mining land uses include wildlife habitat, livestock grazing, open space, dispersed recreation, and mineral exploration and development. The methods proposed to achieve these land uses are intended to meet Cortez's general reclamation goals including: prevention of slope instability, control of soil erosion and sediment transport, reduction of visual impacts, restoration of surface hydrology patterns, minimization of safety impacts, revegetation of disturbed surfaces, and establishment of diverse and perennial vegetation communities.

The BLM and Cortez have agreed to a bond variance for the 1992 Plan of Operations. All planned surface disturbances proposed (i.e., engineered) in the Plan of Operations would be bonded per the NDEP/BLM Memorandum of Understanding. The Bond Determination Letter would be issued by the BLM Battle Mountain District Office at the Record of Decision. Cortez has submitted a reclamation plan and bond to the BLM that identifies all disturbance at the entire Cortez mine site that occurred before January 1, 1981, and disturbance after that date. The bond and plan covers reclamation of all mine disturbance that has occurred after January 1, 1981, that is not associated with the Expansion project or this Proposed Action.

The specific reclamation procedures that would be conducted are described in the following subsections. These procedures are subject to modification by the BLM, in consultation with other applicable state and federal agencies and with Cortez. Areas disturbed to accomplish reclamation of proposed activities are shown on Figure 2.2-2. Cross sections of the proposed reclamation are shown in Figures 2.2-4 and 2.2-5.

Topsoil Removal and Stockpiling

The quality and depths of soils vary from place to place. The existing vegetation and topsoil would be removed with conventional mining or earthmoving equipment prior to disturbance for mining operations and stockpiled in designated locations for future use during reclamation. The topsoil resource that is currently anticipated to be available in the areas proposed for new disturbance is approximately 3.2 million cubic yards, assuming a 12-inch soil thickness. An additional 2.0 million cubic yards is available in the newly disturbed areas as supplemental topsoil for the Cortez Mine Expansion. The actual amount available would be determined during topsoil stripping operations and would be controlled by the depth of the topsoil horizons and the practicality and safety limitations of removing the topsoil with standard earthmoving equipment (Table 2.2-5).

Topsoil stockpiles would be located away from active mining operations and would be protected from disturbance or erosion. All stockpiles would be marked with signs to prevent their disturbance by mining operations. The surfaces of the stockpiles would be constructed to slopes no steeper than 2.5 horizontal to 1 vertical to reduce erosion. A cover crop of Ephraim crested wheatgrass and cereal rye would be seeded in the fall following construction of the stockpiles to stabilize their surfaces from wind and water erosion. Diversion channels and/or berms would be constructed around the stockpiles as needed to prevent erosion from overland runoff.

<u>Demolition of Facilities</u>

At the completion of all operations, the mining and mineral processing facilities would be dismantled and salvaged. This demolition would be done in an organized fashion to reduce additional disturbance; eliminate long-term health, safety and environmental impacts; and maximize the salvage value of the facilities and equipment.

Mobile mining equipment would be removed from the site by Cortez. Salvageable equipment such as crushers, conveyors, silos, roasters, mills, tanks, pumps, switchgear, transformers, classifiers, filters, kilns, retorts, furnaces, laboratory equipment, and office equipment and furnishings would be sold in place and removed from the site. After salvageable equipment was removed from the site, recyclable metal materials in the facilities would be removed by the demolition contractor, temporarily stored, and removed from the site.

Prior to demolition, all fuels, reagents, and chemicals in storage or use at the facilities would be treated on site or safely packaged and handled according to the applicable regulations. Residues of cyanide or other toxic chemicals in equipment or on surfaces would be treated prior to demolition.

Heap Leach and Tailing Facility Closure

A facility combining heap leach and tailing components is proposed. This facility would consist of an arrangement of cells containing only heap leach material, only tailing material, and both heap leach and tailing material. A continuous synthetic liner would underlie the entire facility, but each cell would be hydraulically isolated from the adjacent cell. A final closure plan would be prepared and submitted to NDEP upon termination of operation of each cell.

The heap leach cell would be decommissioned in accordance with NDEP regulations and guidance for closure. As the termination of operations for a heap leach cell was approached, the amount of leach solution in the system would be gradually reduced through evaporation until the point of termination was reached. The spent heap would then be allowed to drain to the connected solution ponds, and all leach solutions containing gold would either be recycled for use in an active heap leach cell, evaporated, treated in the ponds with a cyanide destroying reagent, or pumped out and recycled to the mill, where the solutions could be used for continued leaching. The spent leach cell would then be allowed to rest undisturbed for about 4 months to allow the WAD and **free cyanide** compounds to degrade naturally.

After the final cell completed an initial rest period, the solution system of the heap leach/ tailing impoundment facility would be used to circulate fresh water through the heap. As the water was evaporated through spraying, additional fresh water would be added to the system. This would continue as long as the concentrations of free and WAD cyanide in the returns from the heap were still decreasing. The goal would be to achieve the standards contained in the NDEP permits for the leach facilities. If these standards could not be met after a reasonable amount of rinsing, the water volume in the circulation system would be reduced by evaporation, and the heap would be allowed to rest again for a few months. Rinsing with fresh water would be reinitiated after this second rest period, and rinsing would proceed until the applicable NDEP rinsate standards were met. If the results of the second rinsing indicated that the NDEP standards could not be met, alternate decommissioning procedures would be discussed with the NDEP.

Decommissioning of the tailing cell and composite heap leach-tailings cell would be in accordance with NDEP regulations and the approved closure plan (Figure 2.2-5). The freely draining design of the cells would promote tailing desiccation. The conceptual method for closing cells in which tailing material is impounded would involve placement of low-permeability cover material graded to minimize infiltration. Embankment **freeboard** would be removed and the final contour of each cell would promote runoff. These factors should allow closure of the tailing cells within the range of chemical stability expected for this material. It is likely that sufficient alluvial overburden material would be available during the mining sequence to allow for concurrent reclamation of tailing cells.

When draindown of the entire heap leach/tailing impoundment facility had been achieved, the final amount of water in each of the solution ponds would be evaporated. All equipment and piping would be removed, and buildings and structures would be salvaged or demolished. The sludge in the bottoms of the solution ponds would be allowed to dry out, and representative samples would be obtained to determine the chemical characteristics of the sludges. The sludges would be handled according to the NDEP permits for the leach pads, and in conformance with NDEP regulations for solid waste handling. Depending on the characteristics of the sludges, they would either be left in the ponds and buried in place, removed and placed on top of the leach facilities, or removed and placed in a permitted landfill.

The pond liners would either be removed and disposed of in a permitted landfill, or they would be removed from the sides of the ponds and folded into the pond bottoms. The ponds would then either be filled with earth and/or breached in a controlled manner to prevent accumulation of water. The surface of the regraded ponds would blend in with the surrounding terrain.

As a concurrent reclamation effort, topsoiling (using alluvial overburden) and seeding of embankment slopes during the mining sequence is planned. This would allow revegetation success to be monitored and refinements made prior to final reclamation. The typical overall slope would be approximately 2.5 horizontal and 1.0 vertical.

The low-permeability caps would be topsoiled to a depth of 24 inches to provide sufficient water-holding capacity for the shallow-rooted seeded vegetation.

Runoff from upgradient sources would be rerouted around the reclaimed leach facility in stable open channels. Maintenance of erosion control and sediment control facilities as required would be conducted until the reclamation of the leach facility was considered to be complete. Monitoring wells around the heap leach/tailing impoundment facility would be maintained until Cortez was released of this requirement by the NDEP. These wells would then be plugged and abandoned according to the requirements of the State Engineer.

Waste Rock Dumps Reclamation

The waste rock dumps would be constructed by end-dumping the waste rock from the outer face of the dumps which would produce a slope of about 1.3 horizontal to 1 vertical. The tops of the dumps would be constructed with a slight slope from the outer edge to the back so that runoff from the tops of the dumps would not drain onto the outer slopes.

When operations on a waste rock dump were terminated, it would be reclaimed to meet certain general objectives including: stable slopes, reduced slope erosion, **mass stability**, rounded edges, revegetated surfaces, and control of sediment. The specific reclamation methods proposed to meet these objectives are described below. Waste dump reclamation at Pipeline would disturb an additional 81 acres. Additional disturbance would result from slope reductions, as shown in Figure 2.2-4.

The outer slopes would be irregularly contoured to achieve natural looking overall slopes ranging from 2.0 to 3.0 horizontal to 1 vertical with a rounded crest to produce a more natural appearance. The actual slope of reclaimed waste rock dumps would be dependent upon results of stability analyses. The upper level surfaces of the dumps would be scarified to break up compaction but would not be regraded. All waste rock dump slopes would be constructed such that they satisfy mass stability requirements, would not sustain undue erosion, and could be effectively revegetated as required by the BLM and the NDEP. The area affected to accomplish reclamation depicted in Figure 2.2-2 is based on the reclamation of 2.5 horizontal to 1 vertical. Steeper slopes would result in a reduction in the area affected to accomplish reclamation.

The long-term stability of waste rock dumps are analyzed from an engineering standpoint to determine if they would be stable over time and under seismic activity. Waste rock dump designs are also compared with similar facilities that have been stable over a long period of time.

When waste rock dumps are engineered, a factor of safety is determined which indicates how stable they will be under a given set of conditions. A factor of safety of less than 1.0 is considered potentially unstable while a factor of safety greater than 1.0 is considered stable. The engineering condition under which a waste rock dump is analyzed would vary from site to site due to such factors as soil conditions underneath the proposed facility and the earthquake (seismic) potential of the area.

As waste rock dumps were constructed, the rock and soil would be allowed to stand at its natural angle or approximately 38°. Waste rock dumps constructed at the natural angle will typically have safety factors of 1.1 under normal conditions and 0.9 if seismic conditions occur. This means that the outer surfaces under normal conditions would be stable; however, earthquake activity would cause outer surfaces to become unstable. Such instability would produce small failures or slides of material along the outer edges.

Upon reclamation of the waste rock dumps, outer slopes would be flattened to a 2.5 horizontal to 1 vertical or less. This reduction in the slope would have the effect of increasing slope stability from a factor of safety of 0.9 under seismic conditions to a safety factor of 1.8, a stable slope.

Reclamation on Pipeline waste rock dumps would be conducted concurrently with regular mine operations. As areas of the waste dump reached their ultimate height, a lift of alluvium and/or topsoil waste material would be spread across the dump and be used as a revegetation growth medium.

Material in the waste rock dumps to be reclaimed under this proposed action are not expected to produce acid in amounts exceeding the **neutralizing potential** of the waste rock. This conclusion is based on the lack of evidence of acid generation in any of the existing waste rock extracted during the deposit exploration. The **acid generating potential** of waste rock generated as a result of the proposed action would be monitored during mining. Waste rock would be characterized according to final closure procedures set forth by the NDEP.

As part of the reclamation process, all of the surfaces of the waste dumps would be uniformly covered with the available topsoil and revegetated to the standards identified in the "Revegetation" section that follows.

It is not expected that ponds would be necessary to control sediments in runoff downstream of the waste disposal facility. However, sediment ponds would be installed if necessary.

Road Reclamation

The Proposed Action is located in a fairly flat basin with roughly a 2 percent grade towards the center of the valley; therefore, large cut and fills for road construction would not be necessary. However, there would be some small cut and fills and it could be necessary to build some berms for safety. These slopes would be reclaimed in a manner described below.

The side berms would be regraded to blend with the general shape of the road. Where the road was located on fill, the side slopes would be rounded and regraded to 2.5 horizontal to 1 vertical. Where the road was built on a side hill cut and fill, the fill material would be pulled back against the cut to produce a more natural appearance. Compacted surfaces of the road would then be scarified and the available topsoil would be uniformly spread over the regraded surfaces. The regraded and topsoiled areas would then be revegetated.

During regrading, any culverts would be removed and stream crossings would be opened to restore their natural flow capacities. Dikes and ditches that would no longer be required would be regraded. Runoff on the road surface would be controlled with waterbars and turnouts to reduce erosion. The spacing of these features would be as follows: 2-5%:100 feet; 6-10%:75 feet; +10%:50 feet.

Open-Pit Reclamation

Mining of the Pipeline deposit would result in an open-pit excavation to a depth of approximately 650 feet below the existing water table. Pit wall slopes would range from 38 to 60 degrees, depending on rock type and geotechnical considerations. Ongoing geotechnical and slope movement monitoring studies would be used to evaluate safety of pit wall slopes. The water table, depressed during operations, would recover when mine dewatering ceased and an artificial lake would form. Post-mining use of the pit lake would depend upon the actual conditions which existed at closure with respect to land status, water quality, access, and public safety.

NDEP regulations prohibit, as the result of open-pit mining below the water table, creation of an impoundment which has the potential to degrade groundwater. The NDEP requires that a predictive evaluation be provided for ultimate pit lake hydrodynamics and water chemistry as part of the permit application. A plan to characterize conditions and model the potential pit lake would be submitted to NDEP. It is not expected that pit lake water quality would be significantly degraded from the baseline water quality due to low reactivity expected in the host rock.

Slope dewatering and in-pit pumping would stop when the pit is completed, and groundwater would be allowed to enter and accumulate within the pit. A slope under hydrostatic conditions — i.e., where there is no flow — has the same factor of safety as a completely drained slope comprised of the same material. This is because the resultant of boundary pore pressures on each slice in a stability analysis is vertical, and the total unit weight is simply replaced by the buoyant unit weight for the analysis. Therefore, slope behavior after flooding should be similar to the behavior of completely depressurized slopes during pit development.

Slope stability during pit flooding would depend on material types and inflow rates. In the relatively competent cap and footwall waste rocks, groundwater inflow is not expected to significantly influence rock slope stability. Once the pit has been flooded back to the current groundwater level, all slopes are expected to be stable.

A characterization and monitoring program would be proposed to refine the pit lake model during operations. A post-mining monitoring plan would be proposed with the goal of demonstrating non-degradation of groundwater quality. Based on current information, degradation of the post-mining pit water quality is not expected to occur during either the short term or long term (Section 4.4.2).

During final reclamation, the open-pit crest area would be bermed and an outboard fence would be installed to control access by people, livestock, and most wildlife. Live streams would not discharge to the open pit because of surface diversions discussed below. Recreation would not be allowed, and no game fish would be stocked.

The pit wall slope(s) at closure are proposed to be those which exist at the cessation of mining. Pushdown or selective blasting to lay back pit walls and reduce final slope angles is not proposed. Pit design has employed conservative wall slopes; consequently, pit wall sloughing as the result of water table recovery is not anticipated but would be controlled by governing the inflow rate using dewatering well siphoning methods.

Surface Water Control

The reclamation of the Cortez facilities would include attention to natural drainage patterns and long-term stability of any permanent drainage alterations.

Smaller drainages that would be altered with road construction would be restored to a through-draining condition similar to their natural configuration. Culverts would be removed and drainage alterations no longer required for the post-mining condition would be regraded. Major storm water diversion structures would be left in place and reclaimed in such a manner as to eliminate long-term maintenance. Diversion of surface water from the open pit would be accomplished by leaving the primary storm water diversion structure in place and constructing secondary perimeter berms and/or ditches. Solution ponds and raised impoundments would be graded to promote site drainage and prevent collection of surface water.

Erosion and Sediment Control

The goals of erosion and sediment control efforts during reclamation would be to prevent topsoil from being lost off site through erosion, to store available water in the form of soil moisture thereby enhancing revegetation efforts, and to prevent degradation of downstream water quality.

Runoff from the reclaimed waste rock dump, tailings and heap leach facility, and other slopes would occur only as a result of direct precipitation on them; there would be no upstream contributing areas. The slopes would generate minimal or negligible runoff due to the increased water-holding capacity of the regraded and topsoiled surfaces, and their gentler slopes. Any runoff that did occur on the slopes has the potential to erode the surface and carry this material to the base of the slopes. Most of the eroded material would be deposited near the base of the slopes on the more gradual natural terrain. Some of the runoff from the slopes would be collected in the ephemeral drainage channels below the toes of the slopes where silt fences or hay bale sediment traps would be constructed to collect any sediment. These would be maintained in operating condition after reclamation construction until the reclamation of the slopes was considered by the BLM to be completed.

Topsoiling and Surface Preparation

During grading operations, the graded surfaces would be left in a loose, uncompacted state. Compacted surfaces not requiring regrading would be scarified to a minimum depth of 8 inches to loosen compacted materials. Any scarifying or ripping operations would be conducted along the contour whenever possible.

At the time of reclamation the topsoil would be sampled and analyzed for soil fertility characteristics including pH, conductivity, phosphorus, potassium, iron, zinc, and nitrogen. The topsoil spreading would be done in such a manner as to leave the finished surface in a rough, irregular configuration. Contour furrowing, discing, pitting, or dozer basins would be used as appropriate to increase moisture retention and reduce soil erosion. This would result in a hummocky surface which would create small microslopes and depressions with numerous aspects. This micro-topography would enhance the storage of runoff, provide for numerous microclimates to help establish colonies of plants, and encourage repopulation of the reclaimed areas by small mammals and reptiles.

Revegetation

All of the reclaimed surfaces would be revegetated to control runoff, reduce erosion, provide feed for wildlife and livestock, and reduce the visual impacts. Seed would be spread with either a rangeland drill or with a broadcaster, depending upon accessibility. Seeding rate would be approximately 16.5 lbs pure live seed (PLS)/acre where drilled and approximately 33 lbs PLS/acre where broadcast methods were used. Seedbed preparation and seeding would take place in the fall after grading and topsoiling of reclaimed areas.

The seed mixture that would be applied upon reclamation is shown in Table 2.2-6. It reflects the goals of the post-mining land uses of grazing and wildlife habitat by providing forage and cover species similar to the pre-disturbance conditions. In addition, the vegetation's effectiveness in providing erosion protection; the ability to grow within the constraints of the low annual precipitation experienced in the region; its suitability for site aspect; and the elevation and soil type have also been considered in determination of the seed mix.

Revegetation would be considered a success when the Disturbed Site Plant Community (DSPC) has achieved 50 percent of the perennial plant cover of the adjacent undisturbed communities. The DSPC would be a desert shrub community based on plant species derived from the native adjacent communities that can be purchased commercially and are compatible with common revegetation practices. The revegetation success would be assessed cooperatively by Cortez and the BLM after two growing seasons, using approved methods, prior to release of the bond in whole or part. See Appendix F for details of revegetation standards and bond release criteria.

Boundary fences (3- or 4-strand barbed wire), built to BLM standard specifications, would be erected around reclaimed areas to exclude livestock grazing on the reclaimed areas until vegetation was re-established and approved by the BLM.

Exploration Activities

There have been many drill holes installed in the Cortez area of operations during the course of exploring for and developing the ore bodies, environmental monitoring of leach pads and tailings pond cells, and water supply wells. Upon termination of all operations, and release from monitoring obligations by the NDEP, all drill holes and wells would be plugged in accordance with State regulations, NRS 534.420 to 534.428.

Exploration roads and pads involving cut and fill construction would be contoured by placing fill material into the cuts. The last part of the replaced fill typically would be topsoil material. Where cuts for road construction would be over three feet deep, the topsoil materials would be salvaged prior to cuttings. The salvaged topsoil materials would be placed on the regraded fills during reclamation. Reseeding with the specified seed mix would follow contouring.

All water wells would be plugged by a licensed well driller. Drill holes that were not wells would be plugged by a qualified driller. Plugging would consist of introducing drill cuttings, bentonite or cement as required by the regulations. Any casings protruding above the ground would be cut off below the ground surface and surface caps would be placed in the tops of the holes.

Reclamation Surety

Cortez has prepared a detailed estimate for the reclamation work included in this proposed action. The cost estimate reflects the potential contractor costs for each of the components of the reclamation as well as supervisory and administrative costs for the BLM and its engineering contractor. The total amount of the cost estimate is $6,580,804.

The surety to be posted by Cortez would be in a form acceptable to NDEP and BLM and would be held by the BLM.

2.2.8 Applicant-committed Practices

Control of Fugitive Dust from Roads and Disturbed Surfaces

Roads and disturbed surfaces within the mining and processing areas would be watered and if necessary treated with a dust suppression chemical. Magnesium chloride has been used effectively in the past by Cortez, and similar measures would be taken to control fugitive dust from the Proposed Action.

Sediment Control

Temporary sediment traps would be installed as necessary in the drainages in the Proposed Action area to limit sediment movement. Flow dissipation and sediment control structures would be constructed in the diversion ditches at appropriate locations. Small sediment dams, designed for catching runoff and storing sediment from exposed and erodible surfaces, would be built prior to construction start-up in each area where they are deemed necessary. These structures would be maintained and cleaned out as often as necessary for as long as erodible surfaces were exposed. Small check dams and hay bale dams would be placed below slopes as temporary erosion control measure until revegetation was sufficiently established to provide a stabilized slope condition. In addition to the use of check dams, hay-bale dams, silt fences, and matting could be installed at strategic locations to limit sediment migration.

<u>Spill Prevention and Containment Plan</u>

Cortez has developed a detailed spill prevention plan as required by the NDEP to mitigate the potential impact of fuel and chemical spillage in the Proposed Action area. Containments to prevent migration of spills and physical methods of neutralization and control would be used in the event of a spill. The plant site is designed to have secondary containment structures in the areas where potentially hazardous materials are stored or used. Heap leach process areas would also be lined and graded to drain into the pregnant solution pond.

In the unlikely event of a spill escaping the containment facilities, the following steps would be taken:

- The source of the spill would be immediately controlled and the shift foreman would be immediately notified;
- The shift foreman would investigate the spill, take those actions which are both appropriate and safe to stop the discharge at source and contain the spill, and report the conditions to the mill superintendent and/or other designated company officials as soon as possible, who would notify the appropriate agencies of a reportable spill;
- The facility would be repaired and returned to operation as soon as possible;
- The contaminated material would be excavated to the extent practical and tested for the level of contamination, and disposed of in accordance with State and federal requirements;
- The area would then be contoured and reclaimed;

- Remediation of a reportable spill would be reviewed for approval prior to and upon completion by all appropriate agencies.

A copy of the Emergency Response Plan which addresses hazardous materials and other emergencies is included in Appendix G.

Human Health, Safety, and Emergency Response Training

Operations conducted by Cortez Gold Mines for the Proposed Action would be subject to the Federal Mine Safety and Health Act of 1977 (MSHA), which sets forth mandatory safety and health standards for surface metal and nonmetal mines. The purpose of these standards is the protection of life, promotion of health and safety, and prevention of accidents. MSHA regulations are codified under 30 CFR Subchapter N, Part 56.

Training. All employees of Cortez Gold Mines are required to receive, at a minimum, the training outlined in Table 2.2-7.

All employees receive 24 hours of new hire training, 8 hours of which includes chemical orientation. All employees also receive 8 hours of annual refresher training.

Emergency Preparedness. Those employees dealing directly with process chemicals, reagents, or exposed to chemical hazards receive an additional 16 hours of specific task training involving handling safety, protective equipment, and emergency procedures.

Currently at Cortez there are 31 certified First Responders who have been trained in the proper handling and treatment of chemical exposure victims. In addition, there are 10 employees having at least 80 hours of training for the types of emergencies specific to Cortez operations--this group forms the Emergency Response Team (ERT). Each member of the ERT group has a minimum of 8 hours training in hazardous materials response specific to the Cortez operation. Two ERT members, one being the Mine Safety Coordinator, have 24 hours of HAZMAT response training.

Cortez meets or exceeds current MSHA and Nevada State requirements for emergency preparedness and training; however, the program is designed to address the known chemical hazard potential and emergency response scenarios specific to the operations conducted on property controlled by Cortez Gold Mines for which direct responsibility is established. Cortez would provide assistance in responding to off-site spills, hazards, or emergencies only at the direction of the authorized Local Emergency Response Official.

Human Health and Safety. MSHA regulates and enforces mine safety. There are numerous provisions for identifying hazards and maintaining safe working conditions. Warning signs, access control, and machine guards are examples of provisions which must be in place where required. Cyanide use areas are well marked and access is strictly controlled and restricted to trained personnel.

Sampling/testing equipment is available on-site to monitor for personal exposure to hazardous or toxic emissions characteristic of specific work areas such as the assay laboratory or refinery. Employees assigned to work areas of potential emissions exposure are subject to blood and urine tests on a quarterly basis or more frequently where necessary. For routine and unplanned maintenance, individual vessel entry procedures are established to assure safe access and working conditions.

SARA Title III Reporting

The Nevada Legislature, has provided the Nevada State Fire Marshall with the authority and responsibility for SARA Title III compliance for the Nevada mining industry. For mine operations, it is not necessary to complete SARA Title III reporting and annual fee requirements as long as the State Fire Marshall permit is properly and accurately maintained.

Using the 1994 permit form as an example, only Item 2 of the Hazardous Substance Information Financial Worksheet need be addressed. This assumes that the initial permit requirement of hazardous chemical inventory, reporting, and site map location is kept current.

Information has been provided in Appendix G which contains the regulatory background on Hazmat Management, SARA Title III Reporting, Nevada State Fire Marshall authority/ permitting, and an example of the Nevada State Hazmat permit and chemical inventory/site description information that would be completed when the proposed action becomes operational.

Monitoring

Monitoring of the proposed facilities would be composed of two components. The first is designed to monitor water quality that could be affected by the operating systems. This plan is intended to comply with Nevada Division of Environmental Protection requirements. A summary of the draft monitoring plan for NDEP requirements is included in Appendix E. Basic objectives of the plan include:

- The manner in which water quality within the area of potential effect is adequately described prior to and throughout the proposed period of mine operations and closure;

- The location, identification, and description of proposed site monitoring and leak detection points;

- The effectiveness of the monitoring system with respect to process component integrity;

- The protocols for sampling at each point; and

- The analytical profile proposed for use in evaluating the sample.

Water quality monitoring would include:

- Water quality of individual wells;

- Composite mine discharge; and

- Hydrochemical parameters for existing wells or springs that show water level change of more than 10 feet in response to infiltration.

The second component is the Surface and Groundwater Monitoring Plan provided to the Nevada State Engineer. A summary of the plan is also provided in Appendix D. The objective of this plan is to provide more detail on the activities proposed for monitoring at the dewatering operation and corresponding hydrologic effects. Descriptions are provided in Appendix E for alluvial monitoring well locations to establish pre-pumping groundwater conditions and to monitor for potential effects from mine dewatering drawdowns.

Groundwater and surface water would be monitored so that early indication of mine dewatering effects on groundwater supplies and surface water features would be possible. This would be accomplished by routine monitoring of: 1) existing and proposed wells; 2) designated surface water features (springs and seeps); and 3) future wells located as necessary based on the results of operational monitoring.

As discussed in Section 4.0, springs and seeps may potentially be impacted by mine dewatering depending upon the magnitude of drawdown occurring in the vicinity of the surface water feature and the extent to which the aquifer undergoing drawdown in hydraulically connected to the surface water feature. Designated springs and seeps that have been identified for baseline monitoring (Appendix D) would continue to be monitored and compared to the baseline conditions in order to detect hydrologic variations. Water level changes of more than 10 feet in existing or proposed wells completed in hydrostratigraphic units common to a seep or spring that shows decreased flow would indicate the need for a detailed hydrogeologic investigation. Hydrogeologic monitoring of existing, proposed, and future wells would provide a positive indication of the onset of drawdown in hydrostratigraphic units common to the designated spring or seep. Where hydrogeologic investigation has established that hydraulic connectivity exists between the surface water feature of concern and the aquifer undergoing drawdown, and hydrogeologic monitoring positively indicates that significant drawdown will develop in the vicinity of the surface water feature of concern, adjustment of the infiltration system would be required to effectively offset the expected drawdown by redistributing aquifer recharge. Correlation of monitoring well data with spring and seep data would also assist in explaining or verifying the cause of observed variations.

In addition to the objectives listed above, a major objective of this monitoring plan is to identify detectable changes in flow from a surface water feature before vegetation or wildlife species are affected. Mitigation measures to replenish surface water features, i.e., infiltration ponds, are discussed in Section 4.0.

2.3 REASONABLY FORESEEABLE PROJECTS

Certain additional mine development activities are anticipated but are not scheduled for development under the Proposed Action. These are presented in Section 5.0 in order to describe reasonably foreseeable projects which need to be considered as potential contributors to cumulative impacts.

2.4 PROJECT ALTERNATIVES

In accordance with NEPA guidelines, the No Action Alternative is addressed in this DEIS. The objective of the No Action Alternative is to describe the environmental consequences that would result if the Proposed Action is not implemented, in order to assist EIS readers with the evaluation of the consequences from the Proposed Action.

In addition to the No Action Alternative, other alternatives to the Proposed Action include various options for location and operation of project components. Project components considered include dewatering system, waste dumps, location and operation of a new heap leach/tailings impoundment facility, and a new 5,000-ton-per-day ore processing facility with support facilities.

The range of alternatives considered consists primarily of operational alternatives for project components rather than location alternatives for the entire project because the feasibility of the project depends upon processing facilities being located relatively close to the orebody. In this alternative evaluation, the following factors were considered: public or agency issues/concerns, technical and economic feasibility, potential environmental advantage, and ability to meet the purpose and need stated by the applicant.

Based on the screening of project component alternatives, no feasible alternatives were retained for detailed analysis. After a description of the No Action Alternative, the sections below discuss the reasons that various operational alternatives considered were eliminated from detailed analysis.

2.4.1 No Action Alternative

Under the No Action Alternative, Cortez would not develop the Pipeline orebody as presently defined. Cortez would continue to mine gold at the Cortez and Gold Acres mine sites until those orebodies were exhausted. For purposes of this EIS, the No Action Alternative would result from the BLM's disapproval of Cortez' 1992 Plan of Operations. However, other circumstances, such as a drop in gold prices or the application of some future legislation, could also potentially result in mine closure.

2.4.2 Alternatives Eliminated from Detailed Consideration

2.4.2.1 Project Component Alternatives

Five operational alternatives were evaluated to examine technical, environmental, and economic feasibility (Cortez Pipeline Project Pre-Feasibility Study, Placer Dome Inc., December 1992). These are discussed below.

Alternative 1. Alternative 1 would involve construction of a new 5,000-ton-per-day mill at the present Cortez millsite instead of adjacent to the new open-pit mine near Gold Acres. Support facilities would be required at both the Cortez millsite and the Pipeline minesite. A new truck shop/warehouse, mine operations office, and changehouse would be constructed near the mine. The present Cortez administration office would continue to be used; however, a new assay lab would be constructed at the Cortez site. A new tailings storage facility would be required at the Cortez site as well. As with the Proposed Action, a new 120-kV transmission line would also be required to provide power to the mine, mill, and mine dewatering activities. Roast ore would be treated the same as the Proposed Action, but a new stand-alone heap leach facility would be built at the Pipeline site.

This alternative does not reduce environmental impacts but has the potential to increase the severity of various environmental impacts. For example, the location of groundwater is perhaps 40 to 50 feet below the surface in acceptable tailings dam sites at Cortez, while at the Pipeline deposit area, the water table is 200 feet below the surface. As a result, there would be more potential for groundwater impacts at the Cortez site. Also, the generation of haul-road dust and vehicle emissions would be greater for Alternative 1 because of the 14-mile round trip required for hauling.

From an economic standpoint, developing a new mill 7 miles from the orebody at the Cortez millsite would produce extra operating costs not required for the Proposed Action. Ore haulage would produce extra operating costs, as well as require extra haulage trucks. Also, the positioning of the office, assay lab, and other support facilities at the Cortez site would produce logistics inefficiencies in running the operation.

__Alternative 2.__ Alternative 2 involves a development similar to Alternative 1 except that the present 2,000-ton-per-day Cortez mill would be refurbished and expanded to a throughput of 5,000 tons per day. However, this option does not allow the simultaneous operation of the Cortez roaster/mill and a 5,000-ton-per-day mill, as does Alternative 1.

Similar to Alternative 1, environmental impacts such as risk to groundwater and fugitive dust emissions would be greater in magnitude than for the Proposed Action. Operating and hauling costs would also be higher, as discussed for Alternative 1.

__Alternative 3.__ Alternative 3 would include the refurbishment of the Cortez mill operating at 2,000 tons per day. Support facilities would be built at both the mine site and the Cortez millsite similar to Alternative 1. A heap leach facility would still be constructed near the mine, and the 120-kV transmission line would still be required to power the mine and dewatering operations.

Environmental impacts are the same as for Alternatives 1 and 2. In addition, Alternative 3 was economically not feasible due to the low milling rate that could not generate a cash flow that would offset the high upfront capital required to develop the open pit mine. Refurbishing the Cortez mill would require a mill shutdown of 12 to 15 months, and developing a new mill 7 miles from the orebody would produce extra operating costs not required for Alternative 1.

__Alternative 4.__ Alternative 4 would also involve the refurbishment of the Cortez mill to allow processing of 2,000 tons per day. High-grade oxide ore (>0.150 oz Au/T) would be fed to the mill, while lower-grade oxide ore (>0.050 oz Au/T <0.150 oz Au/T) would be crushed and heap leached at an average rate of 3,000 tons per day. Hence, the mine schedule would still call for an ore production rate of 5,000 tons per day. A heap leach for lower-grade ore would also be operated as in the other alternatives. Support facilities would be identical to those required for Alternatives 1, 2, and 3. In addition, a crushing and agglomerating plant would be constructed at the heap leach site to crush the higher-grade heap leach ore and convey the material to the leach pad.

Environmental impacts would be similar to Alternatives 1, 2, and 3. However, there would be additional disturbance and reclamation requirements because of expanded heap leach operations. Heap leaching as proposed in Alternative 4 presents more economic risk due to uncertainty of gold recovery when compared to milling. In addition, operating and hauling costs would be greater, as discussed for Alternatives 1, 2, and 3.

Alternative 5. Alternative 5 involves the development of an underground mine that would feed a refurbished 2,000-ton-per-day Cortez mill. The underground mine would be accessed by a shaft and utilize a trackless mining method. Support facilities would be constructed at the shaft site and at the Cortez millsite. A hoist house, changehouse/office, and small shop would be constructed at the shaft site. At the Cortez millsite, a new assay lab would be constructed. A new 120-kV transmission line would also be required in this option to power the mine dewatering wells and the underground mine.

Alternative 5 does not meet the purpose and need of the applicant and would not be developed by the applicant because of the degree of economic risk and limitations on the development of the whole orebody due to high mining costs. It is therefore equivalent to the No Action Alternative.

2.4.2.2 Alternatives for Discharge of the Pumped Water

Six alternatives for discharge of pumped water from pit dewatering were considered. Reasons for elimination from further consideration are given below based on the report by Water Management Consultants "Preliminary Characterization of Groundwater Conditions and Dewatering Pre-Feasibility," May 1992, and BLM analyses of a proposal by the Town of Crescent Valley.

__Alternative 1__. Alternative 1 would involve re-injection of pumped water into bedrock along the Shoshone range front. Water would be piped from the mine site to a re-injection wellfield located along the range front some 3 to 4 miles from the pit. Water would be distributed to an array of 600-foot-deep wells. The wellfield would be roughly at the same elevation as the mine site. Although this alternative would be acceptable to the State Engineer and would limit to some degree the impact of pumping within the bedrock, it was eliminated from further consideration for the following reasons:

- High maintenance
- Would not be effective in reducing the impact (drawdown) on the Basin Fill aquifer (alluvium)
- Less efficient and more energy intensive to operate
- Larger area of long-term surface disturbance
- Relatively high reclamation/abandonment costs
- May require the operation of a remote power source for backwashing
- Water from the backwash may require secondary discharge
- High energy and economic cost

__Alternative 2__. Alternative 2 would involve re-injection of pumped water into alluvial deposits via a wellfield. Water would be piped from the top of the east wall to a re-injection wellfield located some 4 to 5 miles to the east of the Proposed Action. The pipeline would fall from an elevation of around 5,040 feet at the mine site to an elevation of around 4,900 feet at the re-injection wellfield. Water would be distributed to an array of 400-foot-deep wells. This alternative would also be acceptable to the State Engineer, would limit open water surface, and would more directly control recharge to the alluvial system. However, it was eliminated from further consideration for the following reasons:

- Potential operating difficulties
- Larger area of long-term surface disturbance
- Relatively high reclamation/abandonment costs
- May require the operation of a remote power source for backwashing
- Water from the backwash may require secondary discharge
- High overall cost

Alternative 3. Alternative 3 calls for discharge of pumped water to surface waters. The discharge water would be conveyed by means of a canal/ditch to the drainage at the low point of the valley. It would ultimately flow northward, pooling in the play areas located along the axis of Crescent Valley. This alternative would be inexpensive and low maintenance. However, this alternative was eliminated from further consideration for the following reasons:

- It is not acceptable to the State Engineer or other agencies because it would not be efficient in recharging groundwater
- Erosion and land use impacts could occur
- Evaporation rates would be increased
- There are possible long-term (post-mining) implications of having to supply water to secondary users

Alternative 4. In Alternative 4, discharge water would be conveyed by means of a ditch/canal to an area considered suitable for agricultural development. The area would be at a lower elevation than the mine site. A reservoir would be constructed at the end of the canal and the water would be pumped into a distribution/irrigation system. This alternative would provide profit from sales and would have a lower overall operating cost. However, this alternative was eliminated from further consideration for the following reasons:

- It would not account for all of the discharge water

- It is of little value during the winter months

- A major commitment/investment is required for agricultural development

- Availability of water could not be assured during the post-mining period

- It is not acceptable to the State Engineer, unless the scheme were to incorporate the transfer of existing water rights

Alternative 5. In Alternative 5, discharge water would be conveyed by means of a ditch/ canal to an area some 6 to 10 miles from the mine to a site which would be suitable for development of a wetlands area. The area of development would probably be around 6 to 8 square miles. About 5 to 6 miles of berm would have to be constructed to impound the water. Consideration could also be given to combining a wetlands development with a re-infiltration scheme. This would reduce the size and cost of the wetlands. The alternative could be implemented at a relatively low cost, would provide short-term benefits to wildlife, and would have low reclamation/abandonment costs. However, this alternative was eliminated from further consideration for the following reasons:

- It is not acceptable to the State Engineer because it does not effectively maintain the basin water balance

- Evaporation rates and water loss would be high

- There are long-term (post-mining) implications, including no practical way to maintain water supply once dewatering has ended

Alternative 6. Several citizens of the Town of Crescent Valley proposed that the water produced from the dewatering be piped to the Indian Creek Canyon area north of the Proposed Project. The water would be impounded by a dam proposed to be constructed at the mouth of the canyon. Several people suggested the dam would need to be 400 feet high. The BLM considered the proposal, but did not analyze this alternative in detail for the following reasons:

- The State Water Engineer's permit/approval of the dewatering project permits Cortez to use only that water incidental to mining. The remaining water is required by the State Engineer to be returned to the basin it originated in. Thus, the Town's proposal does not comply with Cortez' permit to dewater.

- There are extensive private property holdings in the Indian Creek drainage. The length of time to negotiate and purchase these inholdings (mixed with Public Lands) would not fit Cortez' proposed mine schedule. The Town's people did not propose a funding source for the BLM to make these purchases.

- It is likely that extensive cultural resources exist along Indian Creek. Mitigation associated with recording or archiving these resources could be time consuming and financially prohibitive..

- The Town's people made no proposal for Cortez or the BLM to provide a continued source of water to the dam/recreation site after mine closure. Pumping costs would be substantial. The Town provided no proposed funding source to keep the pumps going (or for their maintenance) after mine closure.

- The geotechnical suitability of a very large dam (estimated by townsfolk to be 400 feet high) has not been provided for. The delay associated with such a study does not fit Cortez' proposed mine schedule, nor did the Town propose a funding source for such a complex, time-consuming study.

- Geotechnical studies for the proposed inundated area have not been provided for. There is no assurance that the proposed dam would hold water.

- The Shoshone-Eureka Resource Management Plan does not provide for such a recreation site development. A Land Use Plan Amendment at the Environmental Impact Statement level would likely be required for such a project. This level of Land Use Plan Amendment would likely take 2 to 4 years to complete. No funding for completion of such a Land Use Plan Amendment has been requested or is anticipated by the BLM. Implementation of the proposal could not go forward until the Plan Amendment was completed. Again, this schedule would not meet Cortez' proposed timeframes.

Therefore, this alternative was not considered in any detail.

TABLE 2.1-1

SUMMARY OF PLANS OF OPERATIONS AND ENVIRONMENTAL ANALYSIS DOCUMENTS FOR CORTEZ GOLD MINES 1981-PRESENT
(Page 1 of 3)

Plan date	Plan Case File No. General Location BLM Administration	Description of Operation	Prop. Acres	Environ. Assessment No./ROD	Plan Approval Date	Comments and Remarks
3-30-81	N64-81-001P Cortez Mine/Cortez Canyon BLM-Battle Mtn	East pit, Horse Canyon pit, waste dumps, heap leach pad, leach ponds, mill, tailings disposal, lab, shop, 17 mile haul road + other ancillary facilities.	1857	N64-EA1-47 by Neal Brecheisen, BLM Geologist	8-11-1981 Letter of Authorization on post 1981 disturbance.	Existing operation when 3809 regulations became effective. Cortez submitted a plan of operation as required by regulations.
5-10-84	N64-81-001P Amendment #1 Cortez Mine/Cortez Canyon BLM-Battle Mtn	Construction of additional tailings cell/pond and surrounding access roads, monitoring wells.	105	Undocumented	10-22-86	Phone conversation records in case file indicate Area Manager verbal approval 10-22-86
8-86	N14-81-001P Horse Canyon/Mt Tenabo BLM-Elko	South Extension pit, South Silicified pit, waste dumps.	55.8	Undocumented	10-16-86 Letter of Authorization	
3-19-87	N14-81-001P Amendment #1 Horse Canyon/Mt Tenabo BLM-Elko	Access and drill road construction and drilling.	5			
8-12-87	N64-87-010P Cortez Canyon/Pixie area BLM-Battle Mtn	construction and drilling.	10	N64-EA7-46 by Ahmed Mohsen, BLM Geologist	10-26-87 Letter of Authorization	Exploration activities were conducted under Notices up to then. An exploration Plan was required for Cortez' exploration and assessment work on unpatented mining claims.
8-17-87	N64-87-010P Amendment #1 Gold Acres area/N.Shoshone BLM-Battle Mtn	Exploration:Access and drill road construction and drilling	5	N64-EA7-57 by Ahmed Mohsen, BLM Geologist	9-28-87 Letter of Authorization	Additional exploration activities on claims held by Cortez.
11-9-87	N64-87-010P Amendment #2 Gold Acres area/N. Shoshone BLM-Battle Mtn	Exploration:Access and drill road construction and drilling	1	N64-EA8-13 by Ahmed Mohsen, BLM Geologist	12-3-87 Letter of Authorization	Additional exploration activities on claims held by Cortez.
11-19-87	N64-87-010P Amendment #3 Cortez Canyon area BLM-Battle Mtn	Exploration:Access and drill road construction and drilling	1	N64-EA8-16 by Ahmed Mohsen, BLM Geologist	12-14-87 Letter of Authorization	

TABLE 2.1-1

SUMMARY OF PLANS OF OPERATIONS AND ENVIRONMENTAL ANALYSIS DOCUMENTS FOR CORTEZ GOLD MINES 1981-PRESENT

(Page 2 of 3)

Plan date	Plan Case File No. General Location BLM Administration	Description of Operation	Prop. Acres	Environ. Assessment No./ROD	Plan Approval Date	Comments and Remarks
5-10-88	N14-81-001P Horse Canyon/Mt Tenabo Amendment #1 BLM-Elko	Exploration:Access and drill road construction and drilling	1	Undocumented		Additional exploration activities on claims held by Cortez
5-17-88	N64-87-010P Amendment #4 Cortez Canyon area BLM-Battle Mtn	Exploration:Access and drill road construction and drilling	1	N64-EA8-65 by Ahmed Mohsen, BLM Geologist	6-13-88 Letter of Authorization.	Additional exploration activities on claims held by Cortez
6-13-88	N64-87-010P Amendment #5 Cortez Canyon area BLM-Battle Mtn	Exploration:Access and drill road construction and drilling	1	N64-EA8-83 by Ahmed Mohsen, BLM Geologist	8-16-88 Letter of Authorization	Additional exploration
6-29-88	N14-81-001P Amendment #2 Four Mile area/Mt Tenabo BLM-Elko	Exploration:Access and drill road construction and drilling	1.32	Undocumented	Letter of approval	
7-12-88	N14-81-001P Amendment #3 Upper Mill Cy/Mt Tenabo BLM-Elko	Exploration:Access and drill road construction and drilling	1	Undocumented	8-2-88 Letter of approval	
7-18-88	N64-87-010P Amendment #6 Cortez Canyon/Pixie area BLM-Battle mtn	Access and drill road construction and drilling	12	N64-EA8-91 by Ahmed Mohsen, BLM Geologist	10-3-88 Letter of Authorization	
10-6-88	N64-86-001P Amendment # 2 Gold Acres Mine/N. Shoshone BLM-Battle Mtn	Expansion of waste dumps and processing of old leached ore piles.	Undocumented	N64-EA9-11 by Ahmed Mohsen, BLM Geologist	11-25-88 Letter of Authorization	Extension of waste dumps and remaining of old ore stockpiles
1-23-89	N64-81-001P Amendment #2 Cortez Mine/Cortez Canyon BLM-Battle Mtn	Development of the ADA 52 deposit and pit and waste dump expansion.	75	N64-EA9-34 by Ahmed Mohsen, BLM Geologist		

TABLE 2.1-1

SUMMARY OF PLANS OF OPERATIONS AND ENVIRONMENTAL ANALYSIS DOCUMENTS FOR CORTEZ GOLD MINES 1981-PRESENT

Plan date	Plan Case File No. General Location BLM Administration	Description of Operation	Prop. Acres	Environ. Assessment No./ROD	Plan Approval Date	Comments and Remarks
4-19-89	N64-87-010P Amendment #7 Cortez Canyon/Pixie area BLM-Battle Mtn	Access and drill road construction and drilling.	5	N64-EA8-91 by Ahmed Mohsen, BLM Geologist	5-2-89 Letter of Authorization	Previous plan proposed 12 acres; only 7 were conducted. Cortez shifted remaining acreage to an adjacent location that is of similar affected environment.
4-27-89	N64-81-001P Amendment #3 Cortez Mine area F-Canyon project BLM-Battle Mtn	Mining F-Canyon pit and waste dumps.	60	N64-EA0-17 by Ahmed Mohsen, BLM Geologist	2-8-90 Letter of Authorization	Development of the F-Canyon pit to increase amount of oxide ore to mill until roaster comes on line.
11-29-88	N64-87-010P Amendment #8 Cortez Canyon area BLM-Battle Mtn	Access and drill road construction and drilling	10	N64-EA9-25 by Ahmed Mohsen, BLM Geologist	3-14-89 Record of Decision	A 1500-acre exploration target under Cortez' control was identified. Programmatic EA to cover exploration activities as submitted by Cortez and approved by BLM.
5-3-90	N64-87-010P Amendment #9 Cortez Canyon+Gold Acres area BLM-Battle Mtn	Access and drill road construction and drilling	5	Tiering on existing EA for the project area	9-17-90 Record of Decision	Administratively determined to be within the scope of previously prepared EAs for the project area.
1-90	N64-87-1010P Amendment #10 Cortez and Gold Acres area BLM-Battle Mtn	Expansion - tailings, heap leach, open pit expansion	428	N64-EIS3-54	9-20-93 Record of Decision	EIS required by BLM for Expansion activities.

TABLE 2.2-1

SUMMARY OF PROPOSED DISTURBANCES (ACRES)

Area	Total Disturbance[a]
PROPOSED DISTURBANCE:	
Waste Disposal Area	586
Additional Disturbance (Disposal Area Reclamation)	81
Tailing/Heap Leach Facility and Process Solution Ponds	440
Open Pit	241
Dewatering Infiltration Ponds	126
Plantsite	80
Public Road Relocation	72
Haul Roads	41
Runoff Diversion	33
Light-Vehicle Access	24
Gold Acres Haul Road Expansion	46
Carbonaceous Stockpile	8
Soil Stockpiles	20
CIL Stockpiles	82
Total	1,880[b]

[a] Exploration disturbance would occur at about 12 acres per year during the early years of the project. Based on concurrent reclamation of the mineral exploration disturbance, a maximum of 48 acres would be unreclaimed at any one time. This amount would be in addition to the proposed disturbance of 1,880 acres.

[b] Of the total amount of surface disturbance, 52 acres have been previously disturbed by the old Gold Acres operations.

TABLE 2.2-2

OPEN-PIT MINE MOBILE EQUIPMENT

Unit	Number
Electric Shovels (30 yd^3)	2
Front Loaders or Hydraulic Shovels (25 yd^3)	2
Haul Trucks (180-190 ton)	11-15
Drills (50,000 lb)	4-5
Track Dozers	4
RTD Dozers	1
Graders	2
Water Trucks	2
Loaders (13 yd^3)	1

TABLE 2.2-3

CHEMICAL REAGENTS USED FOR MILLING AND HEAP LEACH OPERATION

Reagent	Form
Sodium Cyanide	briquette
Sodium Cyanide	liquid
Lime	pebble
Baroid	liquid
Caustic Soda	granule
Sodium Hypochlorite	liquid
Hydrogen Peroxide	liquid
Sulfuric Acid	liquid
Sodium Carbonate	pebble
Flocculent[a]	powder
Hydrochloric Acid	liquid
Sodium Hydroxide	liquid

Note: Sodium hypochlorite, hydrogen peroxide, and sulfuric acid are used as neutralizers and are kept onsite in cases of emergencies.

[a] Flocculants used include Thatcher Polymer T-Floc, A-830, Nalco Nuclear 9708, DULV Flocculant D8D.

TABLE 2.2-4

WORKFORCE DURING CONSTRUCTION PERIOD

Job Type	Average	Peak
Management/Supervision	50	65
Mine Development	100	110
Construction	135	200
TOTAL	285	375

TABLE 2.2-5

TOPSOIL BALANCE - PIPELINE PROJECT

Facility	Acreage	Soil Map Unit[a]	Topsoil Depth (inches)	Salvage Volume (cy)[b]	Seedbed 12 inches deep (cy)	Net Volume (cy)[c]
Pit	23	5a	20	61,844	0	+61,844
	77	Bk	24	248,453	0	+248,453
	141	ML	0	0	0	0
Waste Dumps	574	Bk	24	1,852,107	926,054	+926,053
	12	Wr	24	38,720	19,360	+19,360
Reclamation	68	Bk	24	219,413	109,707	+109,706
	8	Wr	24	25,813	12,907	+12,906
	5	A	24	16,133	8,067	+8,066
Tailings/Heap Leach[d]	200	Bk	24	645,333	645,333	0
	220	Wr	24	709,867	709,867	0
Process Pond[d]	20	Bk	24	64,533	64,533	0
Infiltrate Ponds	126	Wr	24	406,560	203,280	+203,280
Plantsite	72	Bk	24	232,320	116,160	+116,160
	8	Wr	24	25,813	12,907	+12,906
Public Road Relocation	72	N/A[e]	0	0	0	0
Haul Roads	·41	Bk	24	132,293	66,147	+66,146
Runoff Diversions	8	Wr	24	25,813	12,907	+12,906
	25	Bk	24	80,667	40,334	+40,333
Light Vehicle Access	24	N/A[e]	0	0	0	0
Gold Acres Haul Road Expansion	45	Bk	24	145,200	72,600	+72,600
	1	Wr	24	3,227	1,614	+1,613
Carbonaceous Ore Stockpile	8	Bk	24	25,813	12,907	+12,906
CIL Stockpile	42	Bk	24	135,520	67,760	+67,760
	20	6a	20	53,778	32,267	+21,511
	17	5a	20	45,711	27,427	+18,284
	3	ML	0	0	4,840	-4,840
Topsoil Stockpiles	20	N/A[e]	0	0	0	0
Exploration[f]	12 12/year	N/A[e]	0	0	0	0
Subtotal	1,892			5,194,931	3,166,978	2,027,953
Totals[g]				4,675,438		1,825,158

[a] Soil map units are described in Section 3.3.
[b] Salvage operations may result in a topsoil loss of 10 percent.
[c] Stockpiled growth medium not used in reclamation of the Pipeline Project (i.e., "left-over" growth medium).
[d] Calculations indicate a topsoil depth of 24 inches over an impermeable cap.
[e] N/A - Areas which would not require growth medium salvage or placement.
[f] Exploration disturbance would occur at about 12 acres per year during the early years of the project. Based on concurrent reclamation of the mineral exploration disturbance, a maximum of 48 acres would be unreclaimed at any one time.
[g] These totals reflect the decrease in topsoil by the 10 percent salvage loss.

TABLE 2.2-6

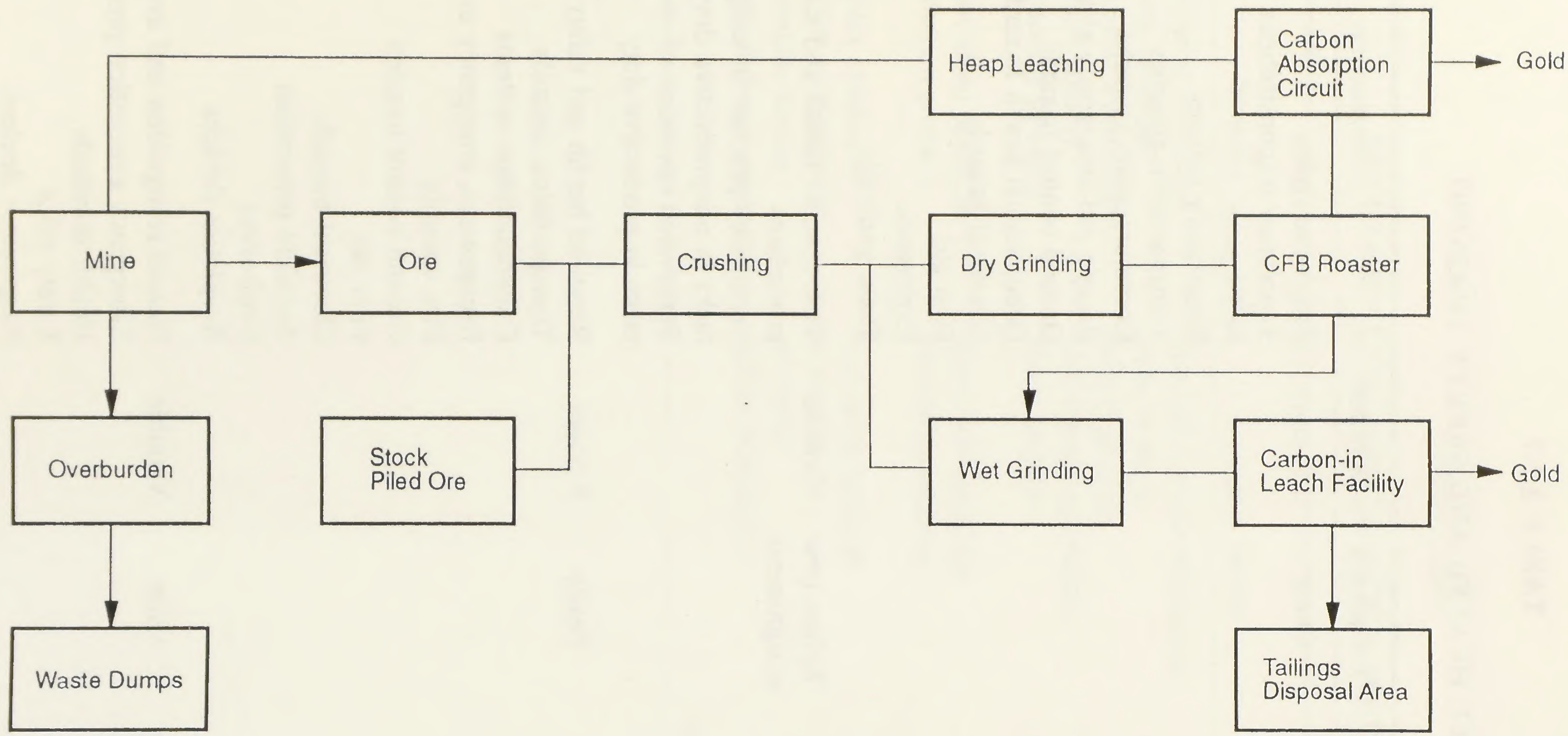
RECOMMENDED REVEGETATION SEED MIXTURE

Species	Common Name	Pure Live Seed (lb/acre)
Agropyron cristatum	ephraim crested wheatgrass	2.0
Elymus cinereus	basin wildrye	2.0
Oryzopsis hymenoides	Indian ricegrass	1.0
Sitanion hystrix	bottlebrush squirreltail	1.0
Sporobolus airoides	alkali sacaton	0.5
Sphaeralcea ambigua	desert globemallow	1.0
Penstemon palmeri	Palmer penstemon	1.0
Atriplex canescens	four-wing saltbush	2.0
Atriplex confertifolia	shadscale	2.0
Ceratoides lanata	winterfat	2.0
Chrysothamnus nauseosus	rubber rabbitbrush	2.0
	Total	16.5

TABLE 2.2-7

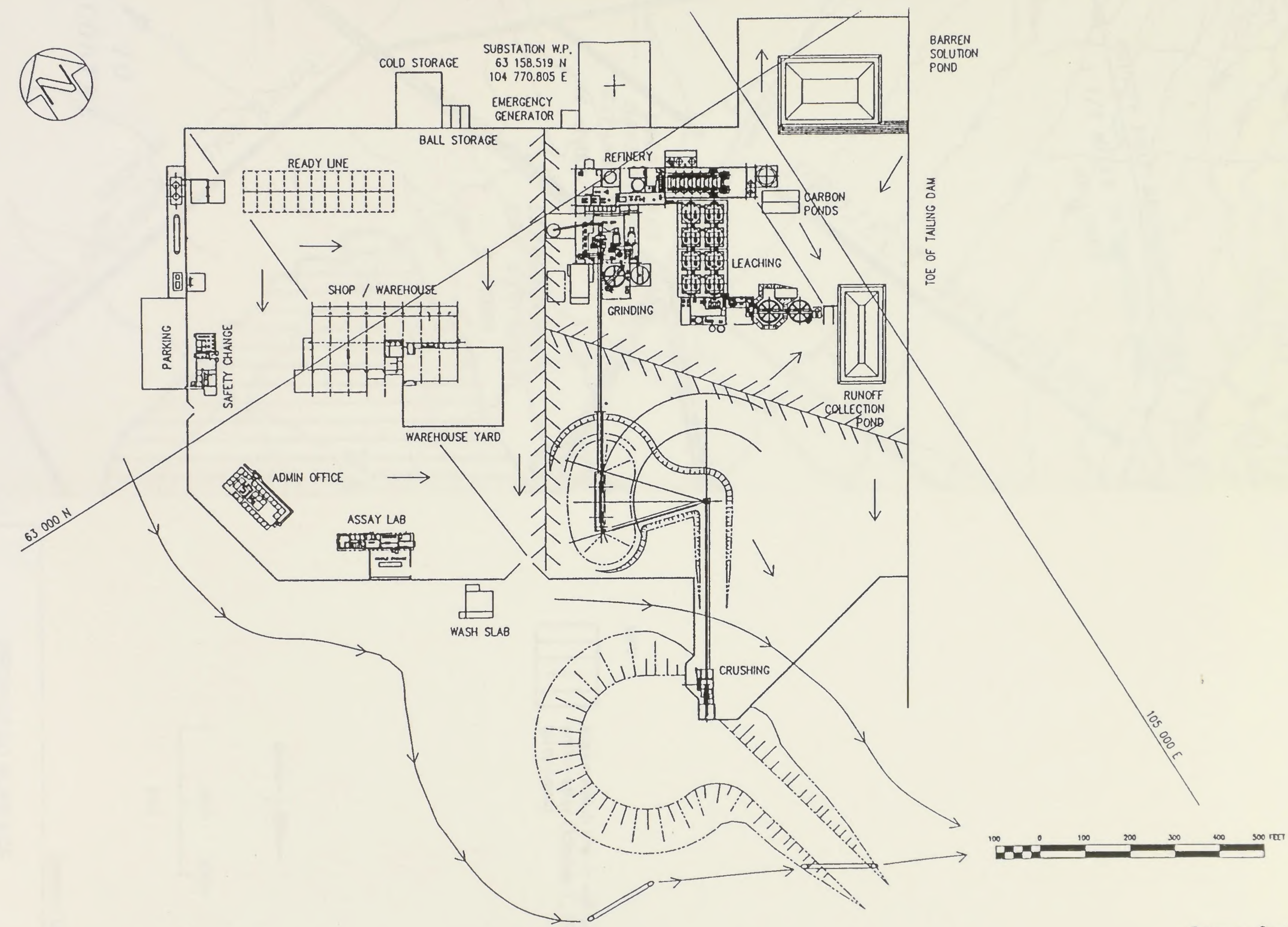
EMPLOYEE HEALTH AND SAFETY TRAINING

Course	Personnel	Frequency	Duration	Instruction
New-hire training	All new hires exposed to mine hazards	Once	24 hours	Employee rights Supervisor responsibilities Self-rescue Respiratory devices Transportation controls Communication systems Escape and emergency evacuation Ground control hazards Occupational health hazards Electrical hazards First aid Explosives Toxic materials
Task trainer	Employees assigned to new work tasks	Before new assignments	Variable	Task-specific health and safety procedures Supervised practice in assigned work tasks in nonproductive duty Supervised operation of assigned work tasks in productive duty
Refresher Training	All employees who received new-hire training	Yearly	8 hours	Required health and safety standards Transportation controls Communication systems Escapeways, emergency evacuations Fire warning Ground control hazards First aid Electrical hazards Accident prevention Explosives Respirator devices
Hazard Training	All employees exposed to mine hazards	Once	Variable	Hazard recognition and avoidance Emergency evacuation procedures Health standards Safety rules Respiratory devices



Reference: Water Management Consultants (1992a)

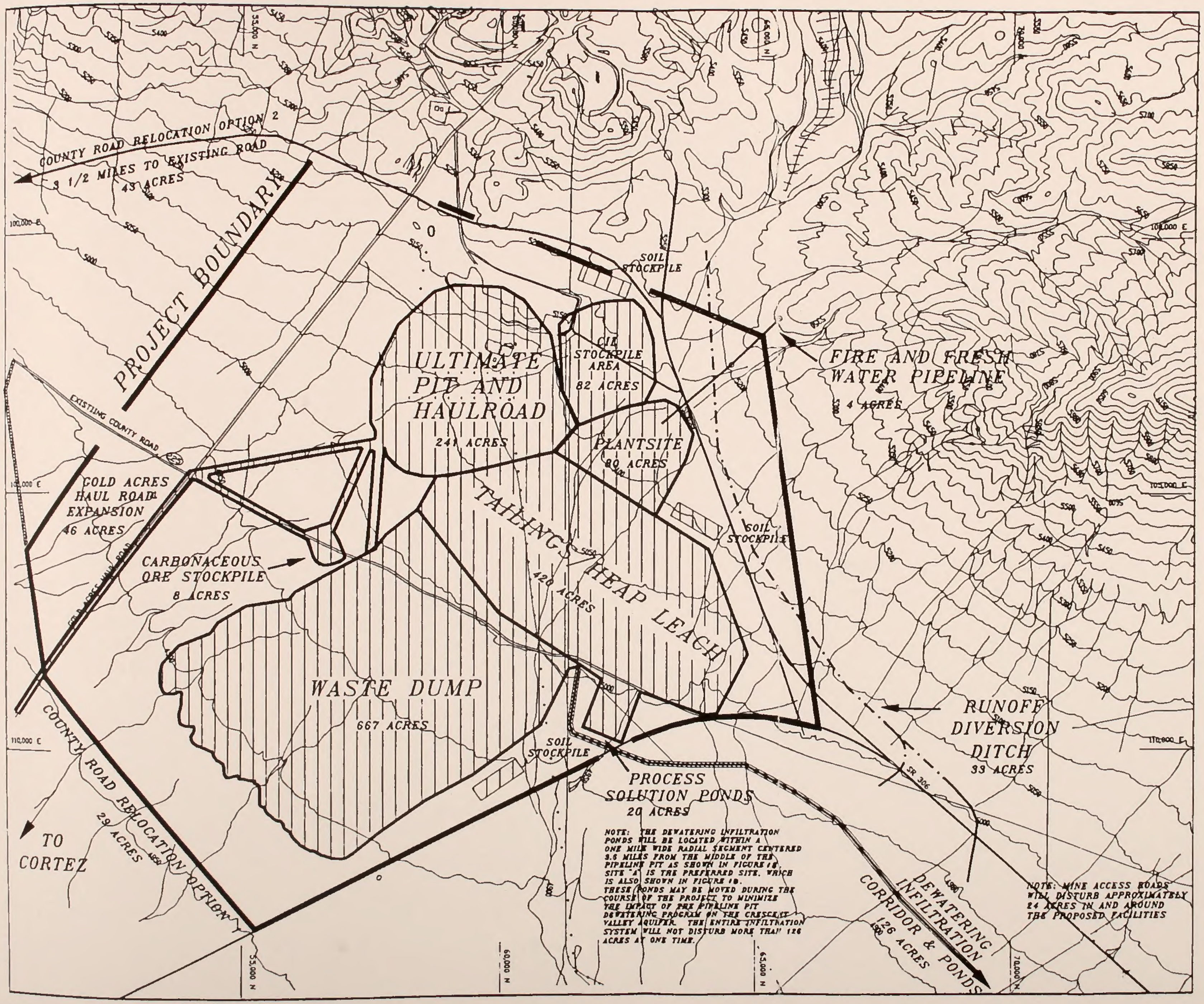
Project No. 92C0756A	Pipeline Deposit EIS	SIMPLIFIED GOLD PRODUCTION PROCESS	Figure 2.0-1



Source: Cortez Gold Mines

Project No. 92C0756A	Pipeline Deposit EIS	PROPOSED PLANT SITE PLAN	Figure 2.2-1

92C0756A-0010/110493



KEY

Areas which are or will be active after October 1, 1990 (proposed)

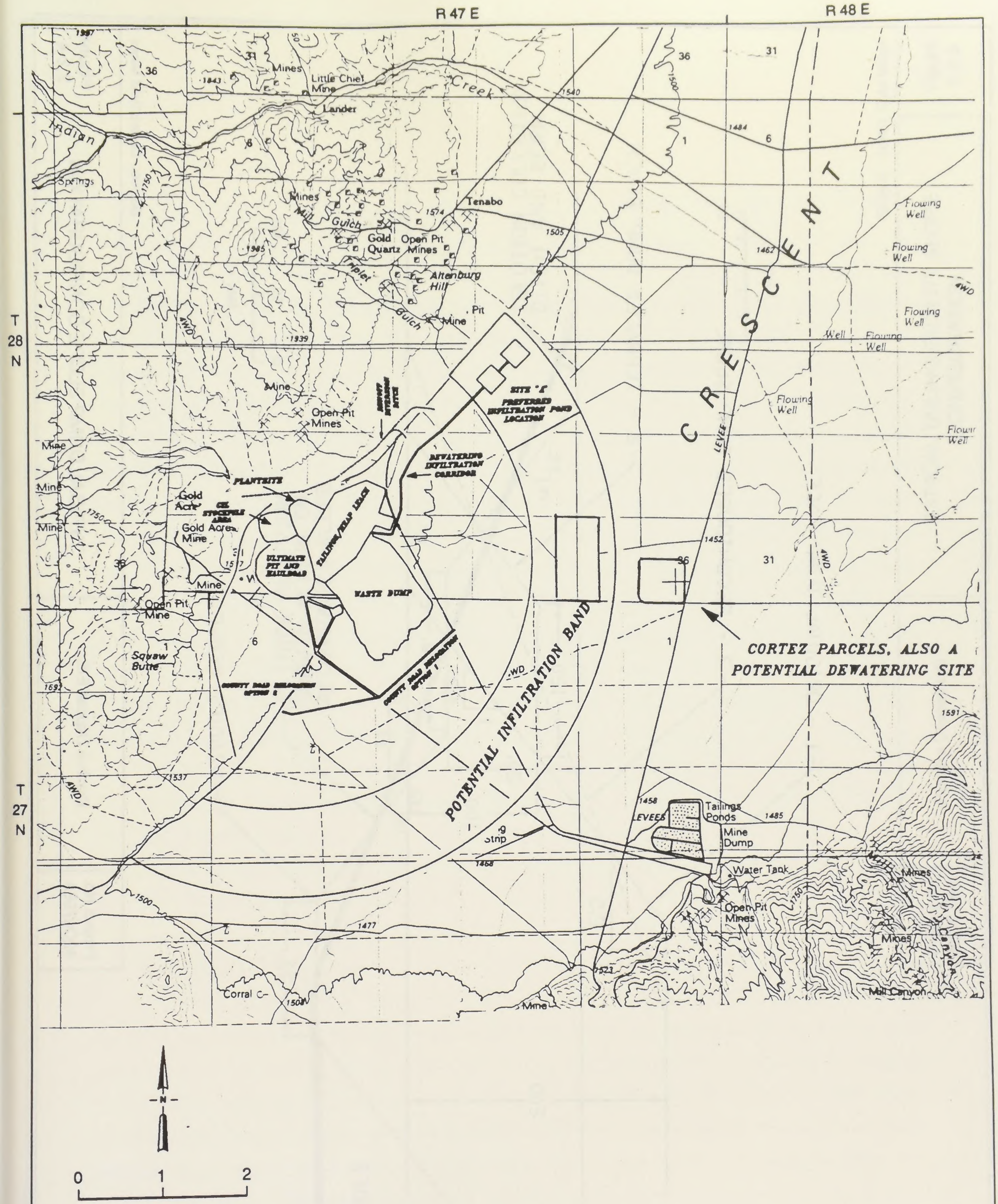
0 1000 2000

feet

Source: Cortez Gold Mines

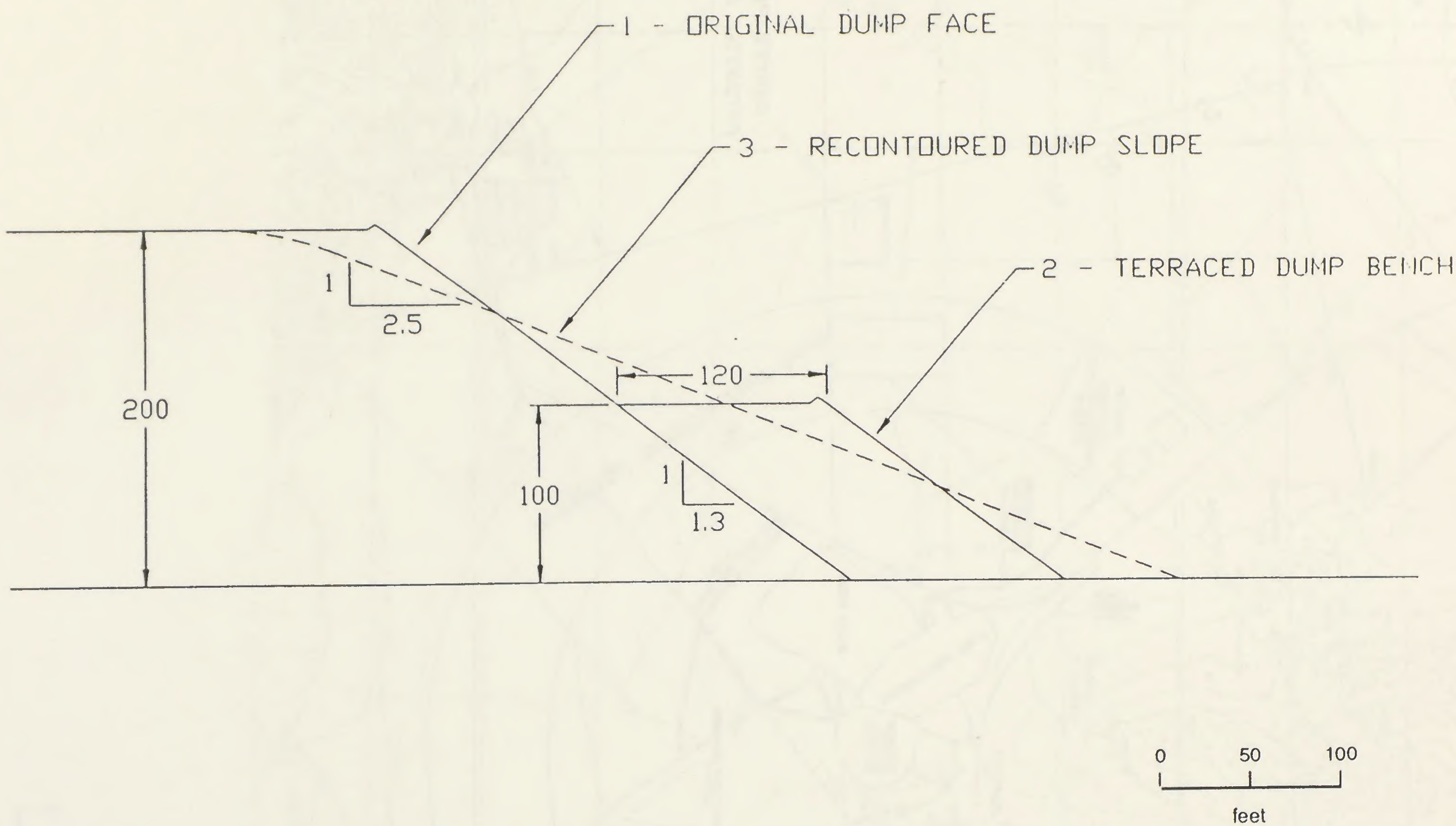
PROPOSED SURFACE DISTURBANCE AREAS	Figure 2.2-2
Project No. 92C0756A	Pipeline Deposit EIS

92C0756A-0010/110493



Source: Cortez Gold Mines

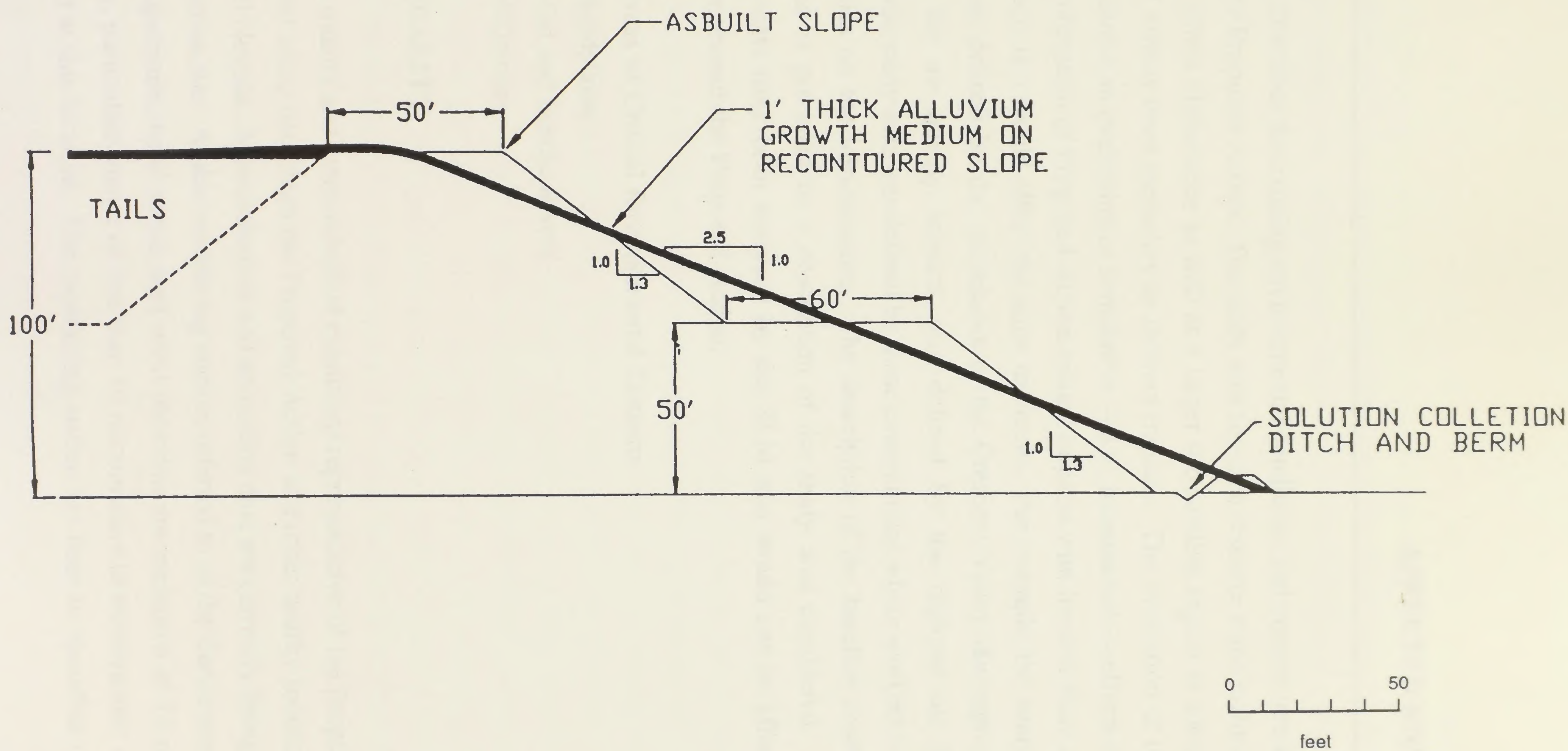
Project No. 92C0756A	Pipeline Deposit EIS	PROPOSED DEWATERING INFILTRATION GALLERY LOCATIONS	Figure 2.2-3



Source: Cortez Gold Mines

Project No. 92C0756A	Pipeline Deposit EIS	TYPICAL DUMP SLOPE CONFIGURATION	Figure 2.2-4

92C0756A-0010/110493



Source: Cortez Gold Mines

Project No. 92C0756A	Pipeline Deposit EIS	TYPICAL TAILING FACILITY SLOPE CONFIGURATION	Figure 2.2-5

92C0756A-0010/110493

3.0
AFFECTED ENVIRONMENT

This section describes the existing environmental conditions and present trends in the general vicinity of the Proposed Action. The study area for each resource topic includes the locations of proposed direct disturbance as well as a larger surrounding region to adequately evaluate the potential effects from secondary or indirect impacts. The evaluation of this surrounding region also allows an evaluation of cumulative — i.e., incremental — effects that could result from the combination of Proposed Action-related impacts with impacts from other mining or related projects that would affect the same resources. For example, the study area for water resources was defined by the boundaries of the Crescent Valley Hydrographic Basin; the study area for air quality impacts was defined by the regional air basin; and the socioeconomic study area was defined by those communities where workers would reside and place demands on the infrastructure. The description of the baseline conditions for each resource area is preceded by a description of the study area considered. The following critical elements have been analyzed by the BLM and would not be affected or are not present in or around the Proposed Action:

- Areas of Critical Environmental Concern
- Floodplains
- Wild and Scenic Rivers
- Wilderness

3.1 AIR QUALITY

Baseline air quality and meteorological conditions representative of the Proposed Action area were assessed using data from the Proposed Action and other nearby monitoring stations in north-central Nevada. Meteorological and air quality data are currently being collected at the Proposed Action site. At this monitoring station, referred to as the Cortez monitoring station, ambient temperature, wind speed, and wind direction are measured at 10 meters (33 feet). Additionally, particulate matter of less than 10 micrometers in aerodynamic diameter (PM_{10}) is monitored at this location. The monitoring station has been in operation since June 1992.

3.1.1 Study Area

The Proposed Action site is located in north-central Nevada, approximately 80 miles southwest of Elko, in Lander County. The Proposed Action site is located 2 miles east of the active Gold Acres open-pit mine, and just north of the haul road that connects the Gold Acres pits to the Cortez mill. The Proposed Action site is located near the southwestern end of the Crescent Valley (Figure 1.1-2).

The air quality study area used for evaluation of potential impacts is defined as the Crescent Valley Air Basin, which includes the area bounded by the crest of the Shoshone Range and Tuscarora Mountains to the north and west and the crest of the Toiyabe and Cortez mountains to the south and east. This is also the area defined as Hydrographic Basin 54. Air basins are defined as areas over which airflow is unimpeded by major topographical barriers.

3.1.2 Climate

The climate of the Proposed Action region is characterized by arid-to-semiarid conditions, with bright sunshine, low annual precipitation, and large daily ranges of temperatures. The climate is controlled primarily by rugged and varied topography to the west; in particular, the Sierra Nevada Range. The prevailing westerlies move warm, moist Pacific air over the western slopes of the Sierra Nevada Range where the air cools, condensation takes place, and most of the moisture falls as precipitation. As the air descends the eastern slope, compressional warming takes place and very little precipitation falls.

The closest sources of long-term meteorological data are National Weather Service stations located in Winnemucca and Elko, Nevada. Winnemucca Station is located approximately 70 miles northwest of the Proposed Action site, while the Elko Station is about 55 miles northeast of the Proposed Action site. Based on a review of long-term data from these two stations (USDC 1987), which cover a 30-year period (1958-1987), there do not appear to be significant differences in annual climatological data between the two stations (Table 3.1-1). Therefore, the closer Elko Station was selected as being representative of long-term diameter conditions in the Proposed Action region.

Located in the Humboldt River Valley of northeastern Nevada, the Elko Station is at the Municipal Airport, 1 mile west of town, at an elevation just above 5,000 feet. Several mountain ranges with many peaks near or exceeding 10,000 feet dominate the landscape, but the immediate terrain consists of sagebrush-covered valleys and low foothills, the highest of which are approximately 2,500 feet above station elevation.

Temperature

Owing to the high elevation and proximity of the mountains, there is a wide temperature range. High night-time radiation makes cool nights the rule even in mid-summer. At Elko Station, the annual average temperature is 46 degrees Fahrenheit (°F). The annual average maximum temperature is 63°F, and the annual average minimum temperature is 30°F. The hottest month is July, with an average temperature of 70°F. The coldest month is January, with an average temperature of 24°F. The average first occurrence of 32°F in the fall is in early September and the average last occurrence is in early June (USDC 1987).

At the Cortez monitoring station, for the period from July through December 1992, the average temperature was 55°F. The highest hourly average temperature was 96°F in August, and the lowest hourly average temperature recorded was 1°F in December.

Precipitation

The Proposed Action area is effectively cut off by the Sierra Nevada Mountains from the moisture source of the Pacific Ocean. At the Elko Station, precipitation is light, with the highest amounts falling during the winter months as snow. Summer precipitation occurs mostly as showers. Summer is typically dry, with an average relative humidity of 25 percent during the day, and 51 percent during the night. Annual average rainfall at Elko and Winnemucca is 9 inches and 8 inches, respectively. At the Proposed Action area, the annual precipitation is estimated to be about 8 inches (USDC 1987).

Winds

On an annual basis, the prevailing wind at Elko Station is from the southwest. The annual average wind speed is 6 mph. The month-to-month variation of average wind speed is small, with a lowest average value of 5 mph in October and December, and highest average value of 7 mph in April (USDC 1987).

At the Cortez monitoring station, for the period from July through September 1992, the prevailing wind was from the southwest occurring about 15 percent of the time. For the period from October through December 1992, the prevailing wind was from the west, occurring about 16 percent of the time. The average wind speed for the 6-month period was 8 mph. Table 3.1-2 provides a summary of the wind data collected at the Cortez monitoring station for July through December 1992.

Dispersion Conditions

Atmospheric dispersion is influenced by several parameters, including wind speed, temperature inversions (mixing height), and atmospheric stability. Mixing height provides an indication of the potential vertical extent of pollutant diffusion. It is a measure of the thickness of the layer of the lower atmosphere in which pollutants may freely disperse. Inversions restrict vertical movement of the air in the lower atmosphere, thereby preventing atmospheric pollutants from mixing with the air above the inversion. Lower mixing heights can be expected to produce high pollutant concentrations since the volume of air with which pollutants can be mixed is limited. Pollutant mixing in regions of lower elevations can be greatly restricted when an inversion limits the vertical mixing and surrounding terrain limits horizontal mixing. Spatial variations in mixing depth are complex depending upon local elevations and ground surface properties. Mixing heights normally increase during the day and decrease during the night.

As is typical for the weather pattern of "cold night/hot day" and sharp temperature change, the mixing height can be quite high during the afternoon due to strong convective activity mixing the air vertically throughout the lower levels of the atmosphere. Conversely, mixing heights can be quite low at night and in the morning because of night time radiational cooling, which causes surface-based or low-level inversions to form. At the Proposed Action site, the mean annual morning mixing height is estimated to be 250 feet and the mean annual afternoon mixing height is about 2400 feet (Holzworth 1972).

Another factor that can be used to assess the ability of the atmosphere to disperse pollutants is atmospheric stability. Atmospheric stability is usually expressed in terms of Pasquill-Gifford categories, ranging from Class A (very unstable) to Class F (very stable), and is a measure of the degree of atmospheric turbulence. Stable conditions will suppress atmospheric turbulence, resulting in decreased pollutant dispersion; unstable conditions will enhance atmospheric turbulence, increasing pollutant dispersion. Based on measurements taken at the Elko Station during 1989, good dispersion conditions (Classes A through D) occurred 54 percent of the time. Poor dispersion conditions (Classes E and F) occurred 46 percent of the time.

Meteorological data from Elko were used as input to the air quality modeling assessment Proposed Action emissions because these data are the nearest source of continuous wind speed and direction data. The on-site data was not used since only 6 months of data were available.

3.1.3 Air Quality Baseline Conditions

Regulatory Background

Several State and Federal air quality regulations potentially apply to the Proposed Action mining and processing operations. These include Prevention of Significant Deterioration/New Source Review (PSD/NSR), New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAPS), Standards for Permits to Construct, State air toxics regulations, and National and State Ambient Air Quality Standards (AAQS).

National and State AAQS. National ambient air quality standards for ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), total suspended particulates (TSP), and lead (Pb) were established by the U.S. Environmental Protection Agency (EPA) after the passage of the Clean Air Act of 1970. A national standard for PM_{10} was established in 1987, and a state standard for PM_{10} was established in 1991.

Nevada's ambient air quality standards are equal to or more stringent than the national standards. The state is responsible for developing a State Implementation Plan (SIP), which details how the state intends to reduce pollutant levels and bring nonattainment areas into compliance with the National AAQS. National air quality standards, both primary and secondary, and state air quality standards are listed in Table 3.1-3. The primary standards are designed to protect public health, while secondary standards are intended to prevent other adverse air quality effects, such as reduced visibility and property damage.

Air basins are classified as being in attainment of the national or state air quality standards for a particular pollutant if air quality monitoring data show ambient pollutant concentrations to be below the standard. Air basins are classified as nonattainment of national or state standards for a particular pollutant if monitoring shows ambient concentrations to be above the air quality standard. If there is no air quality monitoring for a particular pollutant, the air basin is unclassified for that pollutant, in terms of air quality standards.

PSD/NSR. In an area where air quality meets the National AAQS, a source that would emit more than 250 tons per year of those pollutants that have established AAQS (criteria pollutants) would be subject to PSD regulations. In computing the 250-ton-per-year threshold, fugitive emissions from the source or facility operation are not to be included. These regulations are intended to prevent degradation of good ambient air quality. The PSD regulations also protect Class I areas from pollutant impacts. Class I areas are generally of pristine air quality, such as national parks, monuments, and wildlife refuges. The only Class I area in Nevada is the Jarbidge Wilderness Area, which is approximately 118 miles away from the Proposed Action site. The proposed facility is not subject to PSD review, because its emissions are less than the PSD threshold.

A source of air pollution is regulated under NSR if it is to be constructed in a nonattainment area and would emit more than 100 tons per year of the nonattainment pollutant or, if located near a nonattainment area it would significantly affect the air quality of the nonattainment area. The proposed facility is not subject to NSR, because it is located in an area that is not classified as nonattainment for any of the regulated air pollutants, and would not significantly affect any nearby nonattainment areas.

NSPS. Standards of performance for stationary sources were established by the Clean Air Act of 1970. These are standards for new or modified stationary sources to achieve the best demonstrated emissions control technology. The NSPS apply to specific processes, of which the metallic minerals processing industry is one. NSPS that apply to the Proposed Action are for Metallic Mineral Processing Plants (40 CFR Part 60, Subpart LL).

NESHAPS. NESHAPS are standards of emission for seven substances: mercury, arsenic, beryllium, vinyl chloride, asbestos, benzene, and radionuclides. Although the proposed facility has sources of mercury and arsenic, it is not subject to NESHAPS regulations, as they apply to different types of specific sources (e.g., mercury ore processing). Instead, mercury and arsenic sources for the Proposed Action are subject to Nevada's air toxics regulations, discussed below.

Permits to Construct. Before a potential source of air pollution is constructed, an air quality application for potential sources must be submitted to the Nevada Division of Environmental Protection (NDEP), in order to obtain a Permit to Construct. The NDEP is the air quality permitting authority for all of Lander County. The proposed action will require permits for emission sources associated with the processing facility, in addition to permits for land disturbance.

Air Toxics Regulations. Nevada state regulations contain criteria for evaluating emissions of toxic or hazardous air contaminants from stationary sources. An air contaminant is defined as toxic or hazardous under one of two conditions: it has been assigned a Threshold Limit Value (TLV) by the American Conference of Governmental Industrial Hygienists, based on its toxic properties in humans; or it has been determined by the Director of the Nevada State Department of Conservation and Natural Resources to cause or contribute to air pollution such that exposure may result in increased mortality or irreversible morbidity.

The State has defined acceptable concentrations for toxic or hazardous air contaminants for the quality of ambient air (ACQAA) that are based on Threshold Limit Values (TLVs), or other toxic factors determined by the NDEP, divided by a safety factor. Compliance with ACQAAs must be demonstrated through ambient air monitoring and/or emission sampling and/or dispersion modeling techniques. For the existing Cortez facility, toxic air emissions of mercury and arsenic have already been addressed as part of the State's air quality permitting process and were found to be below ACQAA levels. Toxic air emissions of mercury, arsenic, or crystalline silica (quartz silica) could also occur from sources at the proposed processing facility. These are addressed in Section 4.1. Ambient standards for these toxic contaminants are listed in Table 3.1-4.

Existing Air Quality

Air quality in the Proposed Action region is governed by several factors: pollutant emissions and meteorological conditions. Meteorological factors such as wind speed, mixing heights, and atmospheric stability all affect the dilution rate of emitted pollutants, and solar radiation affects photochemical oxidant production. Frequent short-term variations of air quality usually result from changes in atmospheric conditions. Long-term variations typically result from changes in pollutants emission amounts.

The study area defined for evaluation of air quality impacts, the Crescent Valley Air Basin, is currently unclassified for all pollutants having an air quality standard. This is because there has been no ambient air quality monitoring in the Crescent Valley Air Basin. It is also classified as a Class II area by EPA for purposes of PSD air quality regulations. The Battle Mountain Air Basin, which is adjacent to the Crescent Valley Air Basin, is a federal nonattainment area for particulate matter less than 10 μm (PM_{10}). The Battle Mountain Air Basin is approximately 15 miles northwest of the Proposed Action site and is separated from the Crescent Valley Air Basin by the Shoshone Range. Modeling results from the NDEP for permitting of sources at the existing Cortez facility shows no pollutant impacts to the adjacent (Battle Mountain) Air Basin. It is therefore assumed that Cortez would not have an effect on the air quality of the Battle Mountain Air Basin.

For the Proposed Action, the primary pollutant of concern are particulates (TSP and PM_{10}). Ambient TSP or PM_{10} monitoring is not carried out by the state in the Crescent Valley Air Basin.

Ambient PM_{10} concentrations, representative of the baseline air quality in the Proposed Action area are available from the Cortez monitoring station located at the Proposed Action site. PM_{10} is measured using two co-located PM_{10} samplers. Concentration data are available for the third and fourth quarters of 1992 (July through December). Table 3.1-5 shows the measured PM_{10} concentrations, along with the average concentration for the July through December period. While only six months of monitoring data are currently available, this data should be representative of both short-term as well as annual average PM_{10} concentrations since the monitoring period included the summer season which typically has the highest concentrations.

The highest measured PM_{10} concentration was 45 μg/m^3, which occurred in July, while the average PM_{10} concentration for the period was 18 μg/m^3. These concentrations are less than the State and National AAQS for PM_{10} of 150 μg/m^3 for a 24-hour average, and 50 μg/m^3 for an annual average.

3.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

3.2.1 Study Area

The study area includes the Proposed Action area, as well as a larger surrounding area bounded roughly by the town of Crescent Valley to the north, Bald Mountain to the south, the Shoshone Range to the west, and the Cortez Mountains to the east. This study area was selected to consider the resource base that could sustain cumulative impacts due to other nearby mining projects affecting the same resources. This general discussion for each resource is followed by a description of baseline conditions for the specific mine area.

3.2.2 Geological Baseline Conditions

Rocks in the study area can be categorized into three groupings. Limestone with minor amounts of shale and quartzite were deposited in the east part of the study area and referred to collectively as the eastern carbonate assemblage (Roberts et al. 1958; Gilluly and Gates 1965). Clastic sedimentary rocks such as sandstone and volcanic rocks deposited in the western portion of the study area are collectively referred to as the western siliceous and volcanic assemblage. Rocks transitional to the eastern and western assemblages are referred to as the transitional assemblage. These three groupings underlie the large majority of the study area.

Quaternary (0 to 2 million years ago) deposits consist primarily of valley alluvium, alluvial fans that flank the mountains, and lesser playa, talus and landslide deposits. Some older alluvial gravel and sand deposits are of late Tertiary age (2 to 24 million years ago).

3.2.3 Seismic Baseline Conditions

In addition to the many flat-lying thrust faults exposed throughout the area, there are numerous high angle faults striking north, northeast, and northwest. These faults have been determined to have formed at least 360 million years ago (Gilluly and Gates 1965) with the most recent activity during Basin and Range development (12 to 15 million years ago).

The seismic zone map in the Uniform Building Code shows the Proposed Action area as zone three on a scale ranging from one (indicating less damage expected) to four (indicating the most damage expected). Table 3.2-1 shows the historic earthquake activity for a 50-mile radius around the Proposed Action area.

3.2.4 Mineral Baseline Conditions

The study area has been, and continues to be, the site of substantial mineral exploration and production in both metallic and industrial minerals. It has been a historic producer of gold, silver, barite and turquoise and lesser amounts of copper, lead and arsenic. Gravel deposits in valley alluvial fill have been worked intermittently to construct and maintain local roads and highways. To date, most of the region's mineral production comes from gold mining and barite operations.

There are three recognized mining districts located within the study area. They are the Bullion district located on the eastern slope of the Shoshone range, the Cortez-Mill Canyon district at the south end of the Cortez Mountains, and the Buckhorn district on the eastern slope of the southern Cortez Mountains. The largest historic producing mines of each district are gold mines: the Gold Acres Mine, the Cortez Gold Mine, and the Buckhorn Mine, respectively.

The various deposits within the study area occur primarily within the Battle Mountain-Eureka or Cortez Trend which trends roughly north-northwest through the study area. While the explanation for the location and extent of this mineral trend is uncertain, the trend may be spatially related to crystalline rocks at depth (Bagby and Berger 1985).

A listing of mining and exploration ventures occurring within the study area and their important characteristics is given in Table 3.2-2. Figure 3.2-1 shows the locations of the mines and exploration projects within the study area.

3.2.5 Paleontology Baseline Conditions

A paleontological resources report which addresses vertebrate and invertebrate fossils in the study area is provided in Appendix A. No known paleontological locations occur within the area to be directly disturbed by mining. No impacts to significant paleontological resources are expected to result from implementation of the Proposed Action.

3.2.6 Baseline Conditions for Area of Direct Disturbance

Gold ore targeted for the Proposed Action occurs in rocks similar to those found at Cortez and Gold Acres that have been buried by valley alluvium. The proposed mine facilities are located in an area where valley alluvium ranging from approximately 50 to 250 feet thick covers gold mineralization in the Silurian Roberts Mountains Formation (eastern carbonate assemblage). The deposit occurs near the eastern margin of the Gold Acres stock.

The deposit of interest for the Proposed Action is a Carlin-type disseminated gold occurrence typified by gold mineralization evenly distributed throughout the carbonate host rock, with anomalous levels of arsenic, antimony and mercury associated with the gold. The top of the target mineralized zone is approximately 500 to 600 feet below the surface. The deposit occupies an area of approximately 2,500 by 1,500 feet and ranges from 50 to 350 feet in thickness.

The majority of the deposit is oxidized. However, there is some unoxidized carbonaceous material containing a small amount (<2%) of sulfide in the form of pyrite.

3.3 SOILS AND TOPOGRAPHY

3.3.1 Study Area

The study area for soils and topography extends from a point about 1 mile north of Mount Lewis in the Shoshone Range, west to the crest of the Cortez Range, southwest along the crest of the Cortez Mountain Range to Bald Mountain in the Toiyabe Range, west-northwest to Red Mountain, the north to the point approximately 1 mile north of Mount Lewis in the Shoshone Range (Figure 3.3-1).

3.3.2 Topography

The topography in the study area is typical of that found in the Basin and Range Physiographic Province. North to northeast trending mountain ranges are separated by alluvial valley floors. In the study area, the Shoshone Range, with Mount Lewis at 9,680 feet above mean sea level (amsl) the highest point, borders the northwest corner. The mountains slope southeast to Crescent Valley, the lowest elevation in the study area at approximately 4,725 feet. At the southeast edge of Crescent Valley, the Cortez Mountains rise sharply. Mount Tenabo, at 9,153 feet, is the highest point in the Cortez Mountains. Cortez Canyon, a narrow winding canyon, separates the Cortez Mountains from the Toiyabe Range. Bald Mountain in the Toiyabe Range is at an elevation of 8,543 feet. Rocky Pass at the southwest end of Crescent Valley separates the Toiyabe Range from the Shoshone Range.

The area that would be disturbed by the project is situated on alluvial fan at the eastern edge of the Shoshone Range.

3.3.3 Soils Baseline Conditions

Soils within the area of direct disturbance (1,880 acres) were mapped in the fall of 1992 during the course of an Order II soil survey. An Order II survey separates soil associations and maps the large soil units as individual units. Smaller units may still be defined as inclusions and mapped with the large soil unit; closely associated soils with undefinable boundaries may be mapped as complexes. Figure 3.3-2 depicts the results of this mapping. Table 3.3-1 provides a summary of soil characteristics for each mapping unit. Descriptions of map units and soil families corresponding to the table and figure are provided in Appendix B.

In general, soils are coarse textured in the western foothills portion of the area, and fine textured (silt loams and clays) on the less steep slopes in the eastern portion of the project area. The soils range from moderately to very strongly alkaline, with strongly to very strongly alkaline soils being predominant. For the purposes of mine reclamation, the soils are rated from fair to poor for use as a growth medium. The primary limiting factors for suitability as growth medium are clay content and alkalinity.

The Creemon silt loam map unit, encompassing approximately 60 acres of the Proposed Action area, meets the soil requirements for prime farmland if irrigation water is provided and if there was a longer growing season. The criteria for designation as prime farmland include: adequate and dependable moisture supply (from either precipitation or irrigation); favorable temperature and growing season; acceptable level of acidity or alkalinity; presence of few if any rocks; permeability to air and water; not excessively erodible or saturated with water for long periods; location on slopes ranging from 0 to 6 percent (Soil Conservation Service undated). Because of the short growing season and because the soil is not currently under irrigation in this area of Crescent Valley, the area is not considered prime farmland.

The southwest portion of the county road relocation was not mapped at an Order II level; however, soils in this area have been mapped at an Order III level (Soil Conservation Service undated). These areas are depicted on Figure 3.3-2 and are distinguishable from the Order II map units by the numbering system used. Order II map units are given either an alphanumeric symbol or a two letter symbol. Order III map units have a three or four digit numeric symbol. Two Order III soil map units are traversed by the proposed county road relocation (Table 3.3-2).

3.4 WATER RESOURCES

Cortez Gold Mines, with the assistance of the consulting firm Water Management Consultants (WMC), of Denver, Colorado, collected the baseline data and prepared the groundwater model for mine dewatering as described in the Proposed Action. The Nevada BLM lacked a sufficient level of technical expertise to provide a thorough peer review of this information.

In order to ensure an adequate technical review of the Cortez/WMC analysis, the BLM selected Dr. Leland "Roy" Mink, Director of the Idaho Water Resources Research Institute, University of Idaho, Moscow, Idaho, to provide the BLM a peer review of the hydrogeolgoy in this document and its associated supporting baseline data. Assisting Dr. Mink were Dr. Dale Ralston, Professor at the Institute, and Dr. David Allman, Senior Scientist, Earth and Life Sciences Branch, EG&G Idaho, Inc. (retired). Cortez Gold Mines facilitated this review by providing the funding for the review.

The baseline data, groundwater computer model, and associated reports were developed over a 2-year period and comprise a large database. In order to facilitate the peer review for Dr. Mink et al., Water Management Consultants and Cortez prepared a summary report of the supporting data. This report is available, upon request, to the reviewing public. While the report is available, it is important for the reviewer of this EIS to recognize that this EIS represents the findings, in summary, of all the supporting data for the mine dewatering program. It is presented in nontechnical terms, for ease of understanding. The field of hydrogeology and groundwater modelling is quite technical and complex. The BLM recommends a complete review of this EIS before a request is made for the summary report.

3.4.1 Study Area

<u>Groundwater Resources</u>

The groundwater resources study area corresponds to the area identified as potentially impacted by drawdown of the groundwater table during pit dewatering. This area was defined by an extensive groundwater modeling study of the Crescent Valley Hydrographic Basin, which includes the existing (Gold Acres) and Proposed Action (Pipeline deposit) mining areas (Figure 3.4-1) performed by Water Management Consultants, Inc. (WMC). The model domain for these studies was established to include a large enough area around the proposed mine so that the model boundaries would not influence the estimation of groundwater table drawdown in the vicinity of the proposed mine (Appendix Figure C-1). The model domain generally conforms to the boundaries of the Crescent Valley Hydrographic Basin (Nevada Department of Water Resources Basin No. 054). Based on the extent of potential impacts, the baseline study area for groundwater resources also includes a small area in the northeastern portion of Carico Lake Valley (Nevada Department of Water Resources

Basin No. 055) that is outside the model domain. This area (primarily the Cook's Creek drainage area) was included in the study area because modeled drawdown indicates that the water table may be lowered in this area. The groundwater resources study area is described by straight lines between the following features:

> From Mount Lewis in the Shoshone Range, south across the northeast portion of Carico Lake Valley along Cook's Creek to Red Mountain (Carico Peak), Red Mountain east to Bald Mountain in the Toiyabe Range, northeast along the crest of the Toiyabe Range to Mount Tenabo, then northeast along the crest of the Cortez Mountains to the head of Cave Canyon, then west through Hot Springs Point to Mount Lewis.

Surface Water Resources

The surface water resources study area is the same as that area identified for groundwater resources. This will allow the evaluation of potential effects to surface water flow rates due to changes in groundwater elevations. It is also a study area that includes sufficient area to adequately analyze potential changes in surface water quality associated with the proposed project.

Water rights appropriations for the Proposed Action will be covered under a blanket application and will be reviewed by the Nevada State Engineer's office. Approval of the application for water rights will be based on that review, including the hydrogeologic characterization and dewatering feasibility studies conducted by WMC (1992a,b, 1993).

3.4.2 Conceptual Basin Description

Crescent Valley is a semi-enclosed basin that conceptually is relatively simple to describe in terms of groundwater and surface water. Figure 3.4-2 is a schematic flow chart to describe the various water inputs and outputs. The basin is comprised of the rock and sediment filled lowland areas surrounded by Shoshone Range and Cortez Mountains. Water is present in the basin as groundwater temporarily stored in the pore spaces, fractures and faults within the bedrock and between the grains of the silt, sand and gravel sediments (alluvium) and to a smaller degree as surface water. The groundwater is considered in temporary storage because it is gradually flowing in the direction of the hydraulic gradient toward the north-northeast and the Humboldt River. The groundwater enters the basin as precipitation and snowmelt runoff on the mountains that infiltrates the ground surface and flows toward the center of the basin. Groundwater flowing from Carico Lake Valley through Rocky Pass also becomes part of the Crescent Valley system. Groundwater leaves the basin via consumption by plants called phreatophytes and evaporation from the soil (the combined process of plant use and evaporation is known as evapotranspiration), springs, pumping wells and some contributes to the flow of the Humboldt River.

Very little surface water is present in Crescent Valley even considering the flow in the Humboldt River, compared to the volume of groundwater present. Surface water exists primarily as precipitation and snowmelt runoff which collects in streams. This water usually infiltrates the surface and or evaporates before it reaches the valley floor, so it does not remain above ground for a long time. A smaller volume of water that it is present as surface flow for much of the year occurs in streams fed by springs. This water too infiltrates into the ground or evaporates before it reaches too far onto the valley floor, but generally flows year round or as long as the spring flows. An even smaller quantity of surface water is used for irrigation or stock.

The following sections summarize baseline conditions for groundwater and surface water conditions. The topics in these sections include:

- Descriptions of the water-bearing rock formations and their hydraulic properties
- Depths to groundwater, flow directions, and input and output to the groundwater system
- Groundwater quality and water rights
- Surface water drainages and flow conditions
- Surface water quality and water rights

Appendix C provides additional detailed discussion and graphics.

3.4.3 Groundwater Resources

__Hydrogeology of Crescent Valley__

The hydrogeology of Crescent Valley, and, to a much smaller degree, the Cortez Mountains and Shoshone Range surrounding Crescent Valley, has been studied by the U.S. Geological Survey and reported in Water-Supply Paper 1581 (Zones 1961). Three hydrogeologic reports, prepared by WMC in 1992 and 1993 for the applicant, provide additional information on water resources in Crescent Valley and, more specifically, in the Proposed Action. Much of the following section is derived from WMC (1992a,b; 1993), and BLM (1992b). For additional information, see WMC (1992a,b; 1993).

Groundwater in the Cortez Mountains and Shoshone Range surrounding Crescent Valley occurs mainly in joints and fractures within the metamorphic and sedimentary bedrock. Most precipitation falling on the mountains travels downslope in ephemeral (intermittent) streams toward the valley floor. Recharge from this runoff enters the regional groundwater system as it crosses the alluvial deposits of the valley uplands at the base of the mountains. Groundwater moves through these alluvial deposits (fanglomerates) towards the alluvium beneath the valley floor where large quantities of groundwater are stored. The valley floor is a relatively flat area of playas, small dunes, and some terraces. Geophysical data from gravity and seismic surveys conducted by the USGS and others show that the alluvium may be as much as 9,300 feet thick in some portions of Crescent Valley (WMC 1992b). In other intermountain basins in central Nevada, alluvium is likely to exceed several hundred feet, and may be up to several thousand feet in thickness (Zones 1961).

__Principal Aquifer Units__. Groundwater flow in the Crescent Valley Hydrographic basin occurs in several bedrock and alluvial aquifer units including:

Bedrock:	Carbonate rocks
	Siliceous rocks
	Tertiary volcanics
Alluvium:	Older alluvium
	Younger alluvium

Only the carbonate and alluvial aquifer units are present in the upper 1,000 feet in the vicinity of the Proposed Action. Figure 3.4-3 is a schematic geologic cross section through the deposit which shows the positions of alluvium and carbonate formations. The following sections describe the occurrence, extent, and hydraulic characteristics of these aquifer units. A more detailed discussion is presented in Appendix C.

Knowing the hydraulic characteristics of an aquifer provides information on how much water it contains, how easily water flows through it, how much water flows through it, and the quantity of water that a well may produce from a given formation. These çharacteristics can also be used to estimate how much a well or series of wells might draw down (lower) the water level (water table), under pumping conditions.

The basic aquifer characteristics described below include porosity, hydraulic gradient, hydraulic conductivity, and transmissivity. Porosity describes the amount of open space between sand grains or in fractures through which groundwater may flow; it is sometimes expressed as a percentage. Hydraulic gradient is the rate of decrease in the elevation of the water level in an aquifer over a given distance; it is expressed as feet per feet, or as a dimensionless number more commonly. Hydraulic conductivity is the characteristic of an aquifer material (rock or alluvium) to allow water flow through it. Hydraulic conductivity can be expressed as feet per day and is a function of how well interconnected and how large the pore spaces (porosity) is of that material. Transmissivity describes how well groundwater flows through an aquifer of a given thickness. It is the product of hydraulic conductivity times the aquifer thickness and can be expressed in terms of square feet per day.

Carbonate Rocks. A regional carbonate (a rock comprised mostly of the mineral calcium carbonate) aquifer system that covers most of the state of Nevada is also present in the Crescent Valley. Within the study area, the carbonate rocks are comprised of the Roberts Mountain Formation, Wenban Limestone and Pilot Shale. The Roberts Mountain formation is the significant water bearing bedrock unit in the vicinity of the Proposed Action. The Roberts Mountain formation is exposed in the Gold Acres area of the Shoshone Range and near the Cortez Mine in the Cortez Mountains. Exploration drilling for the project showed that the Roberts Mountain formation can attain thicknesses of 2,000 feet or more.

Based on well pumping and production tests conducted by WMC (1992b), groundwater flow in the carbonate rocks is controlled by the presence of geologic structures such as open faults and fractures (also known as joints). Groundwater elevations in the Roberts Mountain formation near the Proposed Action are about 300 feet below the land surface (about 4,795 feet of elevation) and are consistent with the elevations of the water table in the alluvium in the basin. Figure 3.4-4 shows groundwater elevations in wells throughout Crescent Valley measured by WMC (1992b). Transmissivity values (the rate at which water flows through a unit thickness of an aquifer) range from 150 to 110,000 ft^2 per day, with the higher values probably corresponding to major water-producing zones in open fault and fracture zones.

Siliceous Rocks. Siliceous rocks (rock comprised mainly of silicon dioxide minerals) overlie the carbonate rocks throughout much of the Crescent Valley, except where the carbonate rocks are exposed at the ground surface and the siliceous rocks have been eroded away. Drill hole data and geologic mapping suggest that siliceous rocks may be up to 3,000 feet thick in the Indian Creek area north of the Proposed Action. It is uncertain as to the extent of these rocks beneath the valley floor between the deposit and the Cortez mine.

Groundwater flow is controlled by the presence of geologic structures such as faults and fractures, similar to the carbonate aquifer units. In unfractured rock, the hydraulic conductivities are low ranging from 5×10^{-6} to 1×10^{-1} ft/day. Wells which have intercepted fracture zones have test pumped up to 130 gallons per minute (gpm) or 200 acre-feet per year (WMC 1992b). An acre-foot is the quantity contained in a body of water that is 1 acre in area and 1 foot deep and is about 325,000 gallons of water. Several wells have been constructed on the slopes of the Cortez Mountains and Shoshone Range which produce water from siliceous rock units. The water levels are elevated in these wells above the water levels in the alluvial wells because the siliceous rock units receive significant amounts of groundwater recharge from snow melt and precipitation at higher elevations.

Tertiary Volcanics. Volcanic-origin rocks of Tertiary age crop out in the northern Shoshone Range in the Malpais Mountains. The Tertiary is a geologic period that represents the time from about 65 million years ago through the present. Volcanic activity was common in the western North American continent during this period. Drilling near Mud Spring Gulch north of the Proposed Action in the Shoshone Range showed Tertiary volcanic rocks up to several hundred feet to over 3,000 feet thick near Beowawe. No hydrogeologic information was available for these rock units in Crescent Valley, however, hydraulic conductivity values for Tertiary volcanic rocks in Boulder Valley north of the Humboldt River ranged from 0.1 ft/day to 10 ft/day (WMC 1992b).

Older Alluvium. The alluvial material that fills Crescent Valley is comprised of older alluvium, Tertiary sediments and Tertiary age volcanic layers. The overall shape of the valley basin is asymmetrical with the deepest area located about 6 to 7 miles east-northeast of the Proposed Action along the Eureka-Lander County lines. Here the alluvium may reach a thickness of about 9,000 feet based on seismic and gravity geophysical data (WMC 1992b). The slope of the basin floor is much steeper beneath the eastern side of the valley floor than beneath the western side near the Proposed Action, which is reflected in the present topography and configuration of younger alluvial fans.

Finer-grained material overlying the older alluvium on the eastern side of the valley may act as an upward vertical barrier to groundwater flowing from the Cortez mountains underneath the valley floor. The result is a water table (piezometric surface) that is higher than the ground surface in some portions of the basin east and northeast of the Proposed Action. When a well is drilled into the older alluvium in these areas, the higher hydraulic head causes the well to flow freely to the surface without being pumped. Several of these types of wells are identified on USGS topographic maps in the area.

Most of the wells in Crescent Valley are completed in the alluvial fan material within the upper 500 feet of these sediments. Many wells are completed through both the younger and older alluvium. The major water producing zones occur in the coarsest sand and gravel layers within these units. Values of hydraulic conductivity range from about 0.1 ft/day to 10 ft/day (WMC 1992b). Two ancient stream channels (paleochannels) have been tentatively identified by WMC (1993) in the southeast and northeast sides of the Proposed Action. The channels lie in eroded low areas in the bedrock and are buried by 500 to 1,000 feet of alluvium. The paleochannels may have different hydraulic properties than surrounding alluvial material (more transmissive in this case), making them potentially preferred groundwater flow pathways. The paleochannels are discussed in further detail in Appendix C.

Younger Alluvium. The younger sediments that form the alluvial fans at the margins of the valley consist of coarse grained poorly sorted materials including cobbles and boulders. The larger more extensive fans on the western side of the valley may reach thicknesses of 700 to 800 feet with smaller fans on the eastern side reaching thicknesses of 400 to 500 feet. Streambed sediments consisting of a wide variety of material (from boulders to silt and clay) are often deposited within these fans. Younger alluvium also occurs as sand silt and clay deposits at the toes of many of the alluvial fans toward the center of the valley.

Groundwater flow in the younger alluvium is generally from the margins of the basin toward the valley floor. Because of the contrast in hydraulic conductivities between younger alluvial fan material and finer grained underlying material, groundwater sometimes discharges at the toes of alluvial fans in the form of springs and seeps. These springs are more common along the eastern side of the valley.

Hydraulic conductivities and transmissivities in the younger alluvium are highly dependent on grain size, degree of sorting (uniformity of grain sizes), and the amount of cementation of the grains. Conductivities are relatively high near the alluvium/bedrock contact. Values of transmissivity calculated from pump-test data by WMC (1992b) range from 9,000 ft^2/day to 12,000 ft^2/day.

Playa deposits occur within the younger alluvium. Playas form the low-lying areas of intermountain basins like Crescent Valley which receive water and sediment deposits during periods of high surface runoff. These deposits consist of finer grained sediments which may act as a confining layer for groundwater flow in underlying sediments. Groundwater movement within the deposits can be complex due to variable porosity caused by solution and secondary precipitation of evaporite minerals. Hydraulic conductivity values have not been measured but can be expected to be low because of the fine grained nature of the sediments.

Groundwater Elevations and Flow Direction

Groundwater elevations for wells in Crescent Valley are shown on Figure 3.4-4. Elevations are calculated by subtracting the depth to water measured in the well from the surface datum elevation. All available historic data were compiled by WMC (1992b). In many cases, the surface datum had not been surveyed, so it was estimated from drillers logs or topographic maps. Groundwater elevations are the highest around the margins of the basin and lowest in the center of the valley. Groundwater flows from the areas of higher to lower elevation. The highest groundwater elevation recorded in the valley was at Rocky Pass (5,025 feet above sea level), although the depth to water in that area is less than 10 feet (WMC 1993). The groundwater table in the vicinity of the Proposed Action is about 300 feet below ground surface corresponding to an elevation of about 4,900 feet. Depth to the water table at Crescent Valley township is about 60 feet (elevation 4,730 feet) and a depth of about 20 feet (elevation 4,700) at Beowawe.

Groundwater elevation estimates have been used by WMC (1992b) to prepare a contour map (Figure 3.4-5) which shows the direction of groundwater flow in the vicinity of the Proposed Action. Based on those contours the flow direction is easterly across the project site and generally northeasterly along the axis of the basin.

Groundwater Recharge

Surface water entering the groundwater system is referred to as recharge. Groundwater recharge to Crescent Valley occurs primarily from snowmelt and runoff along the mountains and piedmont slopes around the margins of the basin. Seepage from streams which cross the alluvium of the piedmont slopes is the main mechanism for recharge. Most streambeds are composed of sand and gravel material.

At higher elevations, seepage from streams percolates into the bedrock and into the thin veneer of alluvium that overlies the bedrock. Since groundwater movement in the bedrock is probably restricted in most areas by the geologic structure, much of the recharge moves downslope in the alluvium as shallow underflow and then either percolates directly into the alluvial fans or appears as springs.

Following periods of high precipitation, when flow rates in the streams are greatest, surface flow extends further onto the piedmont slopes and the alluvial fans. Only during times of exceptionally high flow does the surface flow reach the lower slopes of the fans and the valley floor. Runoff and streamflow is likely to be higher in the Cortez Mountains where the alluvial fans are steeper. Surface flow therefore reaches the valley floor more frequently on the eastern side of the basin.

Additional recharge to groundwater in Crescent Valley occurs from minor surface flow and groundwater underflow from Carico Lake Valley through Rocky Pass. The average surface inflow to the basin from Rocky Pass has been estimated to be about 5×10^7 to 1×10^8 gallons or 150 to 300 acre-ft per year (WMC 1992b). About 3×10^7 gallons per year is thought to recharge groundwater in the younger alluvial sediments (WMC 1992b). The remaining surface water flow is thought to be lost in evapotranspiration. During periods of higher than average flow, some groundwater recharge to shallow alluvial sediments from the Humboldt River may occur along certain portions of the river. In general, the Humboldt River receives flow from the aquifer rather than recharges it (see Groundwater Discharge below).

Groundwater Discharge

Water leaving the groundwater system is referred to as discharge. Groundwater discharge occurs in the valley through evapotranspiration, spring discharge, groundwater discharge to the Humboldt River during periods of low flow, and groundwater pumpage. Evapotranspiration is the loss of water through transpiration by plants during growth and evaporation from the soil. Evapotranspiration by plants whose root systems tap into the water table (phreatophytes) generally occurs up to a depth of 15 to 20 feet, but could be as great as 30 to 40 feet (WMC 1992b). The rate of evapotranspiration is a function of the depth to the water table, the type and density of the vegetation, soil type, water quality, and climatic factors such as wind velocity, temperature, and humidity.

Although no direct measurements have been made in Crescent Valley, data collected by the USGS (unpublished) from Boulder Valley to the north, and from other similar basins in northeast Nevada, indicate that the average annual evapotranspiration rate may be on the order of 1 foot per year. The potentially affected area for evapotranspiration in Crescent Valley is approximately 240 to 260 square miles, mostly in the playa areas along the central part of the valley floor. Using an evapotranspiration rate of 1 foot per year, the potential annual average evapotranspiration is estimated to be about 900 million gallons per year or 2,800 acre-feet per year (WMC 1992b).

Groundwater discharge also takes place in the form of springs and seeps. Two of the spring systems in the valley are thermal springs; the remainder are cold springs. The largest spring system in the valley is located near the southern extremity of the Dry Hills at Hot Springs

Point. This thermal system consists of five springs with an estimated total cumulative discharge of approximately 100 gpm (WMC 1992b). Water temperatures are between 79°F and 138°F. The Chillis Hot Springs occur near the alluvium-bedrock contact near Rocky Pass, east of the Filippini Ranch. The discharge rate has been measured at about 10 gpm and the temperature was recorded to be 102°F.

Figure 3.4-4 shows the main springs and seeps in the valley recorded from published data (primarily USGS maps). Many of these occur at higher elevations around the margins of the valley, often in response to localized groundwater movement. It is estimated that the total combined discharge rate does not exceed 150 to 200 gpm, or 80 to 100 million ($8x10^7$ to $1x10^8$) gallons per year. Numerous springs also occur on the valley floor near the toe of the alluvial fans, probably due to the local contrast in hydraulic conductivity between the coarser alluvial fan materials and the finer-grained valley fill deposits. Combined flow from these springs has been estimated to be less than 50 gpm throughout the valley. A group of 8 to 10 shallow wells and springs occur around the Dean Ranch, close to the lower edge of the piedmont slope below Indian Creek. These are located 5 to 7 miles east-northeast of the Proposed Action.

Groundwater discharges to the Humboldt River between Rose Ranch and Beowawe during normal flow conditions (Figure 3.4-4). Data collected by a comparison of stream gaging measures during October 1992 indicate that this may be up to 2,700 gpm, although estimating flow volumes in the river is complicated due to local irrigation diversions (WMC 1992b). It is likely that a minor amount of groundwater also leaves the basin as underflow through the gap at Beowawe. Although no records are available for the depth to bedrock in this area, it is thought that the discharge rate is unlikely to exceed 100 million gallons (300 acre-feet) annually (WMC 1992b). As discussed above, some flow from the Humboldt River recharges the shallow alluvial aquifer during periods of high flow along some reaches of the river.

Groundwater discharge also takes place through well pumpage for domestic, industrial, municipal, and agricultural purposes. Records on groundwater pumpage for Crescent Valley are incomplete, but it is estimated that the total average groundwater pumpage from the valley does not exceed 10,000 gpm, or 5 billion gallons (16,000 acre-ft) annually. Most of these wells derive water from the basin fill sediments. The maximum permitted groundwater diversion rate for the valley is discussed in Appendix C.

Hydrochemistry

To characterize the present groundwater chemistry in the Crescent Valley, and specifically in the vicinity of the Proposed Action, WMC (1992b, 1993) collected a total of 53 samples from the following sources:

- 19 alluvial and bedrock well samples from the Crescent Valley region
- 24 samples from exploration drill holes in the Proposed Action area
- 10 bedrock and alluvial wells before, during, and after aquifer testing in the Proposed Action area

The analytical suite included all parameters listed in the Nevada Division of Environmental Protection (NDEP) Standard Profile, plus a 36-element by Inductively Coupled Plasma (ICP) standard suite of metals. The well samples were filtered and preserved in accordance with NDEP requirements. The samples from the exploration drillholes were not filtered. A summary of wells sampled and the analytical results for all 53 samples are presented on Table C-3.

Bedrock Aquifer. The bedrock aquifer water quality is a sodium calcium bicarbonate dominant water of generally good quality, based on the samples collected to date. The total dissolved solids (TDS), or dissolved mineral contents, range from 434 to 872 milligrams per liter (mg/L) and generally exceed the EPA Secondary Drinking Water Standard of 500 mg/L, especially in samples collected from exploratory boreholes near the Proposed Action. Fluoride levels around the proposed pit area average 2.7 mg/L which exceeds the EPA Secondary Drinking Water Standard of 2 mg/L. In the Proposed Action area, the mean of all other parameters tested are less than EPA Drinking Water Standards. Two samples collected from bedrock bore hole PL-49 at 680 feet of depth and 960 feet of depth showed weak acid dissociable (WAD) cyanide at concentrations of 0.021 mg/L and 0.023 mg/L, respectively. The presence of WAD cyanide in these samples suggest that groundwater recharge may have come into contact with material from old mine workings. Arsenic was not detected in these same samples; however, it was detected at 0.018 μg/L in a sample from bedrock hole PL45 at 800 feet of depth. Neither the cyanide or arsenic concentrations exceed EPA drinking water standards.

Regional Alluvial Aquifer. The regional alluvial groundwater quality around the proposed pit area is slightly different in character from the bedrock groundwater. The TDS of the regional samples ranged from 236 to 582 mg/L. Many of the alluvial samples also had a slightly lower sulfate concentration and a slightly higher chloride content than bedrock samples. Sulfate content averaged 153 mg/L, while the regional alluvial samples averaged 85 mg/L. The difference in chloride content may be somewhat misleading since the samples from the Crescent Valley township well were high in chloride.

Arsenic exceeded the EPA primary drinking water standard of 0.05 mg/L in a sample from alluvial observation well OW-8 at a concentration of 0.202 mg/L located in the proposed pit area. The average concentration of samples collected in alluvial wells in the valley is below the primary drinking water standard for mercury of 0.002 mg/L. Iron and manganese levels exceed the secondary standards of 0.3 and 0.05 mg/L, respectively, with average values of 0.302 mg/L for iron and 0.066 mg/L for manganese. Again, the mean of all other parameters is within the limits for drinking water. TDS values within the alluvium to the east of the proposed pit are between 412 and 582 mg/L.

Water Rights

The maximum permitted groundwater diversion rate for the valley is around 30,000 gpm (49,000 acre-ft/yr), with a total **annual duty** of around 7 billion gallons (22,000 acre-feet). A map of the water rights in the southern part of the valley is shown on Figure 3.4-6. The Nevada Division of Water Resources groundwater abstract for the valley is provided in Appendix C.

Nineteen individual applications were filed with the State Engineer's office to appropriate water for mining, milling, dewatering, and domestic purposes for the Proposed Action. The individual applications each describe a point of diversion at the center of a 160-acre quarter section. The applications are combined into a "blanket," whereby the total diversion rate from all of the permits combined can be up to 67 cubic feet per second (30,074 gpm) continuously. Using accumulation and rotational procedures, the water may be diverted from any number of wells located anywhere within the blanket area. Although the initial point of diversion has been specified as the center of each 160-acre quarter section, this point of diversion may be changed to conform to the actual current diversion points. Changes would be reported to the State Engineer's office on an annual basis. Within the area of each individual permit, the location of the dewatering wells may be moved and changed without filing for a temporary change of location. In addition, the diversion rate of any one permitted area may be moved to another permitted area, as long as the maximum pumping rate for all permits combined is not exceeded.

Table 3.4-1 lists the existing wells and associated water rights in the vicinity of the Proposed Action plus other significant users in the valley. Many of the water rights within about a 5-mile radius around the Proposed Action have recently been acquired by Cortez Gold Mines. The majority of the groundwater rights are designated as irrigation and industrial (mining and milling). The only municipal groundwater rights are those of the Crescent Valley township.

3.4.4 Surface Water Resources

<u>Surface Water Hydrology of Crescent Valley and Carico Lake Valley</u>

The amount of surface water in the Great Basin of Nevada is quite small due to the low annual precipitation and the dry climate that results in evaporation. Rainfall and snowmelt that occurs in the higher elevations and runs off typically evaporates and infiltrates the ground in the stream channels and washes before it reaches the valley floor. The water that infiltrates becomes part of the groundwater system and provides the only means of groundwater recharge. This interaction forms an important relationship between groundwater and surface water.

The surface water study area spans the southern two-thirds of Crescent Valley and the northeastern portion of Carico Lake Valley to correspond with the limits of potential impacts of groundwater drawdown due to pit dewatering. These valleys are within the Humboldt River Basin, which is in the Great Basin section of the Basin and Range physiographic province. The Great Basin Region is characterized by alternating valleys and mountain ranges that are generally aligned north to south. Within the Humboldt River Basin, stream courses drain into other tributaries and terminate in playas on the valley floor or into the Humboldt River.

Rainfall in the Crescent Valley watershed typically evaporates or infiltrates. Many of the streams draining snowmelt or rainfall from the mountains surrounding Crescent Valley do not reach the dry lake beds on the valley floor; instead, they branch into smaller channels that eventually dry up. Runoff from Crescent Valley flows into the Humboldt River only after large storms. Surface water flow in the Carico Lake Valley coalesces into Cook's Creek, which enters Crescent Valley through Rocky Pass. Cook's Creek flows approximately 1 mile into Crescent Valley and then becomes dry.

Valley uplands are the areas of intermediate slope between the mountains and the valley floors. In areas where the valley uplands are underlain by hard rocks, the streams do not lose much water to infiltration. In other areas where the streams are not underlain with hard rock, such as in Crescent Valley, the streams quickly lose water by infiltration through the stream bottoms. In these latter areas, runoff only reaches the valley floors during high flows. Within the study area, most of the streams do not flow year-round, with the exception of larger streams, such as Indian Creek and Pine Creek. The center of Crescent and Carico Lake valleys consist of dry lake beds. None of the streams within the project study area flow into the Humboldt River except possibly under extreme flood conditions.

Shoshone Range Drainages. There are four creeks that drain the eastern slope of the Shoshone Range within the study area (Figure 3.4-4). From north to south, these include: Black Rock Canyon, Mud Spring Gulch, Indian Creek, and an unnamed drainage west of the Proposed Action site. Field reconnaissance conducted by WMC (1992b) in August and September 1992 showed some measurable flow in portions of Indian Creek. The other creeks, including the unnamed drainage closest to the Proposed Action, were dry.

Toiyabe Range and Northeastern Carico Lake Valley Drainages. Three drainages originating in the Toiyabe Range enter Crescent Valley (Figure 3.4-4). Surface water in the northeastern portion of Carico Lake Valley drains via Elder Creek, which joins Cook's Creek at Rocky Pass. The surface water flow which generally occurs only after heavy precipitation or snowmelt runoff enters Crescent Valley usually seeps into alluvial material within 1 mile of Rocky Pass. A small amount of groundwater underflow through Rocky Pass is believed to occur year-round. Two catchment areas (designated as Toiyabe Catchment areas No. 1 and No. 2) also drain into Crescent Valley from the Toiyabe Range. Seventeen springs have been mapped in the higher elevations in Catchment area No. 1. Three unnamed creeks and Copper Canyon form the drainage for Catchment area No. 2. No flow was observed in any of the unnamed drainages in the area during reconnaissance in August 1992.

Cortez Mountains Drainages. Eleven creeks drain into Crescent Valley from the Cortez Mountains within the study area (Figure 3.4-4). These include from north to south: Frenchie Creek, Sod House Creek, Duff Creek, Dewey Dann (and Hand-me-down Creek), Little Cottonwood Creek, Cottonwood Creek, Brock Canyon, Mule Canyon, Fourmile Canyon, Mill Canyon, and Cortez Canyon. Of these 11 creeks, only Frenchie Creek, Sod House Creek, Duff Creek, Brock Canyon, Fourmile Canyon, and Mill Canyon had measurable flow during reconnaissance in August and September 1992.

The lower portion of Thomas Creek flows into the Crescent Valley within the study area. Thomas Creek drains a portion of Iron Blossom Mountain and flows intermittently where springs flow into it. No flow was observed in August 1992 more than 1 mile downstream of the springs.

Most of the annual runoff within the study area is from snowmelt water. A large percentage of the annual precipitation falls as snow and is stored as snow pack in the higher elevations during the winter months. In the spring months, typically April through early June, snowmelt water produces significant runoff. In many of the high mountain drainages, this snowmelt runoff produces the highest annual flows. Occasionally, spring season rainfall coincides with the snowmelt runoff, resulting in extremely high runoff flows. The hot, dry weather in mid to late summer produces the lowest annual flows due to little or no rain and high evaporation rates.

Winter and spring floods occur in the Humboldt River Basin (Eakin et al. 1966). Winter floods are caused primarily by large rainstorms falling on low-lying snow or frozen ground. Winter floods are generally high-volume but short-duration events. Spring floods occur as warming temperatures melt the snow packs that accumulate over the winter and spring months. Heavy rains during the spring can rapidly accelerate the generation of snowmelt runoff. Summer floods also occur as the result of localized high-intensity rainfall from thunderstorms. However, large-volume, short-duration storms that cause flash flooding can exceed the snowmelt peak in magnitude. Flash floods, caused by thunderstorms originating in the mountains, deposit large volumes of debris and sediment on the valley uplands or valley floor.

Surface water flow in the region is used for grazing and mining, and by wildlife. There is no historic or existing use of surface water for domestic purposes within the Proposed Action area.

Surface Water Hydrology in the Vicinity of the Proposed Action

The Proposed Action is located in the unnamed drainage north of Squaw Butte on the eastern flank of the Shoshone Range (Figure 3.4-4). The streams that drain the eastern side of the Shoshone Range are longer and have a more gradual slope than those that drain the western slopes of the Cortez Mountains on the opposite side of Crescent Valley. Only Indian Creek, located about 5 miles north of the mine, is known to flow year-round. All of these streams, including Indian Creek, dry up and disappear as they cross the valley upland and flow towards the valley floor.

The areas surrounding the proposed facilities contain numerous channels and washes that flow only during times of intense precipitation and snowmelt. The Proposed Action facilities would be protected from surface runon and storm events by berms and diversion ditches. The watersheds above the Proposed Action facilities drain an area of approximately 14.3 square miles (9,140 acres) of steeply to moderately sloped terrain. Topographic relief varies from about 5,150 feet at the road above the millsite to 6,690 feet at the highest point within the drainage basin. The longest water course is approximately 5.3 miles with a change in elevation of about 1,240 feet. The watershed above the site was divided into seven subbasins, ranging in size from 1.1 to 4.2 square miles.

Runoff from 25-year and 100-year 24-hour storm events was evaluated using rainfall depths selected from the Precipitation Frequency Atlas 2 for Nevada, Volume VII, and soil type information obtained from the Soil Conservation Service (SCS). Much of the watershed is characterized by poorly drained soils with relatively high coefficients of runoff.

A precipitation depth of 2.4 inches was selected for the 100-year event within the higher watersheds and 2.2 inches was utilized for the remaining watersheds evaluated at lower elevations. The corresponding precipitation depths for the 25-year event were 1.8 and 2.0 inches. Distribution of the 24-hour rainfall was according to the Type II storm distribution developed by the SCS. Peak flows for the various design storms were estimated by Cortez Mines (1992) using the SCS Hydrograph method as available in the HEC-1 Model developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers. Based on this analysis, the peak runoff estimated for the 25-year, 24-hour storm is 1,400 cubic feet per second (cfs), and 2,200 cfs for a 100-year, 24-hour storm.

The FEMA floodplain maps for the Proposed Action were reviewed for identification of floodplains in the vicinity of the mine site. The mine site is located in an area identified as being outside the 500-year floodplain. The nearest mapped flood hazard area is the 100-year floodplain located about 3 miles to the southeast (FEMA 1988).

Surface Water Quality

Available surface water quality data are limited to sampling performed by WMC in 1992. A total of four surface water samples were collected from Indian Creek, Mill Creek, and the Filippini Ranch stream at Rocky Pass. Additionally, two hot springs were sampled: the Filippini Hot Spring and Hot Springs Point. All of the samples were analyzed for NDEP standard Profile 1 and 36 metals by ICP.

Samples from the two hot springs have high TDS and very different ratios of major ions. The sample from Hot Springs Point had a slightly lower pH and elevated levels of magnesium, potassium, sodium, and chloride. Water from the Filippini Hot Spring had a pH of 8.5 and was high in fluoride, magnesium, and potassium. Arsenic was also detected at low concentrations (0.01 mg/L), which was slightly greater than the method reporting limit, in the Filippini Hot Spring sample.

The surface water samples from Indian Creek and Mill Creek had low TDS (394 and 380 mg/L, respectively), with calcium and bicarbonate ions being dominant. The Filippini Ranch stream sample reported TDS at 3,433 mg/L, similar to the Filippini Hot Springs sample. Selenium at 0.022 mg/L and manganese at 0.577 mg/L exceeded the NDEP maximum contaminant level (MCL) in the Filippini sample. Some of the surface water samples showed elevated levels of trace constituents such as WAD cyanide (Indian Creek only), aluminum, barium, boron, lithium, magnesium, manganese, molybdenum, nickel, selenium, silver, strontium, and sulfur.

Surface Water Rights

Surface water rights exist on the following streams in the study area: Mud Spring, Duff Creek, Sod House Creek, Frenchie Creek, Mule Canyon, Brook Canyon, Hand-me-down Creek, Little Cottonwood Creek, and Mill Creek. Numerous springs in the valley are also diverted and have associated surface water rights. These are listed in Table 3.4-2. There are no known surface water rights in the unnamed drainage basin to the west of the Proposed Action. Surface water rights on Cook's Creek in the Carico Lake Valley are presently being researched.

3.5 VEGETATION

3.5.1 Study Area

The study area for vegetation is the same as for other natural resources -- e.g., soils, water, and wildlife (Figure 3.5-1).

3.5.2 Vegetation Baseline Conditions

The following discussion on vegetative communities in the study area is based on site visits, information from both published and unpublished reports by the USDA Soil Conservation Service, Section 3.5.2 of the Expansion EIS (BLM 1992b), and other sources, referenced where applicable. The study area includes diverse community types. Wetlands and riparian areas are scattered throughout the study area near springs and along streams. Upland community types include shadscale/black greasewood, shadscale/bud sagebrush, sagebrush/grass, pinyon-juniper/sagebrush, and mountain mahogany. Each of these community types are described below along with typical vegetation associated with them. Not all listed species occur throughout each community.

Wetlands

In the study area two kinds of wetlands are predominant. Wet meadows are created either by seeps and springs or exist along the floodplains of creeks. Saline flats in Crescent Valley are formed by streams and creeks which have no outflow. Typical species associated with these wetlands are listed in Table 3.5-1.

Jurisdictional wetlands are protected by the U.S. Army Corps of Engineers (Corps) and defined by the Corps (U.S. Department of the Army 1987) and the Environmental Protection Agency (EPA) as:

> Those 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. Wetlands generally include swamps, marshes, bogs, and similar areas. (EPA, 40 CFR 230.3 and Corps, 33 CFR 328.3)

Approximately 68 seeps and springs supporting 40.5 acres of wetlands are located within the study area. Each seep or spring was examined for wetland characteristics in accordance with the criteria contained in the Technical Report Y-87-1, <u>Corps of Engineers Wetland Delineation Manual</u>, by Environmental Laboratory, Department of the Army, Waterways Experiment Station, Vicksburg, Mississippi, January 1987 (U.S. Department of the Army 1987). Wetlands were classified according to the method outlined in the publication <u>Classification of Wetlands and Deepwater Habitats of the United States</u> (U.S. Department of the Interior 1979). Plant indicator status categories are as follows (U.S. Department of the Army 1987):

- OBL - obligate wetland plants
- FACW - facultative wetland plants
- FAC - facultative plants
- FACU - facultative upland plants
- UPL - obligate upland plants

Most wetland sites are in the form of hillside seeps and springs, often with associated wet meadows and riparian areas, classified as Palustrine Emergent Wetlands. These sites are generally dominated by Nebraska sedge (Carex nebrascensis - OBL), fowl bluegrass (Poa palustris - FACW), marsh buttercup (Ranunculus cymbalaria - OBL), baltic rush (Juncus balticus - FACW), and watercress (Nasturtium officinale - OBL). Other commonly found species include Kentucky bluegrass (Poa pratensis - FACU), and saltgrass (Distichlis spicata - FAC+).

Several springs and seeps were found emanating from the beds of perennial and/or intermittent drainages. These sites are generally dominated by baltic rush (Juncus balticus - FACW), few-flower spikerush (Eleocharis pauciflora - OBL), American brooklime (Veronica americana - OBL), watercress (Nasturtium officinale - OBL), yellow willow (Salix lutea - OBL) and coyote willow (Salix exigua - OBL).

The vegetative community at nearly every site showed signs of being affected by heavy grazing, and in many cases by severe grazing and/or trampling. Many springs were "developed" for stock water or other uses, thus drying up the spring at the surface, and allowing upland vegetation to dominate the remnant site.

Table 3.5-2 lists each seep and spring surveyed, including wetland parameters and acreages.

Riparian Areas

Riparian areas are defined as areas where vegetation is the product of the presence of perennial or intermittent surface water, associated high water tables or soils which exhibit some wetness characteristics (Thomas et al. 1979). Vegetation species associated with riparian areas are listed in Table 3.5-3.

While riparian areas exhibit some of the characteristics of wetlands, not all riparian areas meet all three of the criteria of hydrophytic vegetation, hydric soils and wetland hydrology, which would technically classify them as Jurisdictional wetlands under protection of the Corps. However, many of these riparian areas in the study area are within stream channels, below the ordinary high water mark (OHWM), and thus are regulated by the Corps as part of the Waters of the United States.

Riparian areas are typically located along perennial or intermittent streams. Many are in steep canyons with occasional heavy livestock use. Riparian areas are located in at least 220 locations along approximately 50 miles of various perennial and intermittent streams and channels in the study area. Most riparian areas are in poor condition due to cattle grazing and trampling. However, some areas in steep canyons are in good to fair condition where they are less accessible to livestock. Surveys conducted by the BLM in 1991 in the Cortez Range found that "almost without exception, stream and riparian habitat conditions were found to be poor. Streambanks are cut and eroding, riparian vegetation is lacking, sedimentation levels are excessive and stream channels are wide and narrow. . . . Poor livestock grazing practices resulting in overuse of the riparian zone are the primary cause of poor habitat conditions along streams in the cumulative effects study area." Table 3.5-4 summarizes the results of these 1991 surveys.

Upland Communities

Upland plant communities within the study area include shadscale/black greasewood, shadscale/bud sagebrush, sagebrush/grass, pinyon-juniper, and mountain mahogany. Plant communities do not have sharp boundaries, but tend to blend or grade into each other. A vegetation map is provided in Figure 3.5-1.

Shadscale/Black Greasewood Community. Shadscale/black greasewood communities are found in the valley bottoms, such as Crescent Valley. Understory vegetation consists of salt/sodium tolerant grass species. Elevation of these valley floors is approximately 5,000 feet above mean sea level (amsl). Precipitation in these areas is approximately 7 inches per year. Soils are strongly alkaline and sodium affected. When disturbed, invader species in this community type include Russian thistle, annual mustards and halogeton. The shadscale/black greasewood community encompasses approximately 41,000 acres within the study area. Vegetation species commonly found in the shadscale/black greasewood communities are listed in Table 3.5-5.

Shadscale/Bud Sagebrush Community. Shadscale/bud sagebrush communities are found around the edges of the valleys and on the alluvial fans. Grasses are the predominant understory vegetation. Soils may be neutral to strongly alkaline. Indurated duripans (strongly cemented silica hardpans) are commonly found in many soils of this community type.

Annual average precipitation is approximately 7 inches. The community may be found at elevations up to 6,000 feet. Common invader species on disturbed sites in this community include cheatgrass, tansymustard, and halogeton. The shadscale/bud sagebrush community encompasses approximately 86,000 acres within the study area. Vegetation species commonly found in the shadscale/bud sagebrush communities are listed in Table 3.5-5.

Sagebrush/Grass Community. Sagebrush/grass communities are found throughout the study area, on fans and in the mountains and foothills. The understory vegetation is composed of grasses and forbs. Arrowleaf balsamroot may be a predominant understory forb. Elevations range from above 5,000 to 8,500 feet. Cheatgrass, Russian thistle and halogeton may invade these sites if excessively utilized by livestock. Average annual precipitation may range from 8 to 10 inches. Because this community type occurs over an extensive area, soil types are quite variable. Soils may be neutral to alkaline, shallow to deep, and may or may not be affected by hardpan. This is the most common community type within the study area, encompassing approximately 186,000 acres. Vegetation species commonly found in the sagebrush/grass communities are listed in Table 3.5-5.

Other Vegetation

Pinyon-juniper communities, mountain mahogany communities, and forested land occur in the cumulative study area but would not receive direct or indirect impacts from the Proposed Action. The vegetation types are described in the Cortez Gold Mines Expansion EIS.

Threatened and Endangered Plants

A search of the Nevada Natural Heritage Program records in Carson City indicated two Class 3C plants occur in the area. These are Eriogonum beatleyae (T26N R48E) and Lomatium ravenii (T28N R45E). A Class 3C species is one no longer being considered for listing as threatened or endangered, based upon evidence that the species has been found to be more abundant or widespread than originally thought. No additional records of threatened, endangered or candidate species were found within the study area during a search of the Elko and Shoshone-Eureka Resource Areas' files.

Vegetation in Area of Proposed Disturbance

The vegetation in the Proposed Action area is dominated by the shadscale/bud sagebrush community type. An ecotone (e.g., a gradation) into the sagebrush/grass community type is apparent on the western (higher elevation) portion of the Proposed Action area. Also, some big sagebrush inclusions are scattered sparsely within the shadscale/bud sagebrush community type. Table 3.5-6 lists the dominant plant species that occur within the Proposed Action area. No wetlands, riparian areas, forested lands, or other sensitive communities occur in the Proposed Action area.

Drought conditions and livestock grazing have contributed to degradation of the vegetation communities in this area.

3.6 WILDLIFE RESOURCES

3.6.1 Study Area

The study area for wildlife resources is the same as that identified for soils and vegetation. This study area includes the Proposed Action area and additional surrounding acreage such that potential effects from secondary or indirect disturbances to mobile species such as big game may be adequately evaluated. The study area includes those springs and other water sources for wildlife that could be affected by drawdown from dewatering activities. The size of the study area also allows an evaluation of cumulative, i.e., incremental, impacts that could result from the combination of impacts from the Proposed Action with impacts from other nearby mining projects affecting the same wildlife populations and/or habitats.

3.6.2 Wildlife Resources in the Study Area

The general habitat types found throughout the study area are very similar to those described in the Expansion EIS (BLM 1992b) and in the vegetation section of this report. The focus of the discussion below is on those wildlife populations which could be affected by direct habitat removal and also by a decrease in the availability of critical water sources.

Game species known to inhabit the study area include mule deer, antelope, mountain lion, chukar, sage grouse, small numbers of Hungarian (gray) partridge, mourning dove, cottontail rabbit, California (valley) quail, and Wilson's snipe. A wide variety of nongame species occur in the area. A description of these wildlife resources is provided in the Expansion EIS (BLM 1992b). Some additional information has been gathered since the release of the Expansion EIS. That additional information and updated information pertaining to the modified study area are detailed below. Following this general description, more specific discussions are provided for wildlife resources in the Proposed Action area.

Mule Deer

Mule deer occur throughout the mountains and foothills of the study area. Management Areas 14 and 15 and Management Units 141, 152, and 154 are included within the study area. Mule deer summer range is generally located above 7500 ft in most mountain ranges, while year-long and winter range are found at the lower elevations.

The Elko BLM District identifies most of the Cortez Range as year-long mule deer range. A part of the northern Toiyabe Range is identified as mule deer year-long range. The western slopes of the extreme northern end of the Toiyabe Range are identified as mule deer winter range, as shown in Figure 3.6-1 and Table 3.6-1 (BLM 1983). Much of the Shoshone Range is utilized as year-long range, with summer range again generally found at the higher elevations. A portion of the Shoshone Range south of Goat Peak is also identified as winter range according to BLM/NDOW habitat maps (see Figure 3.6-1).

New roads, built in connection with mineral exploration and development in all three ranges, have resulted in greater access to many areas. This in turn has resulted in reduced deer use of some parts of the study area.

According to the NDOW, mule deer numbers peaked in 1985 but currently are down about 50 percent from this 12-year high in Management Areas 14 and 15. Recent heavy winter fawn losses and already low fawn production are probably due to extended drought conditions (NDOW 1992). In both management areas, prior to the 92-93 winter, fawn production remained low due to poor forage conditions. The heavy snows of the 92-93 winter resulted in significant fawn loss. Competition with livestock for key browse species was also high. Accordingly, the deer population in and near the study area remains at a low level.

Antelope

As described in the Expansion EIS (BLM 1992b), few antelope have been recorded in the majority of the study area. The history of antelope in the area following an introduction in the 1950s is described in the Expansion EIS. The Dry Hills and Frenchie Flat areas in and north of the northeastern part of the study area are mapped as antelope winter range (Figure 3.6-1). Frequent antelope sightings have been reported between Crescent and Carico Lake valleys (Teske 1991). The Shoshone-Eureka ROD (BLM 1986) states that habitat in the Rocky Hills area, just south of the study area, will be managed to support the release of [up to] 200 antelope to augment the low population in the area.

Mountain Lion

Mountain lions occur in low numbers in the mountain ranges of the study area, including the Cortez Mountains. Estimates of lion populations in ranges in and near the study area are cited in the Expansion EIS (BLM 1992b). The BLM notes lion numbers in the Cortez Range may have decreased due to the decrease in deer numbers in the range (Sherwood 1991). However, the NDOW notes lions may be able to supplement their diet by preying upon weakened wild horses (Teske 1991).

Sage Grouse

Sage grouse utilize mountainous parts of the study area as both winter and brood rearing areas. Sage grouse utilize traditional leks for courtship in spring. Nesting usually occurs within 2 miles of a lek. Wet meadow and riparian areas are utilized as brood rearing habitats. The wet meadow and riparian habitats provide a crucial source of insects and succulent forage for the young birds. On the western side of the Cortez Range, the NDOW identifies Cottonwood Canyon as a sage grouse brood rearing area.

In Crescent Valley, leks occur or formerly occurred at four locations: (1) near Tenabo, a ground found to be inactive when last checked in 1969; (2) north of Indian Creek, a ground found to be active in 1992; (3) near the Clipper Mine, a ground found to be active when last checked in 1974; and (4) near Mud Spring Gulch, a ground of uncertain status. Three active leks are located just west of the study area northwest of Carico Lake Valley. Brood habitat is located nearby in the Shoshone Range.

Chukar

Chukar occur throughout the foothills and lower-elevation mountain habitats of the study area, with a concentration found in the northern Toiyabe Range south of Cortez Canyon. As noted in the Expansion EIS (BLM 1992b), BLM Battle Mountain District wildlife biologists identified this area as one of the best chukar habitats in the Shoshone-Eureka Resource area. Like sage grouse, chukar are dependent on water sources and riparian and wet meadow habitats for brood rearing, and on water sources in general as necessary components of their habitat.

Other Game and Furbearers

Hungarian partridge occur in low numbers in the area. A population high was recorded in the early 1970s, but subsequently, populations have declined (NDOW 1983).

Mourning doves are usually one of the more common game species found in the area during spring, summer and early fall. Mourning doves require water sources as well as seeds and insects.

Other game species found in the area, including scattered California (valley) quail populations, pygmy and cottontail rabbits, white-tailed jackrabbits, and Common (Wilson's) snipe, are discussed in the Cortez Expansion EIS (BLM 1992b). Preferred habitats of these species are also discussed in the Expansion EIS.

Furbearers occurring in the study area include kit fox at lower elevation, gray fox in mountainous areas, and coyote, bobcat, badger, and other mustelids throughout the study area. The NDOW emphasizes the importance of streamside riparian habitats for many furbearer species (NDOW 1982, 1983).

Birds

Waterfowl and shorebird habitats in the study area are limited, consisting primarily of ranch ponds and fields. These waters attract migrating water and shore birds, while perennial water in the area may support a few nesting pairs of mallards, cinnamon teal, gadwall, killdeer, and spotted sandpipers.

Raptor species occurring in the area include year-round resident golden eagles and red-tailed hawks, wintering rough-legged hawks, and nesting spring and summer residents including Cooper's and sharp-shinned hawks, Swainson's and ferruginous hawks, turkey vultures, northern harriers, prairie falcons, and American kestrels. Great-horned owls may occur throughout the area. Long-eared owls have been observed in the Shoshone Range, while Crescent Valley supports concentrations of burrowing owls (Herron et al. 1985). Short-eared owls have been reported just to the south in Grass Valley (McAdoo 1980). A northern goshawk was observed in the northern Toiyabe Range in the spring of 1991.

The greatest diversities of nongame avian species occur in spring and summer, when a variety of migratory birds breed throughout the area. Within the general study area, wetland and riparian habitats support the greatest diversity of wildlife.

Fisheries

Brook trout may occur in Elder Creek (Teske 1991). Indian Creek in the Shoshone Mountains currently supports such nongame species as Lahontan speckled dace. A single brook trout, probably from an illegal stocking, was found in the creek in 1984 (Johnson 1993). The BLM Shoshone-Eureka RMP identifies as a long-term goal the improvement to good condition of 2.0 miles of riparian/aquatic habitat on Indian Creek.

Important Wildlife Habitats

Several habitat types are particularly important to wildlife species, as noted in the Expansion EIS (BLM 1992b). Many of these key areas within the study area have been degraded by past land use practices, primarily excessive livestock grazing. Bitterbrush, serviceberry, mountain mahogany, and to a lesser extent big sagebrush stands provide an important winter forage source for mule deer. Pinyon-juniper forest, mountain mahogany stands, and areas of dense brush provide thermal and hiding cover for deer and other species. Larger deciduous tree species are limited in occurrence but are highly important, providing elevated nest sites and habitat for cavity nesting birds including kestrels, woodpeckers, and mountain bluebirds. Sage grouse utilize dense sagebrush stands as nesting sites. Land use practices and range fires have decreased the amount of this habitat type present in the area. Pinyon pine nuts form a valuable forage item for such species as pinyon jays, mountain chickadees, and several species of small mammals.

Seeps and springs present in the study area supply water sources to wildlife residing in the habitats surrounding the springs. At those springs which support wetlands or riparian vegetation such as willow, chokecherry, wild rose, aspen or cottonwood trees, a more diverse wildlife community characteristically occurs.

Wetland or riparian areas are rare on the valley floor. Antelope and mourning doves represent the principal game species known to utilize springs on the valley floor. Those valley springs which support ponds or wetland areas, however, afford habitat to waterfowl and shorebirds. The most extensive valley floor wetlands, found near the hot springs in the Dry Hills east of Crescent Valley, and the irrigated fields near Rocky Pass, represent potential northern harrier and long-billed curlew nesting or foraging habitat. Brewer's and red-winged blackbirds frequent these habitats during the spring and summer. Several species of swallows forage over these areas. Other nongame wildlife utilizing valley floor springs include horned larks and western meadowlarks and smaller numbers of black-throated and Brewer's sparrows.

In the foothills surrounding the valleys, wetland and riparian vegetation occurs in association with many springs, as shown in Appendix Table H-1. Because the foothill springs occur in the more structurally complex sagebrush-grass or pinyon-juniper habitats, a greater variety of wildlife, particularly avian species, occurs near these foothill springs as compared to springs in the shadscale-bud sagebrush habitat on the valley floors. Mule deer, sage grouse, and chukar may water or rear young near wetted areas in the foothills of the study area.

Nongame wildlife diversity is also greater near seeps and springs in the foothills, with rufous-sided towhees, sage thrashers, robins, and gray flycatchers common. Pinyon jays and blue-gray gnatcatchers may be found near springs located in pinyon-juniper habitats. Those foothill springs which include well-developed riparian vegetation may support yellow warblers, house wrens, and lazuli buntings. Cottonwood trees which grow near a few springs in the study area (at Rocky Pass, for example) provide nesting habitat for northern orioles and western kingbirds. Ravens and raptors may also nest in cottonwoods or aspens. Many migrant species will utilize riparian areas as resting and feeding stops in the spring and fall, while a few white-crowned and song sparrows and dark-eyed juncos may winter in such habitats. Cottontail rabbits frequent the cover of riparian vegetation as well. Table 3.6-3 lists species recorded principally or only in either wet meadow/wetland/open water or riparian habitats on the Gund Ranch, just south of the study area.

Threatened and Endangered Wildlife

Bald eagles and peregrine falcons may pass through the area, but habitat conditions are not conducive to either species, and neither is expected to linger in the area.

Several Candidate, Category 2 species (species for which listing as threatened or endangered may be warranted, but which require further study before such a determination is made) occur within the study area. These species include the spotted bat, pygmy rabbit, northern goshawk, ferruginous hawk, loggerhead shrike and, possibly, the western snowy plover. The spotted bat is generally a cave dweller and occurs at a variety of elevations and in several habitats (Jameson and Peeters 1988). Pygmy rabbits occur throughout the Great Basin, particularly in rocky habitats dominated by sagebrush, or on floodplains in association with dense rabbitbrush or sagebrush. Pygmy rabbits often remain near dense cover (Jameson and Peeters 1988). Within the Great Basin, northern goshawks generally nest in aspen groves, usually very near creeks (Herron et al. 1985). A single bird was seen in the northern Toiyabe Range during spring 1991 surveys, and a bird was reported from Cottonwood Canyon, in an aspen grove, in the fall of 1981 (Podborny 1991). Little suitable goshawk nesting habitat occurs in the study area, however. Ferruginous hawks have been reported from pinyon-juniper habitats in the northern Toiyabe Range, and are believed to nest in the area (Sherwood 1991). This species often nests in junipers located on alluvial fans or foothills at the extreme edge of juniper stands. Loggerhead shrikes are often a fairly common species in the Great Basin, though their populations appear to fluctuate considerably. A passerine predatory species, the loggerhead shrike nests in a variety of shrub habitats, from sagebrush on valley slopes to serviceberry habitats in the mountains. The western snowy plover nests on playas, either on the bare playa itself or in saltgrass habitats on playa borders (Bradley 1992). Such habitats occur within the study area, but not within or near the Proposed Action area.

Two other species of concern are the western big-eared bat and the long-billed curlew. Three of the four subspecies of the western big-eared bat occurring in the United States are either listed or Candidate, Category 2 species. The subspecies occurring in Nevada (Plecotus townsendii palescens) is not currently listed or a candidate, but may soon be proposed for listing (Bradley 1992). Western big-eared bats are generally found in desert scrub and pinyon-juniper habitats (Jameson and Peeters 1988). The long-billed curlew, formerly a Candidate, Category 2 species, is currently classified as a Category 3 species (a species which appears to be more abundant, widespread or less vulnerable than previously thought). The U.S. Fish and Wildlife Service has stated that the species may be reclassified as C-2 in the future, however (Hamblin 1992). Long-billed curlews nest in a variety of habitats, including in and near wetland areas and in agricultural and meadow habitats. Within the study area, such habitats are located near the hot springs east of the community of Crescent Valley and in irrigated fields west of Rocky Pass.

3.6.3 Wildlife Resources in the Area of Proposed Disturbance

The area of proposed disturbance lies within NDOW Mule Deer Management Area 15, Unit 152. According to the BLM, the Proposed Action area is located east of identified mule deer yearlong range in the Shoshone Mountains (Figure 3.6-1), and deer use of the valley bottom habitats of the Proposed Action area is currently considered minimal (Sherwood 1991, Teske 1991).

Antelope, while uncommon near the Proposed Action area, seem to be expanding their range in the general area. A band of eight animals was recorded in the Proposed Action area in March of 1992. Antelope have been frequently observed in the area between Crescent and Carico Lake valleys (Teske 1991).

The Proposed Action area, containing primarily shadscale/budsage with no riparian areas, is not sage grouse habitat. The nearest recorded sage grouse lek is located near the Clipper Mine, approximately 3 miles northwest of the Proposed Action area.

Chukar and Hungarian partridge may utilize the upper, western edges of the Proposed Action area in small numbers. Lands to the west of the Proposed Action area, however, have been heavily modified by existing mining-related disturbance.

Nongame found in the area includes northern harriers, red-tailed and possibly Swainson's hawks, and ravens, which utilize the area as hunting territory. Passerine species present include horned larks and, in spring and summer, sage thrashers, western meadowlarks, Brewer's blackbirds, and Brewer's, sage, and possibly black-throated sparrows. The shadscale/budsage habitats occupying most of the Proposed Action area generally do not support a particularly diverse avian community. A small mammal population that includes several rodent species and some lagomorphs (rabbits and hares) supports a predator community of the above raptors, coyotes, kit foxes, and badgers. Several species of reptiles also inhabit the area.

Threatened, Endangered and Sensitive Species

No threatened or endangered species have been recorded in the Proposed Action area. However, two Candidate, Category 2 species (species for which listing as threatened or endangered may be warranted, but which require further study before such a determination is made) may occur in the area. Pygmy rabbits frequent areas of dense shrubs, particularly rocky areas dominated by sagebrush (Jameson and Peeters 1988). At the Gund Ranch approximately 15 miles south of the Proposed Action area, McAdoo (1980) found pygmy rabbits to be the least abundant of three lagomorph species. Pygmy rabbits at the Gund Ranch inhabited tall sagebrush clumps. Pygmy rabbits have also been observed in dense rabbitbrush habitats on floodplains. Pockets of dense rabbitbrush occur on some old disturbances within and near the Proposed Action area. Generally, however, these areas are not considered large enough to support a pygmy rabbit colony. Because pygmy rabbits excavate extensive burrow systems, tailings piles may not afford suitable habitat for these small lagomorphs.

Loggerhead shrikes utilize parts of the Proposed Action area. Shrikes have been observed in big sagebrush inclusions within the Proposed Action area (Sherwood 1991).

3.7 RECREATION AND WILDERNESS

3.7.1 Study Area

The objective of the recreational resource study is to identify recreation resources in the vicinity of the Proposed Action area which could be affected by the proposed development. The study area for recreation resources encompasses portions of Elko, Lander, Eureka, Humboldt, and Pershing counties. This area is included in planning Regions IV, V, and VI of the Nevada Statewide Comprehensive Outdoor Recreation Plan (SCORP) (Nevada Department of Conservation and Natural Resources 1987). Study area definition was based on the fact that some workers in the Cortez Mine live up to 70 miles from the mine, with over 50 percent living in Carlin and Elko (see Section 3.9, Socioeconomics). Because developed recreational opportunities are relatively sparse in this part of Nevada, it is assumed that users would travel to some of the remote areas, especially on weekends, to recreate.

Information was compiled from maps and literature supplied by public and private agencies and from meetings and telephone communications with federal, state, county, and community officials.

3.7.2 Baseline Conditions

Recreational opportunities can consist of dispersed recreation (such as hunting) or use of developed recreational facilities. Recreation opportunities also consist of hiking and camping in nearby WSAs (Roberts and Simpson Park) and photography, especially of the historic Cortez structures. There are no developed recreational opportunities within the Proposed Action area. Water-based recreational sites or unusual features that normally attract people are lacking. Primary recreational opportunities consist of hunting, off-highway vehicle (OHV) use, and rockhounding.

The 1987 SCORP indicates that the supply and demand of recreational opportunities is somewhat varied across the three planning regions. Generally, the demand for recreational facilities by residents of the regions is projected to exceed the supply between 1990 and 2000. Additionally, residents of the more populated regions of the state and out-of-state residents also use the facilities of these regions. Opportunities that appear to be particularly stressed are lakes and streams, bicycle trails, tennis courts, and ball fields.

Developed recreations areas in the general region are depicted on Figure 3.7-1. More detailed information on the baseline conditions of recreational facilities is summarized in the Expansion EIS. The Expansion EIS also notes that the numbers used in projections of future stress on recreational facilities were based on data gathered 10 and 15 years ago. Since this was before much of the recent mining activity in the region, the demand figures may be low, and the focus of recreational pursuits may have changed.

3.7.3 Wilderness Study Areas

Due to existing disturbances, the immediate Proposed Action area was never considered a WSA. There are 12 WSAs in the general region, as depicted in Figure 3.7-1. Information about these WSAs is summarized in the Expansion EIS (BLM 1992b).

3.8 VISUAL RESOURCES

3.8.1 Study Area

The study area for visual resources includes those landscapes that viewers could travel through, recreate in, or reside in within which existing views could be affected by the proposed action or its ancillary facilities. The study area for the Proposed Action is bounded on the west by the crest of the Shoshone Range; on the east by the crest of the Cortez Mountains; on the south by the Toiyabe Mountains; and, on the north, several miles north of Crescent Valley where the proposed areas of disturbance can first be viewed.

Visual resources are characterized according to guidelines given in the Visual Resource Inventory Manual (BLM Manual Handbook 8410-1, 1/17/86). The three primary components of the Visual Resource Management (VRM) system are: scenic quality, visual sensitivity, and visual distance zones. Based on these three factors, land is placed into one of four visual resource inventory classes. The inventory classes rank the relative value of the visual resources and provide the basis for considering visual values in the resource management planning (RMP) process.

3.8.2 Baseline Conditions

The study area is located in the northern Great Basin section of the Basin and Range Physiographic Province. The Great Basin is characterized by a rhythmic pattern of isolated mountain ranges and wide basins with broad, open vistas. Vast areas of sagebrush and scattered grasses cover the valley basins. Infrequent linear patterns of riparian willows and cottonwoods outline the larger drainages. At higher elevations, mixed shrubs and scattered pinon-juniper forests cover the mountains.

The mine expansion and surrounding area are characteristic of the province: a broad, flat-to-gently rolling landscape with abruptly rising foothills to the west. The Proposed Action elevation is approximately 5,170 feet. Vegetation is a homogeneous pattern of sagebrush and grasses at lower elevations and pinyon-juniper and mixed shrubs at higher elevations. Proposed mine expansion activities are located within the vicinity of existing visually-dominant mine disturbance areas. Vegetation colors include tawny, gray, brown, and dark green. Soils range from beige to a chalky off-white color, which, when exposed, contrasts highly with the surrounding vegetation. Rock colors vary from light to dark brown to burnt orange.

The Gold Acres area contains smooth, rounded and moderately steep landforms. Vegetation is mottled and finely textured. Colors range from tawny to sage green. A network of lighter colored chalky beige roads are located on foothill slopes. No waterforms are apparent. A few blocky-formed, light-colored, smooth-textured structures are located in the vicinity of the existing mining disturbance. The disturbed area contains waste rock piles of lighter brown to reddish-beige colors which contrast with the surrounding vegetation. Dust plumes from haul truck activity are sometimes visible.

The BLM has established VRM classes for the study area (Figure 3.8-1). Land within the study area has been designated VRM Class IV. To the east and southeast of the Proposed Action area are two areas of VRM Class III land. For Class IV lands, the level of visual change to the landscape can be high, dominate the view, and be a major focus of a viewer's attention. For Class III land, the level of change to the landscape should be moderate and should not dominate the view of the casual observer. Despite the Class III and IV designation of land adjacent to and within the Proposed Action area, every attempt should be made to minimize the impact of the proposed activities on the area's visual resources through careful location of Proposed Action facilities, minimal land disturbance, and replication of the basic landscape elements in Proposed Action design and implementation.

3.9 SOCIAL AND ECONOMIC VALUES

3.9.1 Study Area

The study area includes Battle Mountain in Lander County, Beowawe and Crescent Valley in Eureka County, and Carlin and Elko in Elko County. These are communities where construction and operation workers are likely to reside. This section describes the current demographic characteristics and economic conditions in this three-county study area and the communities listed above.

3.9.2 Population

Table 3.9-1 presents the current and projected population in the study area. Recently, the Elko County population has doubled, going from 17,269 to 33,530, over the period from 1980 to 1990, due primarily to the mining and exploration activities along the Carlin Trend. Population in Lander County grew by about 54 percent over the same period to a total of 6,266 people at the time of the 1990 census. Eureka County recorded a relatively small growth in population (29 percent) over this period with a recorded increase of 1,547 citizens. Most of the growth in the study area population has occurred since 1986, primarily due to immigration of mining workers in response to growth in mining activity. This growth has centered around cities such as Elko, Carlin, and Battle Mountain, (e.g., population growth of 55 percent in the City of Elko, and almost 98 percent in Carlin between 1985 and 1989). According to official Nevada state projections, Elko County population is expected to increase by another 28.9 percent between 1990 and 1995. During the same period, Lander County population is projected to increase by 6 percent. However, growth in Eureka County population is expected to be relatively less marked; an increase of about 2.3 percent is projected (Nevada Department of Administration 1992). Table 3.9-1 includes the population growth projections for the study area through 1997.

3.9.3 Economy and Employment

Nevada's economy is dominated by the service industry, primarily by the hotel, gaming and recreation sectors. However, rapid increases in mining sector employment have been recorded in recent years due to the increase in gold mining in many counties. Eureka and Lander counties depend heavily upon mining for employment. As shown in Table 3.9-2, about 93 and 52 percent of the labor force in these counties was employed in mining in 1991. The economy of Elko County depends more on the service industry, and mining accounted for about 8.5 percent of all jobs in Elko County in 1991. However, Elko residents also commute to mines in adjacent counties in substantial numbers. Unemployment rates in the study area in 1992 ranged from 5.2 in Lander County to 1.4 in Eureka County (Nevada Department of Administration 1992).

According to the Elko office of the Nevada Employment Division the study area labor pool contains ample resources as far as laborers, craftsmen, and equipment operators are concerned, and could supply as much as 90 percent of the needs of any project. However journey level workers, i.e., in skilled trades, are relatively unavailable, and the local area could supply only about 10 percent of the needs of any project. However, closure of some mining operations in Battle Mountain would increase the availability of skilled workers by 200 persons (Lattin 1993). Also the ongoing construction at some of the major mines in the area (namely Barrick and Newmont), when completed, would make construction workers available for other projects.

Cortez Gold Mines currently employs a total of 195 personnel. Table 3.9-3 presents information on the distribution of these employees by place of residence. Most of the employees reside in Elko, Crescent Valley and Carlin.

3.9.4 Housing

Recent U.S. Census data indicate that there were 5,817 housing units in Elko in April 1990 (Naroll 1992). This has grown from 3,883 units in April 1988, including 2,203 renteroccupied units. In general, the supply of housing for sale in the study area appears adequate. However, rental housing continues to be tight in Elko.

Housing stock in Carlin grew from 850 to 888 over 1989-1990; however, the turn-over rate for rental units is low and as a consequence no rental units are available. In fact, the community has begun a waiting list for individuals seeking rental housing. During roaster construction in 1989, under Cortez Housing Assistance Program, Cortez submitted and obtained approval for a subdivision with 27 lots in Carlin. This approved subdivision is currently not built but could be constructed if non-availability of housing in Carlin or the study area was noted to be a constraint on future Cortez development (Chavis 1993). In addition, the city of Carlin has recently acquired 437 acres of land from the BLM. A master plan is being prepared for the development of the parcel and the search for a developer is underway (Aiazzi 1993).

Housing stock in Battle Mountain is reported by the 1990 census to consist of 1,431 units. Breakdown by type of unit is not available for Battle Mountain. However, statistics for Lander County for earlier years reveal that more than half the housing units in Lander County and Battle Mountain are mobile homes. Currently, nearly 150 mobile home unit spaces are available in Battle Mountain due to the recent closure of the underground operations of Echo Bay Minerals Mine (H. Smith 1993).

Lots are available in Crescent Valley for housing construction, and several mobile homes are available for rent (List 1993).

Hotels and motels in the study area are concentrated in the City of Elko. More than 1900 hotel rooms are available in Elko, with 89 rooms are available in Carlin. Between Elko and Carlin, 7 RV parks are in operation, however, the vacancy rate is very low and several of the parks report being full year-round (Parker 1993). Two hundred hotel/motel rooms are available in Battle Mountain (Amize 1993). The smaller communities of Crescent Valley and Beowawe have 16 units and 12 units available, respectively (Williams 1993).

3.9.5 Schools

Schools in the Elko-Carlin area are operated by Elko County School District. Currently there are five elementary schools, a junior high and a high school in the city of Elko, and two elementary schools in Spring Creek, a community near Elko. There is one combined school in Carlin. School capacities and enrollments in 1993 are reported in Table 3.9-4. All schools are at or over capacity. One elementary school is operated entirely out of mobile trailers, and trailers are also used in the other schools, with one-third of all students in trailers. Some of the effects of this overcrowding include classroom loadings above State-mandated levels, very high student-teacher ratios, use of team teaching, inability of the schools to offer all electives or to provide a lunch program, and the elimination of certain special programs. In addition, this overcrowding in Elko-Carlin schools has placed such enormous demands on the District's resources that the District is unable to provide necessary facilities in other schools in Wendover, Jackpot and Owyhee. The District is currently building one school each year. One junior high, high school and permanent elementary school is planned in Spring Creek, and a high school, a junior high and two new elementary schools in Elko. The District's building needs for the next eight years (1991-1999) are projected to be $50 million and the building program is predicated on a $0.75 per $100 assessed value pay-as-you-go tax levy (Billings 1993).

Communities of Beowawe and Crescent Valley are served by an elementary school located in Beowawe. The school enrollment in 1992 was 49 students, although the school has the capacity to accommodate 80 to 100 students (Wright 1993). There are one primary, one elementary, one junior high and one secondary school in Battle Mountain. Total enrollment in the Battle Mountain schools in 1992 was 1,446 students. All schools in Battle Mountain except the primary school have capacity to accommodate additional students. A new elementary school for Battle Mountain is being planned for construction in 1994-95 school year (Lemair 1993).

3.9.6 Water Supply and Waste Water

The City of Elko added two water wells in the summer of 1990. The City has completed Phase I of its sewer treatment modifications, which created a capacity sufficient to serve another 7,000 to 8,000 persons over 1990 population. Phase II of the modification is due to begin in 1993 and it will increase secondary clarifying treatment capacity to more than 3 million gallons (Lipparelli 1993). The City of Carlin has sufficient water and sewer capacity to accommodate a population of 5,000, which is more than 2,500 additional persons over the 1990 population. Information from the City of Carlin indicates that Newmont and Barricle mining companies have assured the City that dewatering operations at those mines would not significantly affect the aquifer that is the source of the City's water supply (Aiazzi 1993).

Homes and trailers in Crescent Valley and Beowawe are served by septic tanks. The water supply system was recently upgraded by Eureka County to include additional mainlines for water distribution to Crescent Valley. The upgrade also included an increase in storage capacity from 180,000 to 360,000 gallons of water (Fiorenzi 1993).

Lander County provides water and sewer services to the residents of Battle Mountain. The sewer treatment plant for the town has a capacity of 800,000 gallons per day, and is currently treating 450,000 gallons per day. The water system has a water storage capacity of 2.3 million gallons (H. Smith 1993).

3.9.7 Solid Waste Disposal

Elko County operates seven landfills through the Public Works and Roads Department. Funding for the county landfills is generated by a 10 percent gasoline tax. The City of Elko operates a 130-acre municipal sanitary landfill, funded by the general fund and user fees. Currently, the landfill is approaching the half-full mark, and the site is due to close in approximately 6 years. The community of Carlin, also in Elko County, operates an 80-acre municipal landfill north of its city limits. The rate of fill in the landfill is less than half an acre per year to date and the life of the landfill is therefore expected to be greater than 10 years (Brown 1993).

The Lander County landfill is located on county-owned land and serves the communities of Battle Mountain and Beowawe. The landfill has a lifespan of at least 15 more years and is less than half full (H. Smith 1993). Eureka County operates a landfill on BLM land under a Recreation and Public Purposes Permit (R&PP). The landfill is due to close this year and City officials are in the process of looking for another site (Echeverria 1993).

3.9.8 Law Enforcement

Law enforcement within the study area is provided by city police departments. Additional enforcement officers are provided by county sheriff departments. In some instances, small communities rely entirely upon the County Sheriff Department for law enforcement.

In Elko County, 20 patrol officers and three detectives are stationed at the Elko County Sheriff's Department, in the City of Elko (Elko County Sheriff's Department 1993). The City of Elko maintains its own patrol force of 33 sworn officers, 19 patrol officers, and 5 detectives. The Department plans to add 3 new officers in 1993, and 11 officers in all over the next 5 years. The City Police Department also handles dispatch for the county and has 10 dispatch personnel. With the current population in the city, there are about 1.7 police officers per 1000 residents (D. Smith 1993). The City of Carlin Police Department employs six patrol officers to cover the 2-mile by 2-mile town (Kranovich 1993).

The Lander County Sheriff's Department, located in Battle Mountain, employs 10 officers to serve within the Battle Mountain area. No city police force has been established (Spealman 1993).

Eureka County employs seven County Sheriff Patrol Officers. One officer is stationed in Crescent Valley. Beowawe is patrolled by two County Sheriff's officers stationed locally (Williams 1993).

3.9.9 Fire Protection

Incorporated areas within Elko County support their own fire departments, and unincorporated areas of the county are served by the Nevada Division of Forestry and the volunteer-based Northeastern Fire Protection District. The Elko Fire Department includes 12 paid firefighters and 18 volunteers housed in two fire stations within the city limits (D. Smith 1993). Carlin has a volunteer fire department made up of 26 community members, 19 of whom are trained emergency medical technicians. The department serves the immediate Carlin town limits as well as the area 12 miles to the east, 25 miles west to Dunphy, 60-70 miles south and 50 miles north of the community (Brown 1993). A mutual aid agreement is in effect with the Nevada Division of Forestry, the State Fire Agency, and the Elko and Eureka County Fire

Departments. Crescent Valley and Beowawe are served by volunteer fire departments of 10 people and 15 people, respectively (Williams 1993).

Battle Mountain in Lander County is served by a volunteer Fire Department with 25 people on staff. Lander County also maintains a mutual aid agreement with the Nevada Division of Forestry and the Bureau of Land Management (H. Smith 1993).

3.9.10 Medical Care and Emergency Response

Elko County provides two ambulances for emergency response medical care. The State Emergency Medical Services in Elko County is composed of 20 volunteer emergency medical technicians (EMTS) or registered nurses. Elko County hospital, with a staff of 215 and a 50-bed facility serves all of the communities and towns in the study area (D. Smith 1993).

In the city of Elko emergency response services are provided by local agencies including the Elko City Fire Department and Police Department. The Elko County Sheriff's Department, Nevada Highway Patrol, Nevada Division of Forestry, Nevada State Ambulance Services, and the Bureau of Land Management also respond to emergencies in the region, if necessary.

The Battle Mountain Hospital in Lander County receives patients for emergency care and stabilization only. That facility has 14 beds and is not staffed or equipped for surgery or other long-term treatment.

Carlin is served by the Carlin Volunteer Fire Department which includes 19 EMTs, one registered nurse and one practice nurse. The community also has access to the state and federal agency assistance listed for the City of Elko above (Brown 1993).

The Battle Mountain Fire Department is staffed by 25 volunteers, 18 of which are EMTs. The department provides one ambulance for community use. Crescent Valley and Beowawe also rely on volunteer fire departments staffed with EMTs (H. Smith 1993).

3.9.11 Social Conditions

Recently, a telephone survey of 151 respondents in Elko, Spring Creek, and Carlin was conducted to obtain information on social conditions and the quality of life in the study area. The survey was conducted by Huntington for the Newmont Gold Quarry Project EIS (BLM 1993b). Some of the relevant findings of the survey are reported here to provide information on social conditions in the area. The survey gathered data on quality of services available in the communities, respondents' views about the area they lived in, social problems, social classes and power groups, and attitudes towards newcomers and growth.

Most respondents have indicated that the society is divided on the basis of income into high-, middle-, and low-income groups. Some respondents have also noted the society to be composed of old-timers, newcomers who would stay permanently, and the "short-termers" who leave the area once the job is done. Power is considered to rest with the state government, county government, and large corporations, especially mining companies.

A vast majority of the respondents appear to be proud of the area they live in, and feel that there is a sense of community among the residents. Most respondents feel that their community is safe to live in, but note that crime has increased in recent years. Social problems in the study area relate mainly to increased crime, especially involving juvenile delinquents; increased drug use and alcohol use; vandalism; and some spousal abuse/domestic violence. Crime involving juveniles is considered by most respondents to be a result of a general lack of activities in the area for teenagers. Most respondents have stated that apart from police action to curb violence and a few other programs, not much is being done to resolve this problem. Crime is noted to be related to factors such as increased alcohol and drug use, gambling, lack of jobs, scarcity of housing, high cost of living, and the general rapid growth in the study area.

Most public services have been rated as average or above average, with the exception of the condition of local streets and hospitals, which are considered by a large section of the respondents to be below average. The majority of the respondents have also rated the communities to be below average in terms of shopping opportunities and rental housing. Although most respondents have indicated that there are community activities in their city, the range of available activities appears limited.

3.9.12 Public Finance

A large percentage of the State of Nevada's revenues is derived from the tax on gaming revenue. Nongaming tax revenues consist of property tax, sales tax, the statewide gas tax, cigarette and liquor tax, the drug manufacturer's tax, the estate and lodging tax, and the net proceeds-from-mines tax. Nevada has a 6 percent sales tax rate, which includes 2 percent state sales and use tax, 1.5 percent school support tax, 2.25 percent County/City Relief Tax, and an optional 0.25 percent Mass Transit Tax. The sales tax in Elko, Lander, and Eureka counties is 6 percent (Ridder 1993).

The ad valorem property tax rate is $2.2344 (1991-92) per $100 of assessed value for Elko County, and $1.6354 (1991-92) per $100 of assessed value for Eureka County. The basic rate is $3.050 (1991-92) per $100 assessed valuation in Lander County, although the tax rate is higher and varies among the eight taxation districts. In addition, mining operation in the State generate net proceeds-from-mines tax revenues. This tax is assessed on the net proceeds or net profits of mining operations and currently is $5 per $100 for net proceeds in excess of $4 million. The rate is lower for operators with net proceeds less than $4 million. The tax is collected by the State and is shared by the State and the county where the net proceeds were generated. The county receives revenues equal to its ad valorem rate applied to the net proceeds. Annual revenues from property taxes, net proceeds-from-mines taxes and sales tax are reported in Table 3.9-5 for the three counties.

Current Cortez Gold Mines operations generate both property tax and net proceeds-from-mines tax revenues for the counties. Taxes paid by Cortez in 1992 are reported in Table 3.9-6. In addition, $7.9 million were paid in salaries and wages in 1992. Given that about 39 percent of personal income is spent on taxable goods (Bureau of Labor Statistics 1989), this payroll generated an estimated $194,860 in sales tax revenues in the regional economy in 1992. Most of the sales tax revenues accrued to the communities where Cortez employees reside.

3.10 LAND USE/LIVESTOCK GRAZING

3.10.1 Land Status

The Proposed Action area (see Figure 1.1-2) comprises 3,496 acres, of which approximately 1,880 acres are proposed for disturbance as described in Section 2.2.1, and is made up entirely of public lands administered by the Bureau of Land Management, Battle Mountain District.

3.10.2 Land Use

The major land uses within the Proposed Action area are livestock grazing and mining. Generally these uses are compatible, although in areas of concentrated mining activity, livestock grazing is affected by the loss of forage on disturbed areas. Historic use patterns and livestock movement are also affected in those areas.

The major transportation route in the vicinity of the Proposed Action area is State Highway 306 traversing Crescent Valley from north to south. The highway is paved from the town of Crescent Valley to about 12 miles south. Lander County Road 225 continues south as a gravel road. Other gravel and dirt roads, including County and BLM roads, occur within the study area.

The existing rights-of-way that have been issued by the BLM for federal lands in or near the Proposed Action area are shown below (Figure 3.10-1):

Right-of-Way Number	Type of Facility
N-30650	Buried Telephone Cable
N-7803	Buried Telephone Cable
NEV-044669	Highway 306
N-7348	23-kV Transmission Line
N-43669	Buried Pipeline
N-43670	Haul Road

BLM has approved a ROW for a Sierra Pacific Power Company 120-kV transmission line to serve the proposed mine development.

Livestock Grazing

Portions of three livestock grazing allotments lie within the study area (Figure 3.10-2). However, the proposed action is confined to the Carico Lake Allotment administered by the BLM's Battle Mountain District. Table 3.10-1 reflects livestock grazing allotment data within the study area. Because of the lack of boundary fences, the potential for livestock drift and trespass occurs between the Carico Lake and South Buckhorn, and between the Carico Lake and Argenta allotments.

The BLM has determined the management of each grazing allotment through a planning process referred to as selective management categorization. The process assigns extent and priorities for activity planning within each allotment including range improvement facilities which would be required to accomplish management objectives. As depicted in Table 3.10-1, the grazing allotments within the study area are classified by the BLM as "Improve" (I) allotments. On category I allotments, the objective is to improve current unsatisfactory conditions.

Livestock grazing is authorized generally on a year-round schedule for the Carico Lake Allotment. Use of higher elevations of the allotment by livestock is dictated by seasonal weather patterns, but use occurs in the vicinity of the Proposed Action area mainly in the spring season and to a lesser extent, in the fall. Licensed grazing use has not been affected by drought conditions. Table 3.10-2 lists active grazing preference by livestock operators in the study area, the class of livestock, and the normal grazing season.

One BLM range improvement is recorded adjacent to the existing haul road leading to the Proposed Action area in Section 8, T27N R47E. The range improvement is a water well, R-4269. According to the BLM records, the well was functional at the 5-9-89 inspection of the facility.

Based on the range survey conducted in the area (BLM 1964-1967) the grazing capacity within the Proposed Action area (all within the Carico Lake Allotment) is 191 Animal Unit Months (AUMs).

Portions of two wild horse management areas do extend into the study area, but no wild horse management areas exist in and around the project area.

3.11 CULTURAL RESOURCES

Cultural resources include prehistoric and historic archaeological sites, historic architectural and engineering remains, and sites of traditional value or religious importance to Native Americans or other ethnic groups. A cultural resource is considered significant when it has been determined that it is eligible for inclusion on the **National Register of Historic Places** (NRHP). Cultural resources are significant in local, state, or national history, based on their architecture, archaeology, engineering, or culture. They must possess integrity of location, design, setting, materials, workmanship, feeling and association. They must contribute to an understanding of history or prehistory through the variety, quantity, clarity, and research potential of the information present, and must:

A. be associated with events that have made a significant contribution to the broad patterns of our history; or

B. be associated with the lives of persons significant in our past; or

C. embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master or that possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or

D. have yielded, or may be likely to yield, information important in prehistory or history.

The present EIS is tiered to the Expansion EIS. A Class III cultural resources inventory was made for 3,454 acres of the Proposed Project. No NRHP-eligible properties were found.

Thus, no impacts to properties are expected to result from implementation of the Pipeline Project. The State Historic Preservation Officer has concurred with this finding.

3.11.1 Study Area

The area of proposed disturbance for the cultural resources analysis is comprised of 1,827 acres where the Proposed Action would occur. These new facilities are located just east of the Gold Acres area (Figure 3.11-1).

Intensive (Class III) cultural resources surveys were conducted on lands that encompass a somewhat greater area than the area proposed for development, 3,454 acres. The results of these inventories are provided in Cultural Resources Technical Reports on file with the Battle Mountain BLM District Office.

3.11.2 Baseline Conditions

This EIS is tiered to the Expansion EIS. Baseline conditions related to cultural resources (prehistory, ethnography, contemporary Native American concerns and history) are provided in the Expansion EIS, available at the BLM Battle Mountain District Office for review.

3.11.3 Previous Cultural Resource Investigations Completed in the Study Area

Summary of Sites in Area to Be Disturbed

A review of prehistoric and historic site records indicates that seven sites have been recorded within the area of proposed disturbance. Four historic sites and three prehistoric sites have been recorded in the study area. The Nevada State Historic Preservation Office (SHPO) has determined that none of these sites is eligible for inclusion on the NRHP.

Class III Survey Results

A Class III cultural resources inventory was made for 3,454 acres of the Pipeline Project. No NRHP eligible properties were found. Thus no impacts to properties are expected to result from implementation of the Proposed Project. The State Historic Preservation Officer has concurred with this finding.

Native American Consultation

A comprehensive Native American consultation program was undertaken for the Cortez Expansion EIS pursuant to the requirements of the American Indian Religious Freedom Act. No issues of significant concern were expressed by Native Americans with regard to the proposed project area for the Expansion EIS (BLM 1993:3-57 to 3-62). The Native American consultation study area for that EIS encompasses an area essentially identical to that of the Pipeline Project EIS. The comments from Native Americans received in conjunction with the Expansion EIS are therefore applicable to this EIS. For specific information regarding Native American concerns, refer to the Expansion EIS.

TABLE 3.1-1

COMPARISON OF ANNUAL CLIMATOLOGICAL DATA FROM ELKO AND WINNEMUCCA NWS STATIONS

	Elko[a] Station	Winnemucca[a] Station
Mean Daily Maximum Temperature (F)	62.1	65.8
Mean Daily Minimum Temperature (F)	30.2	31.7
Monthly Average (F)	46.2	48.7
Mean Sky Cover	5.3/10	5.3/10
Precipitation (inches)	9.3	7.87
Mean Wind Speed (mph)	6	8
Prevailing Wind Direction	SW	S,W

[a] Source: USDC 1987

TABLE 3.1-2

CORTEZ GOLD MINES
Third Quarter 1992
Wind Rose Data
July 1 - September 30, 1992

	Wind Speed					
Wind Direction	0-7 mph (%)	8-11 mph (%)	12-18 mph (%)	19-24 mph (%)	Over 24 mph (%)	Total
N	0.2	0.3	---	---	---	0.5
NNE	2.3	1.3	0.2	---	---	3.8
NE	4.1	0.4	---	---	---	4.5
ENE	2.1	0.2	---	---	---	2.3
E	2.2	0.1	0.1	---	---	2.4
ESE	3.3	0.4	---	---	---	3.7
SE	2.3	0.6	0.2	---	---	3.1
SSE	3.7	0.7	0.4	0.2	---	5.0
S	4.6	2.3	0.8	0.2	---	7.9
SSW	3.8	3.5	4.1	0.2	0.2	11.8
SW	4.8	4.4	4.9	0.8	0.1	15.0
WSW	5.6	2.1	2.0	0.4	0.1	10.2
W	5.9	4.7	1.5	0.1	0.1	12.3
WNW	4.1	6.2	1.3	0.1	0.1	11.8
NW	1.9	1.2	0.6	---	---	3.7
NNW	0.8	0.8	0.4	---	---	2.0
Variable	---	---	---	---	---	---
						100.0%

TABLE 3.1-2 (Concluded)

CORTEZ GOLD MINES
Fourth Quarter 1992
Wind Rose Data
October 1 - December 31, 1992

Wind Direction	Wind Speed 0-7 mph (%)	8-11 mph (%)	12-18 mph (%)	19-24 mph (%)	Over 24 mph (%)	Total
N	0.3	0.3	0.3	---	---	0.9
NNE	4.1	1.2	0.1	---	---	5.4
NE	4.3	0.3	---	---	---	4.6
ENE	3.0	---	---	---	---	3.0
E	3.5	0.3	0.3	---	---	4.1
ESE	3.9	0.3	---	---	---	4.2
SE	3.0	0.2	0.3	---	---	3.5
SSE	3.5	0.2	0.3	0.3	---	4.3
S	5.2	1.8	1.3	0.3	---	8.6
SSW	4.4	3.1	3.1	0.8	0.4	11.8
SW	4.2	1.9	2.2	0.3	---	8.6
WSW	5.7	1.0	1.3	0.4	---	8.4
W	9.8	4.6	1.0	0.3	---	15.7
WNW	6.3	4.0	1.2	---	---	11.5
NW	2.2	0.8	0.7	---	---	3.7
NNW	0.9	0.7	0.1	---	---	1.7
Variable	---	---	---	---	---	---
						100.0%

TABLE 3.1-3

AMBIENT AIR QUALITY STANDARDS
(micrograms per cubic meter)

		National Ambient Air Quality Standards		Nevada Ambient Air Quality Standards
		Primary	Secondary	
Sulfur Dioxide				
3-hour[a]		---	1,300	1,300
24-hour[a]		365	365	365
Annual Average		80	80	80
Particulate Matter < 10 μm				
24-hour		150	150	150
Annual Average		50	50	50
Nitrogen Dioxide				
Annual Average		100	100	100
Carbon Monoxide				
1-hour[a]		40,000	40,000	40,000
8-hour[a]	< 5,000′ MSL	10,000	10,000	10,000
	= > 5,000′ MSL	10,000	10,000	6,670
Ozone				
1-hour[a]		235	235	235
Lead				
Quarterly Average		1.5	1.5	1.5

[a] Short-term national standards and national and Nevada PSD increments (24 hours or less) are not to be exceeded more than once per year, at any location. Short-term Nevada standards are not to be exceeded at any time.

TABLE 3.1-4

AMBIENT AIR TOXICS STANDARDS
(micrograms per cubic meter)

	Nevada Ambient Air Toxics Standards
Crystalline Quartz 8-hour	2.38
Mercury 8-hour	1.19
Arsenic 8-hour	4.76

Source: Nevada Administrative Code (NAC) 445.717.

TABLE 3.1-5

CORTEZ PIPELINE PROJECT
AMBIENT PM_{10} LEVELS, 1992 ($\mu g/m^3$)

Date	PM_{10} Concentrations Sample 1	Sample 2
July 5	34	41
11	31	45
17	21	26
23	20	18
29	21	23
August 4	16	20
10	31	35
16	--	--
22	26	27
28	24	24
September 3	18	17
9	12	13
15	29	28
21	24	27
27	12	14
October 3	6	9
9	14	12
15	27	--
21	21	24
27	15	17
November 3	2	3
9	4	8
14	6	7
20	--	19
26	8	10
December 2	8	12
8	3	6
14	4	--
20	--	--
26	9	--
Number of Samples	27	25
Highest	34	45
Second Highest	31	41
Mean (Arithmetic)	17	19

Source: WCC 1991

TABLE 3.2-1

HISTORY OF EARTHQUAKE ACTIVITY WITHIN 50 MILES OF THE PIPELINE PROJECT AREA (March 23, 1872 - January 25, 1993)[a]

Magnitude[b]	No. of Events
7.00-7.99	1
6.00-6.99	1
5.00-5.99	5
4.00-4.99	22
3.00-3.99	32
unmeasured	10
	71

[a]NOAA Geophysical Data Base, January 25, 1993.
[b]Nine magnitudes were estimated from Modified Mercalli Intensities.

TABLE 3.2-2
SUMMARY OF STUDY AREA - MINING AND RELATED ACTIVITY
(Page 1 of 2)

Mine/Prospect	Operator	Location	Mineralization/ District	Operation	Disturbed Acreage
Elder Creek Mine	Alta Gold Inc.	Sec. 1, 12-14, 23, 24, T28N R45E Sec. 6, 7, 18, 19, T28N R46E	Gold/Bullion	Open Pit/Leach	143 acres
Fire Creek Mine	Aurenco	Sec. 14, 15, 22, 23, T30N R47E	Gold/Bullion	Open Pit/Leach	173 acres (93 public)
Robertson Mine (Gold Quartz)	Coral Resources Inc.	Sec. 8, T28N R47E	Gold/Bullion	Open Pit/Leach	156 acres
Triplet Gulch Mine	Coral Resources Inc.	Sec. 16, 17, T28N R47E	Gold/Bullion	(Undeveloped) Open Pit/Leach	129 acres
Grey Eagle Mine	S/L Corporation	Sec. 13, 14, 24, T29N R46E	Gold-Silver/Bullion	Underground (and Pit?)/Leach	<5 acres (public)[a]
Greystone Mine	MI Drilling	Sec. 23-26, T28N R45E	Barite/Bullion	Open Pit	500 acres[a]
Clipper Mine	MI Drilling	Sec. 5, 6, T27N R46E Sec. 31, 32, T28N R46E	Barite/Bullion	Open Pit	400 acres[a]
Toiyabe Mine	Inland Gold & Silver Corp.	Sec. 13, T25N R46E Sec. 18, 19, T25N R47E	Gold/Unorganized	Open Pit/Leach	266 acres
Buckhorn Mine	Cominco American	Sec. 16-21, 28-33, T27N R49E Sec. 13, 24, 25, T27N R48E Sec. 4-6, T26N R49E	Gold/Buckhorn	Open Pit/Leach	260 acres
Gold Acres Mine	Cortez Gold Mines	Sec. 25, 36, T28N R46E Sec. 30, 31, T28N R47E Sec. 6, T27N R47E Sec. 1, T27N R46E	Gold/Bullion	Open Pit/Leach	881 acres
Horse Canyon Mine	Cortez Gold Mines	Sec. 33, 34, T27N R48E Sec. 3, 4, 9, 10, T26N R48E	Gold/Cortez	Open Pit/Leach	436 acres
Cortez Mine	Cortez Gold Mines	Sec. 13, 14, 23, 24, T27N R47E Sec. 18, 19, T27N R48E	Gold/Cortez	Open Pit/Leach	1286 acres
Fox Turquoise Mine	Fox Mining Company	Sec. 34, T27N R47E	Turquoise/Bullion	Open Pit	4 acres
Indian Creek	Newmont Exploration Ltd	Sec. 6, T28N R47E Sec. 30, 31, T29N R47E	Gold/Bullion	Exploration Drilling	25.6 acres
Cottonwood/Brock Canyons	Cominco American	Sec. 10-15, 23-25, T27N R49E Sec. 7, 18, 19, 30, T27N R50E Sec. 34, T28N R49E	Gold/Buckhorn	Exploration Drilling	20 acres

TABLE 3.2-2
SUMMARY OF STUDY AREA - MINING AND RELATED ACTIVITY
(Page 2 of 2)

Mine/Prospect	Operator	Location	Mineralization/ District	Operation	Disturbed Acreage
Mill Canyon	Santa Fe Pacific Mining	Mill Canyon	Gold/Cortez	Exploration Drilling	250 acres (max)[a]
Lander	Misc. (historic)	Sec. 5, T28N R47E	Silver/Bullion	Historic	4 acres
Utah Mine Camp	Misc.	Sec. 16, T28N R46E	Gold/Bullion	Historic	6 acres
Tenabo	Misc. (historic)	Sec. 9, T28N R47E	Gold/Bullion	Historic	6 acres
Mud Spring Gulch	Misc.	Sec. 18, T29N R47E	Gold/Bullion	Historic placer	21 acres
Cortez Mining District	Misc.	T26-27N R48E	Silver/Cortez	Misc.	142 acres
Notices of Intent Battle Mt. District	Misc. (90 Notices)	Numerous	--	--	450 acres (max)
Notices of Intent Elko District	Misc. (29 Notices)	Numerous	--	--	145 acres (max)

[a] Estimated by U.S. BLM personnel.

TABLE 3.3-1

ORDER 2 SOIL SURVEY DATA
(Page 1 of 2)

Map Unit	Soil Type	Topsoil Suitability - Limiting Factors	Slope (%)	Solum Depth (inches)	Drainage Class	Runoff	Water Erosion Hazard	Permeability	Hydrologic Group
Duric Camborthids									
A	coarse-loamy, mixed, mesic	Poor - clay content	0-4	>60	Well	Very slow	Slight	Mod. slow - mod. rapid	B
Cr	coarse-silty, mixed, mesic	Poor - thin layer	0-4	>60	Well	Slow	Slight	Mod. - mod. rapid	B
Typic Camborthids									
Wr	loamy-skeletal, mixed, mesic	Poor - small stones, area reclaim	0-4	>60	Well	Slow	Slight	Mod. rapid	B
Duric Natrargids									
Bk	fine-loamy, mixed, mesic	Poor - small stones, excess salt, excess sodium	0-4	>60	Well	Very slow	Slight	Mod. slow - mod. rapid	B
Duric Haplargids									
Rf	loamy-skeletal, mixed, mesic	Poor - small stones, area reclaim	5-10	>60	Well	Medium	Slight	Mod. slow - mod. rapid	B
3a	fine-loamy, mixed, frigid	Fair - clay content, carbonates	2-8	>55	Well	Slow	Slight	Mod. slow	B

TABLE 3.3-1

ORDER 2 SOIL SURVEY DATA
(Page 2 of 2)

Map Unit	Soil Type	Topsoil Suitability - Limiting Factors	Slope (%)	Solum Depth (inches)	Drainage Class	Runoff	Water Erosion Hazard	Permeability	Hydrologic Group
Lithic Xerollic Haplargids									
Ju	clayey-skeletal, montmorillonitic, mesic (shallow)	Poor - depth to bedrock, small stones, too clayey	8-15	19	Well	Rapid	Moderate	Slow	D
Rb	clayey-skeletal, montmorillonitic, frigid	Poor - depth to bedrock, small stones, too clayey	5-10	18	Well	Rapid	Severe	Slow	D
2a (65%)	fine-loamy, mixed, frigid, 15-30% slopes	Poor - alkalinity, depth	15-30	7-14	Well	Moderate - slight	Moderate - slight	Mod. slow	D
2a (35%)	fine-loamy, mixed, frigid, 8-30% slopes	Poor - depth	8-30	6-10	Well	Slight - moderate	Slight - moderate	Mod. slow	D
Xerollic Haplargids									
1a	fine, montmorillonitic, frigid	Poor - clay	8-15	19-24	Well	Moderate	Moderate	Slow	D
Haplic Durargids									
5a	fine-loamy, mixed, frigid (shallow)	Poor - alkalinity	2-4	43-48	Well	Slow	Slight	Mod. slow	D
Haplic Nadurargids									
6a (80%)	fine, montmorillonitic, frigid (shallow)	Poor - clay content	0-4	26-32	Well	Slow	Slight	Very slow	D
6a (20%)	fine, montmorillonitic, frigid	Poor - clay content, alkalinity	2-4	36-60	Well	Slow	Slight	Very slow	D

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TABLE 3.3-2

ORDER 3 SOIL SURVEY DATA

Map Unit	Soil Type	Topsoil Suitability - Limiting Factors	Slope (%)	Solum Depth (inches)	Runoff	Water Erosion Hazard	Permeability	Hydrologic Group
290	Creemon silt loam, 0-2 percent slopes	Poor - thin layer	0-2	>60	Slow	Slight	Mod. - mod. rapid	B
2060	Oxcorel-Beoska-Whirlo association							
	Oxcorel very fine sandy loam	Poor - small stones, too clayey, area reclaim	2-8	>60	Slow	Slight	Very slow - mod. rapid	D
	Beoska silt loam	Poor - small stones, excess salt, excess sodium	0-4	>60	Very slow	Slight	Mod. slow - mod. rapid	B
	Whirlo gravelly loam	Poor - small stones, area reclaim	2-8	>60	Slow	Slight	Mod. rapid	B

TABLE 3.4-1

SUMMARY OF WELLS IN THE VICINITY OF THE PROPOSED PROJECT AREA AND OTHER MAJOR GROUNDWATER USERS IN CRESCENT VALLEY
(Page 1 of 3)

Location	Date	Collar Elevation (FT)	Static Water Elevation (FT)	Well Diameter (IN)	Well Depth (FT)	Lithology	Certificate No.	Use	Annual Usage or Allocation (MGA)	Owner	Field Check
28.47.28.41	1937						2599	MM	39.83	Desert Placers	not found
27.47.17.12	1940	4846	4774	6	103	ALLUV	2773	STK	3.77	Filippini	8/23/92
28.47.33.22	1941	4870	4768	14		ALLUV	2908	MM		Gold Acres Well (Old)	9/24/72
28.47.33.22	1952	4870				ALLUV	4127/4425	MM	121	Gold Acres Well (New)	inaccess.
28.47.24.31	1953	4779	4724		95	ALLUV	5400	IRR	52.1	Alexander (Alves)	
28.47.24.11	1953	4798	4728		100	ALLUV	5498	IRR		Mauldin (Alves)	
28.47.35.31	1953	4795	4763	14	200	ALLUV	5314	IRR	71.5	McCoy (Cortez)	9/7/92
28.47.35.11	1953	4795	4763	14	228	ALLUV	5315	IRR	41.97	McCoy (Cortez)	10/14/92
28.47.13.31	1954	4840	4759	14	200	ALLUV	5773	IRR	197.09	Alexander (Alves)	9/8/92
28.47.13.21	1954	4850	4764	14	109	ALLUV	5458	IRR	127.61	Caldwell (Alves)	9/8/92
28.47.10.13	1960	5060	4780		340	ALLUV	6656	MM	32.9	Eakin	inaccess.
28.47.27.23	1975	4835	4786		128	ALLUV	9093	IRR	208.56	Filippini (Cortez)	inaccess.
28.47.27.21	1975	4810	4759		132	ALLUV	9094	IRR	208.56	Filippini (Cortez)	inaccess.
28.47.36.31	1977	4775	4762		150	ALLUV		IRR	208.56	Robertson (Cortez)	inaccess.
28.47.8.42	1980	5405	5123		412	BR		IRR	62.4	Aaron Mining	inaccess.
27.47.8.31	1981	4851	4782	6	103	ALLUV		STK	0	BRLM Windmill	9/9/92
28.47.10.13	1987	5060	4780		340	ALLUV		MM	124	KOMP	inaccess.
27.47.19.33	1953	4872	4767	6	130	ALLUV		STK		Filippini	inaccess.
27.47.5.11	1992	5019	4794	18	803	BR		MM		Cortez BW-1	11/92
28.47.32.31	1992	5007	4791	14	464	ALLUV		MM		Cortez AW-1	11/92
27.47.6.22	1992	5032	4790	2	440	BR		MM		Cortez OW-1S	11/92
27.47.6.22	1992	5032	4790	2	700	BR		MM		Cortez OW-10	11/92
27.47.5.13	1992	4970	4796	2	340	ALLUV		MM		Cortez OW-2S	11/92

TABLE 3.4-1

SUMMARY OF WELLS IN THE VICINITY OF THE PROPOSED PROJECT AREA AND OTHER MAJOR GROUNDWATER USERS IN CRESCENT VALLEY

(Page 2 of 3)

Location	Date	Collar Elevation (FT)	Static Water Elevation (FT)	Well Diameter (IN)	Well Depth (FT)	Lithology	Certificate No.	Use	Annual Usage or Allocation (MGA)	Owner	Field Check
27.47.5.13	1992	4970	4796	2	600	BR		MM		Cortez OW-2D	11/92
28.47.31	1992	5144	4795	2	460	BR		MM		Cortez OW-3S	11/92
28.47.31	1992	5144	4795	2	740	BR		MM		Cortez OW-3D	11/92
28.47.31.22	1992	5093	4793	2	560	BR		MM		Cortez OW-4S	11/92
28.47.31.22	1992	5078	4794	2	410	BR		MM		Cortez PL-49	11/92
27.47.10	1990	4804	4770	2	45	ALLUV		MM		Cortez TB-5	11/92
27.47.14.23	1990	4792	4767	2	60	ALLUV		MM		Cortez TB-4	10/92
27.47.14.22	1990	4789	4766	2	35.6	ALLUV		MM		Cortez TB-3	10/92
27.47.12.12	1991	4780	4761	4		ALLUV		MM		Cortez MW-21	10/92
27.47.1.31	1991	4775	4758	4		ALLUV		MM		Cortez MW-22	11/92
27.47.1.12	1991	4776	4758	4		ALLUV		MM		Cortez MW-23	10/92
28.47.25.31	1958	4772	4761	13 5/8	150	ALLUV		IRR		Wintle	3/26/92
28.47.15.14		4960	4746	6						Unknown ("USGS")	10/2/92
28.47.16.1		5200	4885	6						?	3/27/92
28.47.27.11		4870	4779	10	87					?	10/3/92
28.47.24.31	1957	4798	4728		100	ALLUV		IRR		Wintle	
28.47.11.31	1958	4930	4751	6	212	ALLUV		DOM		Nichols	10/9/92
28.47.15.44		4880	4809								3/27/92
28.47.13.32		4823						IRR		Alves	
28.48.14.41	1950	4740	4727		180		4271	IRR	391	Alves	
28.48.7.14	1976						9470	IRR	402.13	Alves	9/23/92
28.48.7.32	1976						9471	IRR	404.08	Alves	9/23/92
28.48.18.22	1950	4783	4746		325		4249	IRR	281.9	Alves	

TABLE 3.4-1

SUMMARY OF WELLS IN THE VICINITY OF THE PROPOSED PROJECT AREA AND OTHER MAJOR GROUNDWATER USERS IN CRESCENT VALLEY
(Page 3 of 3)

Location	Date	Collar Elevation (FT)	Static Water Elevation (FT)	Well Diameter (IN)	Well Depth (FT)	Lithology	Certificate No.	Use	Annual Usage or Allocation (MGA)	Owner	Field Check
28.48.17.14	1950	4764					4224	IRR	738.1	Alves	
28.48.17.11	198?	4764	4737	6	190?			DOM		Alves	9/8/92
30.48.33.33	1984	4790	4729	8 5/8	300	ALLUV		MUN	23	Crescent Valley Town W	inaccess.
29.49.33.42	1960	4970	4915	14	228	ALLUV	5553	IRR	152.6	Dann	
29.49.34.24	1977	4925			500	ALLUV	12653	IRR	495.3	Dann	inaccess.
29.47.24.22	1980	4930			522	ALLUV	11784	MM	73.58	Major Barite	inaccess.
29.47.24.22	1980	4930	4747			ALLUV		DOM		Major Barite	9/30/92
31.50.16.13	1960	4760	4742		260	ALLUV	6055	IRR	337.93	Colburn/Zeda Corp.	
27.47.24.14	1991							MUN	(2359.05)	Ecovision	
31.51.8.31	1991							MUN	(2359.05)	Ecovision	
27.47.24.24	1968	4798	4675		400	ALLUV	7293	MM	766	Cortez	
27.46.28.12	1969	5030	5021	6	35	ALLUV		DOM		Filippini	10/9/92

Reference: WMC (1992b)

Notes:
- ALLUV - well completed in alluvial aquifer
- BR - well completed in bedrock aquifer
- MM - mining
- STK - stock animals
- IRR - irrigation
- DOM - domestic/household
- MUN - municipal
- Blank indicates that information was not available

TABLE 3.4-2

SURFACE WATER RIGHTS WITHIN STUDY AREA

Spring/Stream	Location	Owner
Harry Polly Spring	27.48.25.24	Tsakopoulos
Unnamed Spring	27.48.25.41	Tsakopoulos
Lata Canyon Creek	26.47.29.21	Filippini, E
Tub Spring	26.46.21.12	Filippini, H
Red Mtn. No. 4 Spring	25.46.6	Filippini, H
Red Mountain Spring	25.46.6.23	Filippini, H
Wood Spring B	25.46.10.21	Filippini, H
Wood Spring A	25.46.10.21	Filippini, H
Blind Spring	25.46.11.21	Filippini, H
Wood Spring #1	25.46.14.11	Filippini, H
Upper Wood Spring	25.46.14.21	Filippini, H
Red Mountain Spring	25.46.6.23	Filippini, H
Spaghetti Spring #2	25.47.6.41	Filippini, H
Spaghetti Spring #3	25.47.8.11	Filippini, H
Spaghetti Spring #1	25.47.6.42	Filippini, H
Coal Canyon Spring #1	25.47.8.33	Filippini, H
Coal Canyon Spring #2	25.47.17.11	Filippini, H
Coal Canyon Spring #3	25.47.8.43	Filippini, H

TABLE 3.5-1

TYPICAL SPECIES ASSOCIATED WITH WET MEADOWS AND SALINE FLATS

Wet Meadows	
Big rubber rabbitbrush	Chrysothamnus nauseosus
Red-osier dogwood	Cornus sericea
Currant	Ribes sp.
Wild rose	Rosa woodsii
Willow shrubs	Salix sp.
Common yarrow	Achillea millefolium
Buttercup	Ranunculus sp.
Curly dock	Rumex crispus
Clover	Trifolium sp.
Spike bentgrass	Agrostis exarata
Redtop bentgrass	Agrostis stolonifera
Cheatgrass	Bromus tectorum
Elk sedge	Carex geyeri
Nebraska sedge	Carex nebrascensis
Blackcreeper sedge	Carex praegracilis
Russet sedge	Carex saxatilis
Saltgrass	Distichlis spicata
Basin wildrye	Elymus cinereus
Arctic rush	Juncus arcticus
Toad rush	Juncus bufonius
Swordleaf rush	Juncus ensifolius var. montanus
Thread rush	Juncus filiformis
Longstyle rush	Juncus longistylis
Fowl bluegrass	Poa palustris
Kentucky bluegrass	Poa pratensis
Rabbitfoot grass	Polypogon monspeliensis
Deerhair bulrush	Scirpus caespitosus
Panicled bulrush	Scirpus microcarpus
Alkali sacaton	Sporobolus airoides
Saline Flats	
Big rubber rabbitbrush	Chrysothamnus nauseosus
Greasewood	Sarcobatus vermiculatus
Cheatgrass	Bromus tectorum
Saltgrass	Distichlis spicata
Basin wildrye	Elymus cinereus

Table 3.5-2. SEEP & SPRING SURVEY

Site Number	Wetland Classification	Soils	Hydrology	Spring Area (Ft^2)	Total Associated Jurisdictional Area (Ft^2)
26,46,21,12 Tub Spring	Palustrine Unconsolidated Shore	Hydric	Inundated	770	770
26,47,04,24	Riverine Rocky Shore	Semi-permanently Inundated	Inundated	50	3,000
27,46,16,11 Dry Hill Spring	Palustrine Emergent Wetland	Hydric	Inundated	250	250
27,46,28,11	Palustrine Emergent Wetland	Hydric	Inundated	1,350	43,200
27,46,28,221	Palustrine Unconsolidated Shore	Hydric	Inundated	2,000	2,000
27,46,28,224	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to within 4 inches	600	51,600
27,47,27,43	Upland	Non-hydric	Water flowing from pipe	0	0
27,47,33,42	Palustrine Unconsolidated Shore	Seasonally Saturated	Inundated	1,100	1,100
27,47,35,32 Copper Canyon Spring	Palustrine Emergent/Scrub Shrub Wetland	Hydric, Permanently Flooded	Inundated	80	30,000
27,48,16,31	Palustrine Scrub Shrub Wetland	Seasonally Flooded	Inundated	50,000	57,000
27,48,19,24	Riverine Rock Bottom	Permanently Flooded	Inundated	32	1,600
28,46,02,34	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	2,800	9,175
28,46,04,33	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	20,200	20,200
28,46,05,42	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	13,100	35,600

Table 3.5-2. SEEP & SPRING SURVEY (continued)

Site Number	Wetland Classification	Soils	Hydrology	Spring Area (Ft^2)	Total Associated Jurisdictional Area (Ft^2)
28,46,06,14	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	5,500	5,500
28,46,06,211	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	2,000	2,000
28,46,06,212	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	3,000	3,000
28,46,06,231	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	3,300	5,100
28,46,06,232	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	1,750	1,750
28,46,07,31	Palustrine Emergent Wetland	Semi-permanently Flooded	Inundated, Saturated to surface	1,600	1,600
28,46,15,32	Palustrine Unconsolidated Bottom	Permanently Flooded	Inundated	1,600	1,600
28,46,17,11	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	3,500	3,500
28,46,21,11	Palustrine Emergent Wetland	Hydric, Permanently Flooded	Inundated, Saturated to surface	700	1,600
28,48,28,14	Palustrine Emergent	Hydric	Saturated to within 3 inches	3,400	3,400
28,48,28,342	Palustrine Unconsolidated Shore	Hydric	Inundated	4,000	4,000
28,48,28,343	Palustrine Unconsolidated Shore	Hydric	Inundated	1,960	1,960
28,48,28,43	Palustrine Emergent	Hydric	Inundated	5,400	5,400
28,48,32,24	Palustrine Emergent	Hydric	Inundated	2,830	2,830

Table 3.5-2. SEEP & SPRING SURVEY (continued)

Site Number	Wetland Classification	Soils	Hydrology	Spring Area (Ft^2)	Total Associated Jurisdictional Area (Ft^2)
28,48,32,32	Palustrine Emergent	Hydric	Inundated	2,830	2,830
28,48,32,33	Palustrine Emergent	Hydric	Inundated	400	3,480
28,48,32,34	Palustrine Emergent	Hydric	Inundated	150	150
28,49,01,14	Palustrine Emergent	Permanently Inundated	Inundated	80	25,000
28,49,01,23	Palustrine Emergent	Permanently Inundated	Inundated	8,640	8,640
28,49,10,12	Palustrine Unconsolidated Shore	Hydric	Inundated	27	5,930
28,49,10,41	Palustrine Emergent	Permanently Inundated	Inundated	10	14,400
28,49,16,24	Palustrine Scrub Shrub	Histic	Saturated to within 12 inches	5,000	5,000
29,46,29,22	Palustrine Emergent Wetland	Histic, Semi-permanently Inundated	Inundated, Saturated to surface	6,400	6,400
29,46,29,233	Palustrine Emergent Wetland	Histic	Saturated to surface	600	600
29,46,29,234	Palustrine Emergent Wetland	Histic	Inundated, Saturated to surface	3,000	3,000
29,46,29,31	Palustrine Emergent Wetland	Histic	Inundated, Saturated to surface	13,200	13,200
29,46,29,32	Palustrine Emergent Wetland	Hydric	Saturated to surface	1,400	1,400
29,46,31,22	Palustrine Emergent Wetland	Semi-permanently Flooded	Inundated, Saturated to surface	800	800
29,46,31,433	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	4,250	4,250

Table 3.5-2. SEEP & SPRING SURVEY (continued)

Site Number	Wetland Classification	Soils	Hydrology	Spring Area (Ft^2)	Total Associated Jurisdictional Area (Ft^2)
29,46,31,434	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to surface	1,500	1,500
29,48,01,14	Palustrine Emergent	Hydric	Inundated, Saturated to within 12 inches	450	17,600
29,48,01,33	Palustrine Emergent	Hydric	Inundated	450	1,150
29,48,11,22	Palustrine Emergent	Hydric	Inundated, Saturated to surface	900,000	900,000
29,48,11,2231	Lacustrine Rocky Bottom	Permanently Flooded	Inundated	110	180
29,48,11,2233	Lacustrine Rocky Bottom,Palustrine Emergent	Permanently Flooded	Inundated	380	380
29,48,11,23	Palustrine Emergent	Hydric	Inundated	110	1,940
29,48,11,24	Palustrine Emergent	Hydric	Saturated to within 12 inches	540	2,340
29,48,11,433	Palustrine Emergent	Permanently Flooded	Inundated	6,360	6,360
29,48,11,434	Palustrine Emergent	Permanently Flooded	Inundated	19,900	19,900
29,48,36,14	Palustrine Emergent Wetland	Hydric, Permanently Flooded	Inundated, Saturated to within 12"	2,200	2,200
29,48,36,321	Palustrine Emergent Wetland	Hydric	Inundated, Saturated to Surface	3,700	3,700
29,48,36,324	Palustrine Emergent Wetland	Histic	Saturated to Surface	4,800	4,800
29,48,36,34	Palustrine Emergent Wetland	Hydric, Semi-permanently Flooded	Inundated, Saturated to within 3"	800	800
29,50,12,411	Palustrine Emergent	Hydric	Inundated	11,880	41,760

Table 3.5-2. SEEP & SPRING SURVEY (concluded)

Site Number	Wetland Classification	Soils	Hydrology	Spring Area (Ft²)	Total Associated Jurisdictional Area (Ft²)
29,50,12,423	Palustrine Scrub Shrub	Hydric	Saturated to Surface	2,700	2,700
29,50,16,43	Palustrine Emergent	Hydric	Inundated	45,600	75,600
29,50,20,23	Upland	Not assessed	Altered	0	0
29,50,20,24	Palustrine Scrub Shrub	Hydric	Saturated to Surface	10,000	90,000
29,50,21,33	Palustrine Scrub Shrub	Hydric	Saturated to Surface	45,000	45,000
29,50,29,31	Palustrine Aquatic Bed	100% Obligate Vegetation	Inundated	460	1,650
29,50,29,34	Palustrine Emergent	Permanently Inundated	Inundated	6,000	48,000
29,50,31,311	Riverine Scrub Shrub	Seasonally Inundated	Inundated	1,200	85,000
29,50,31,314	Palustrine Emergent	Permanently Inundated	Inundated	900	7,900
29,51,18,11	Palustrine Scrub Shrub	Permanently Inundated	Inundated	2,250	2,250
Total Areas (Ft²)				1,273,764	1,753,270

TABLE 3.5-3

TYPICAL SPECIES ASSOCIATED WITH RIPARIAN AREAS

Rabbitbrush	Chrysothamnus sp.
Red-osier dogwood	Cornus sericea
Narrowleaf cottonwood	Populus angustifolia
Quaking aspen	Populus tremuloides
Chokecherry	Prunus virginiana
Currant	Ribes sp.
Wild rose	Rosa woodsii
Willow	Salix sp.
Greasewood	Sarcobatus vermiculatus
Bentgrass	Agrostis sp.
Sedges	Carex sp.
Saltgrass	Distichlis spicata
Basin wildrye	Elymus cinereus
Rushes	Juncus sp.
Bluegrass	Poa sp.
Bulrushes	Scirpus sp.
Alkali sacaton	Sporobolus airoides

TABLE 3.5-4

STREAM AND RIPARIAN HABITAT CONDITIONS IN THE CORTEZ RANGE

Creek Name	Percent of Optimum[a]	Riparian Condition Class[a]	Percent Sedimentation[b]	Width to Depth Ratio[c]
Cottonwood Creek	41.4	32.8	55.9	21.0
Brock Creek	25.4	25.0	43.6	29.0
Cottonwood Canyon Creek	39.8	34.4	20.2	29.0

[a] Based on the following scale: 0-49% = Poor; 50-59% = Fair; 60-69% = Good; 70+ = Excellent.

[b] Streambottom sedimentation levels in excess of 54% are generally considered undesirable.

[c] The following scale can be used to evaluate the width to depth ratio: 26+ - Poor; 15-25 = Fair; 8-15 = Good; <7 = Excellent.

TABLE 3.5-5

TYPICAL SPECIES ASSOCIATED WITH UPLAND COMMUNITIES
(Page 1 of 3)

Shadscale/Black Greasewood Community	
Shadscale	Atriplex confertifolia
Black greasewood	Sarcobatus vermiculatus
Rubber rabbitbrush	Chrysothamnus nauseosus
Nuttal saltbush	Atriplex nuttalii
Basin wildrye	Elymus cinereus
Alkali sacaton	Sporobolus airoides
Inland saltgrass	Distichlis stricta
Bottlebrush squirreltail	Sitanion hystrix
Cheatgrass	Bromus tectorum
Shadscale/Bud Sagebrush Community	
Shadscale	Atriplex confertifolia
Bud sagebrush	Artemisia spinescens
Bottlebrush squirreltail	Sitanion hystrix
Indian ricegrass	Oryzopsis hymenoides
Bluegrass	Poa spp.
Sagebrush/Grass Community	
Basin big sagebrush	Artemisia tridentata tridentata
Wyoming big sagebrush	A. tridentata wyomingensis
Mountain big sagebrush	A. tridentata vaseyana
Black sagebrush	A. arbuscula nova
Low sagebrush	A. arbuscula arbuscula
Shadscale	Atriplex confertifolia
Douglas rabbitbrush	Chrysothamnus viscidiflorus
Antelope bitterbrush	Purshia tridentata
Phlox	Phlox spp.
Lupine	Lupinus spp.

TABLE 3.5-5

TYPICAL SPECIES ASSOCIATED WITH UPLAND COMMUNITIES
(Page 2 of 3)

Arrowleaf balsamroot	Balsamorhiza sagittata
Indian ricegrass	Oryzopsis hymenoides
Bluebunch wheatgrass	Agropyron spicatum
Bluegrass	Poa spp.
Idaho fescue	Festuca idahoensis
Thurber needlegrass	Stipa thurberiana
Basin wildrye	Elymus cinereus
Cheatgrass	Bromus tectorum
Pinyon-Juniper Community	
Singleleaf pinyon	Pinus monophylla
Utah juniper	Juniperus osteosperma
Mountain big sagebrush	Artemisia tridentata vaseyana
Black sagebrush	A. arbuscula nova
Antelope bitterbrush	Purshia tridentata
Snowberry	Symphoricarpos sp.
Serviceberry	Amelanchier sp.
Indian ricegrass	Oryzopsis hymenoides
Basin wildrye	Elymus cinereus
Needle and thread	Stipa comata
Thurber needlegrass	S. thurberiana
Bluegrass	Poa spp.
Bottlebrush squirreltail	Sitanion hystrix
Bluebunch wheatgrass	Agropyron spicatum
Mountain Mahogany Community	
Curlleaf mountain mahogany	Cercocarpus ledifolius
Singleleaf pinyon	Pinus monophylla
Utah juniper	Juniperus osteosperma
Mountain big sagebrush	Artemisia tridentata vaseyana
Snowberry	Symphoricarpos sp.
Bluebunch wheatgrass	Agropyron spicatum
Indian ricegrass	Oryzopsis hymenoides

TABLE 3.5-5

TYPICAL SPECIES ASSOCIATED WITH UPLAND COMMUNITIES
(Page 3 of 3)

Bluegrass	Poa sp.
Thurber needlegrass	Stipa thurberiana
Basin wildrye	Elymus cinereus
Idaho fescue	Festuca idahoensis

TABLE 3.5-6

DOMINANT PLANT SPECIES, PIPELINE PROJECT AREA

Common Name	Scientific Name
Shadscale	*Atriplex confertifolia*
Bud sagebrush	*Artemisia spinescens*
Halogeton	*Halogeton glomeratus*
Cheatgrass	*Bromus tectorum*
Sandberg bluegrass	*Poa secunda*
Bottlebrush squirreltail	*Sitanion hystrix*

TABLE 3.6-1

ACREAGES OF SEASONAL MULE DEER RANGES WITHIN VARIOUS PARTS OF THE STUDY AREA

Mountain Range	Type of Seasonal Range	Acres
Cortez Range	Summer	17,825
	Winter	24,535
Northern Toiyabe Range	Yearlong	12,935
	Winter	8,235
Shoshone Range	Yearlong	23,730
	Summer	8,120
	Winter	4,865

TABLE 3.6-2

RESULTS OF 1991 STREAM SURVEYS CONDUCTED IN THE CORTEZ MOUNTAINS, BLM ELKO RESOURCE AREA

Creek Name	Percent of Optimum[a]	Riparian Condition Class[a]	Percent Sedimentation[b]	Width-to-Depth Ratio[c]
Horse Canyon Creek	32	25.0	20.0	31.3
Cottonwood Creek	41.4	32.8	55.9	21.0
Brock Creek	25.4	25.0	43.6	29.0
Cottonwood Canyon Creek	39.8	34.4	20.2	29.0
Duff Creek	56.8	73.6	14.6	15.0

[a] Based on the following scale: 0-49% = Poor; 50-59% = Fair; 60-69% = Good; 70+% = Excellent.

[b] Streambottom sedimentation levels in excess of 54% are generally considered undesirable.

[c] The following scale can be used to evaluate the width to depth ratio: 26+ = Poor; 15-25 = Fair; 8-15 = Good; <7 = Excellent.

TABLE 3.6-3

SPECIES RECORDED PRINCIPALLY OR ONLY IN EITHER WET MEADOW/WETLAND/OPEN WATER OR IN RIPARIAN HABITATS ON THE GUND RANCH, JUST SOUTH OF THE STUDY AREA
(Page 1 of 2)

Meadow/Marsh/Open Water

Merriam's shrew	marsh hawk
mountain vole	sandhill crane
Great Basin spadefoot toad	American coot
great blue heron	killdeer
cattle egret	common snipe
snowy egret	long-billed curlew
white-faced ibis	spotted sandpiper
Canada goose	willet
mallard	marbled godwit
gadwall	American avocet
pintail	black-necked stilt
green-winged teal	Wilson's phalarope
blue-winged teal	ring-billed gull
cinnamon teal	water pipit
American widgeon	bobolink
redhead	yellow-headed blackbird
canvasback	red-winged blackbird
bufflehead	Brewer's blackbird
ruddy duck	savannah sparrow
common merganser	

TABLE 3.6-3

SPECIES RECORDED PRINCIPALLY OR ONLY IN EITHER WET MEADOW/WETLAND/OPEN WATER OR IN RIPARIAN HABITATS ON THE GUND RANCH, JUST SOUTH OF THE STUDY AREA
(Page 2 of 2)

Foothill Riparian	
western jumping mouse	MacGillivray's warbler
goshawk	common yellowthroat
calliope hummingbird	Wilson's warbler
yellow-bellied sapsucker	northern oriole
hairy woodpecker	western tanager
downy woodpecker	black-headed grosbeak
western flycatcher	lazuli bunting
western wood pewee	American goldfinch
mountain chickadee	lesser goldfinch
dipper	rufous-sided towhee
house wren	dark-eyed junco
American robin	white-crowned sparrow
hermit thrush	fox sparrow
warbling vireo	Lincoln's sparrow
orange-crowned warbler	song sparrow
yellow warbler	

Source: McAdoo, personal communication.

TABLE 3.9-1

DEMOGRAPHIC CHARACTERISTICS OF THE STUDY AREA

Area	1990 (census data)	Population Projections 1991	1993	1995	1997
County					
Eureka	1,547	1,600	1,630	1,630	1,640
Elko	33,530	35,950	37,370	38,570	39,740
Lander	6,266	6,470	6,720	6,410	6,660
City					
Elko	14,853	27,400	--	--	--
Carlin	2,220	2,640	--	--	--
Battle Mountain	3,542	N.A.	--	--	--
Beowawe Division[a]	440	420	--	--	--

Source: Nevada State Demographer, Bureau of Business and Economic Research, College of Business Administration, University of Nevada, Reno, 1993.

[a] Beowawe Division includes approximately the northern half of Eureka County; unofficial estimates of population for Beowawe is about 30 persons, and for Crescent Valley is 200-250 persons (Summers 1991; Shangal 1991).

TABLE 3.9-2

EMPLOYMENT IN THE STUDY AREA (1991)

County	Civilian Labor Force	Total Employment	Unemployment Rate	Employment in Mining[a] (%)
Eureka	3,410	3,360	1.5	93
Elko	15,680	14,990	4.4	8.5
Lander	2,860	2,710	5.2	52

Source: Nevada Employment Security Department, Research Center; Labor Force Summary, 1990, revised March 1992.

[a] Percentage of total employment.

TABLE 3.9-3

DISTRIBUTION OF CORTEZ EMPLOYEES BY PLACE OF RESIDENCE

Community	Number of Employees
Battle Mountain	16
Beowawe	3
Crescent Valley	57
Carlin	35
Elko	71
Spring Creek	13
TOTAL	195

Source: Cortez Gold Mines, Nevada, 1993

TABLE 3.9-4

ELKO AND CARLIN AREA SCHOOLS CAPACITIES AND ENROLLMENT, MARCH 1993

School	Capacity	Enrollment
Carlin Combined School, Carlin	500	491
Southside Elementary, Elko	600	690
Northside Elementary, Elko	500	512
Grammar School #2, Elko	500	529
Mountain View Elementary, Elko	600	948
Sage Elementary, Spring Creek	*	455
Spring Creek Elementary, Spring Creek	600	591
Elko Jr. High School, Elko	600	952
Elko High School, Elko	850	1,606

Source: Elko County School District, March 1993

* This school is operated out of mobile trailers, with plans to build permanent facilities when money becomes available. Mobile trailers are used at a number of schools listed above.

TABLE 3.9-5

TAX REVENUES COLLECTED BY STUDY AREA COUNTIES - 1991-1992

County	Property Tax ($)	Net Proceeds-from-Mines Tax ($)	Sales Tax ($)	Total[a]
Elko	3,012,512	226,748	3,190,000	6,429,260
Eureka	2,279,427	2,780,217	1,858,224	6,917,868
Lander	2,875,621	1,543,997	1,298,037	5,717,658

Source: Rebaleati 1993, Ridder 1993.

[a] This gives the sum of three columns, and does not represent total tax revenues received by the counties from all sources.

TABLE 3.9-6

TAX REVENUES GENERATED BY CORTEZ GOLD MINES - 1992

County	Personal Property Tax ($)	Net Proceeds-from-Mines Tax ($)	Total ($)
Elko	174.00	0	174.00
Eureka	26,922.67	0	26,922.67
Lander	418,420.32	0	418,420.32

Source: Cortez Gold Mines, 1993.

Note: In addition to the taxes above, Cortez paid $20,700 to the State in the form of Nevada Business License Tax, and $215,612 as Sales/Use Tax.

TABLE 3.10-1

LIVESTOCK GRAZING DATA, STUDY AREA

Map Reference Number	Allotment Name	Selective Management Category	Acres of Public Lands	Active Grazing Preference AUMs	Average Licensed Use AUMs[a]	Public/Private Acres in Study Area	
						Public	Private
1	Carico Lake	I	574,129	36,958	27,171	147,380	7,692
2	South Buckhorn	I	226,004	20,654	20,654	75,384	49,362
3	Argenta	I	122,370	14,248	12,107	34,248	25,932

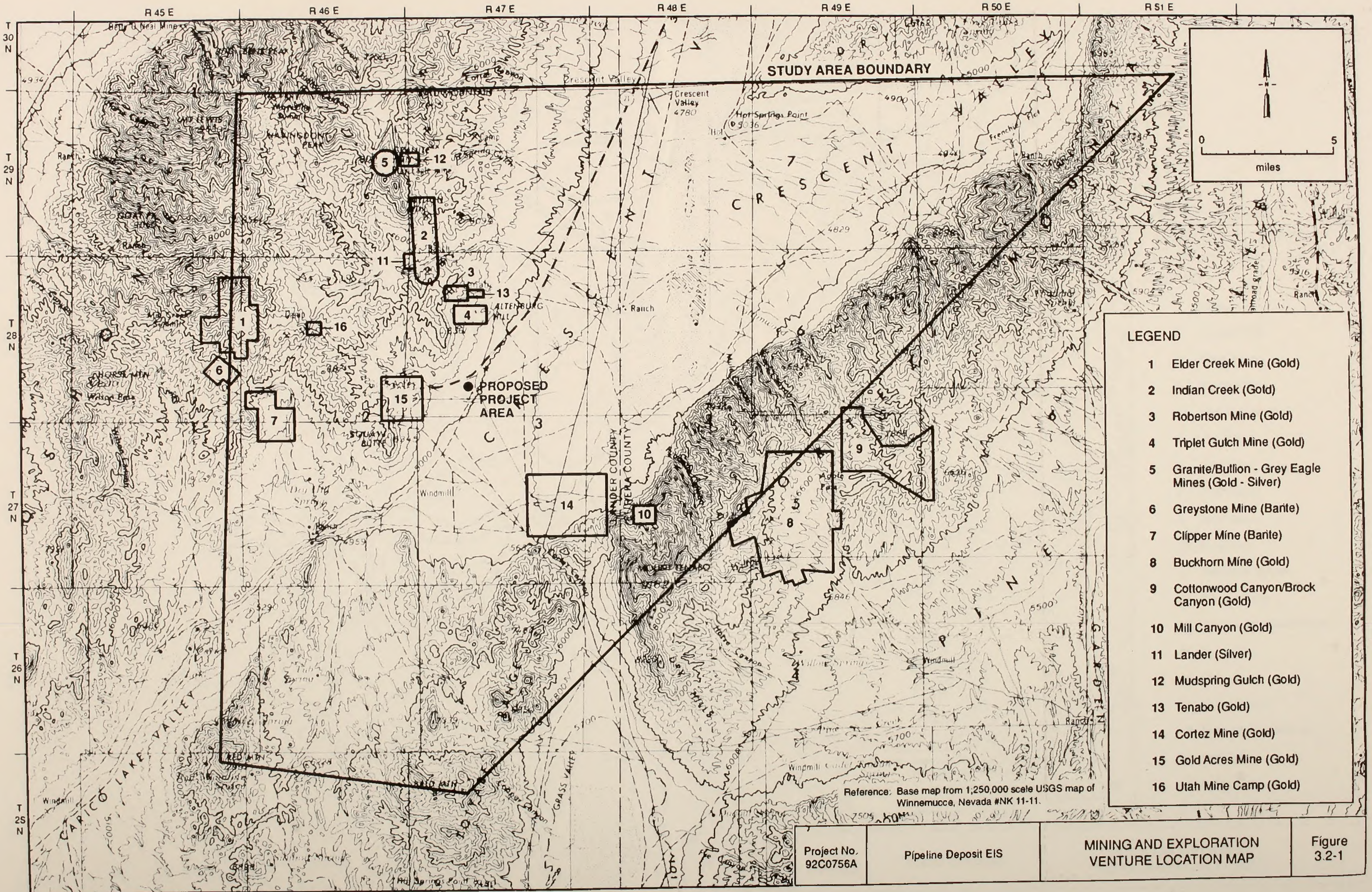
[a] Average licensed use for the period 1979 to 1983.

TABLE 3.10-2

1990 GRAZING USE IN THE LIVESTOCK GRAZING STUDY AREA

Allotment[a] (use area)	Operator	Livestock[b]	Grazing Period	Percent Public Land	AUMs
CARICO LAKE:	Agri-Beef	500 S	04/01 to 06/30	100	299
		300 S	10/11 to 11/30	100	101
	C Ranches, Inc.	1117 C	03/01 to 04/01	100	13,404
		1 C	03/01 to 04/01	100	1
	Alves, M.	433 C	03/01 to 03/31	100	441
		755 C	11/01 to 02/28	100	2,979
SO. BUCKHORN:	Alves, M.				
Frenchie Seeding		1201 C	04/16 to 06/30	69	2,071
Native Pasture		1658 C	07/01 to 10/31	67	4,492
	Lander County	73 C	03/01 to 10/31	100	588
	Development Corp.	7 C	04/01 to 04/30	100	7
ARGENTA:	Agri-Beef	4685 S	04/01 to 06/25	23	1,793
	Alves, M.	308 C	03/01 to 03/31	100	314
		206 C	11/01 to 02/28	100	813
	Zeda, Inc.	65 C	04/15 to 10/14	100	309

[a] Unless specified, use area is federal native range.
[b] S denotes sheep, C denotes cattle, H denotes horses.



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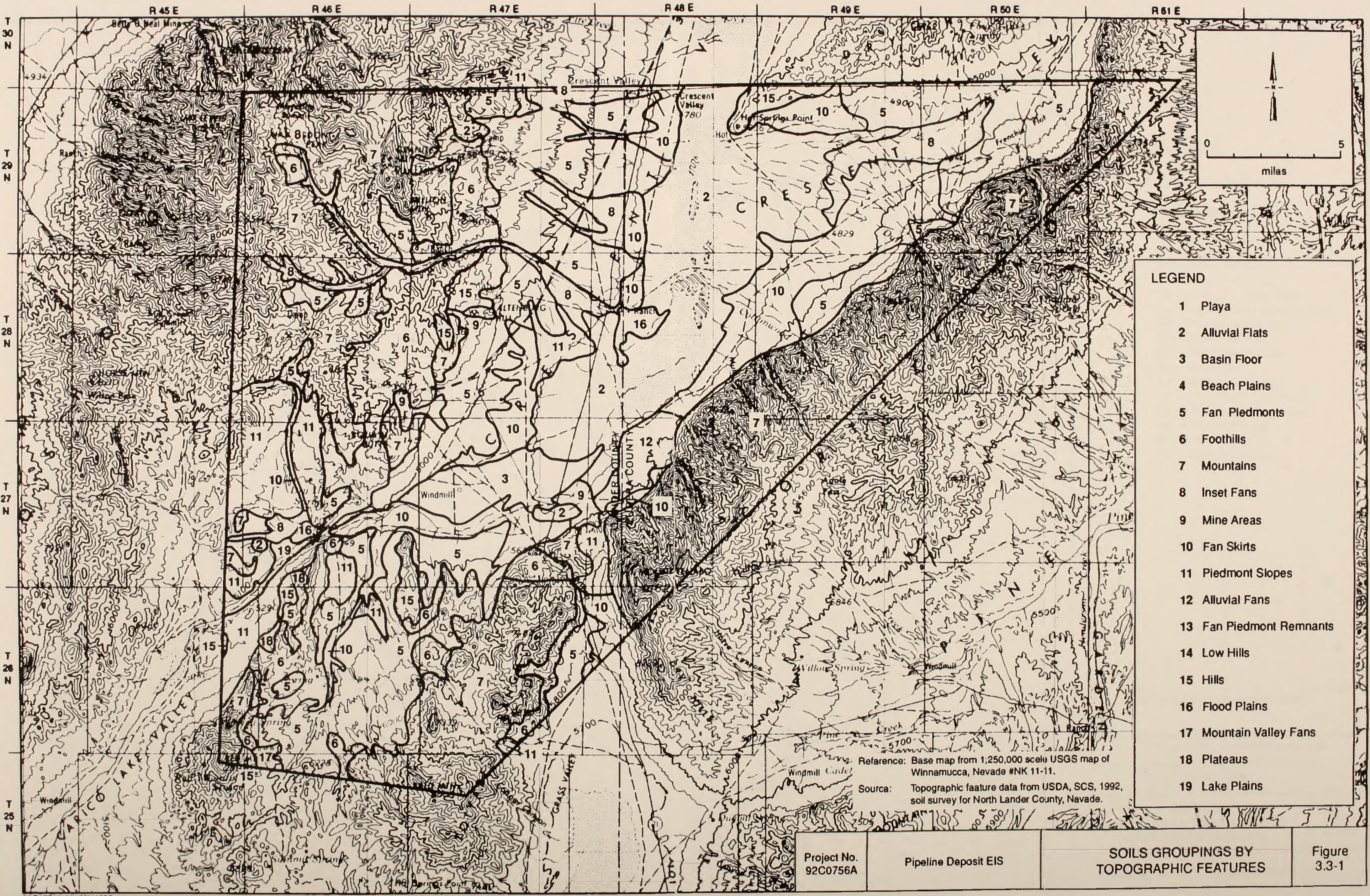

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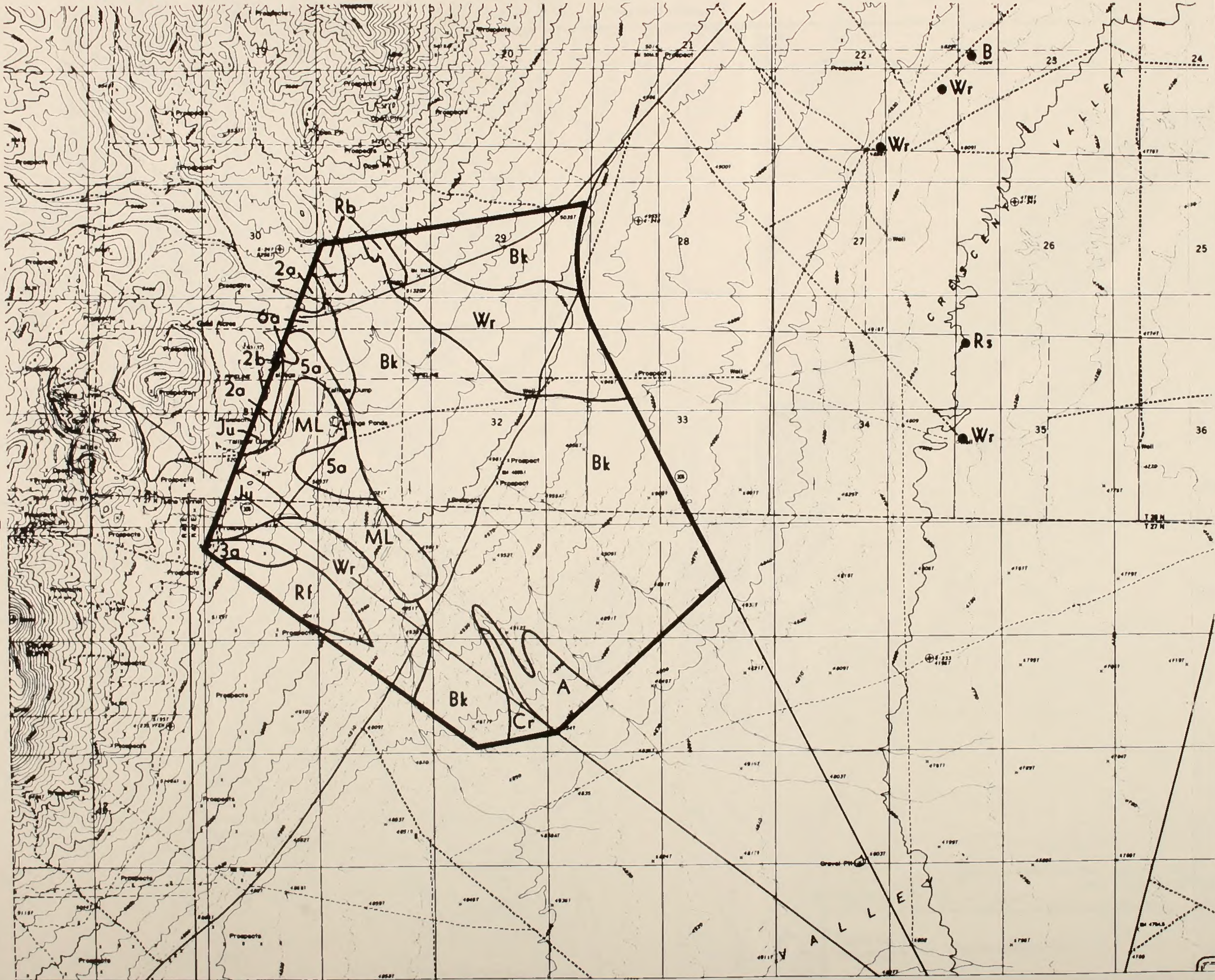
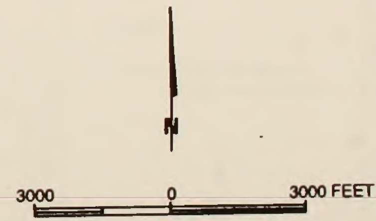


EXPLANATION

● Surveyed Infiltration Pit

Soil Mapping Units

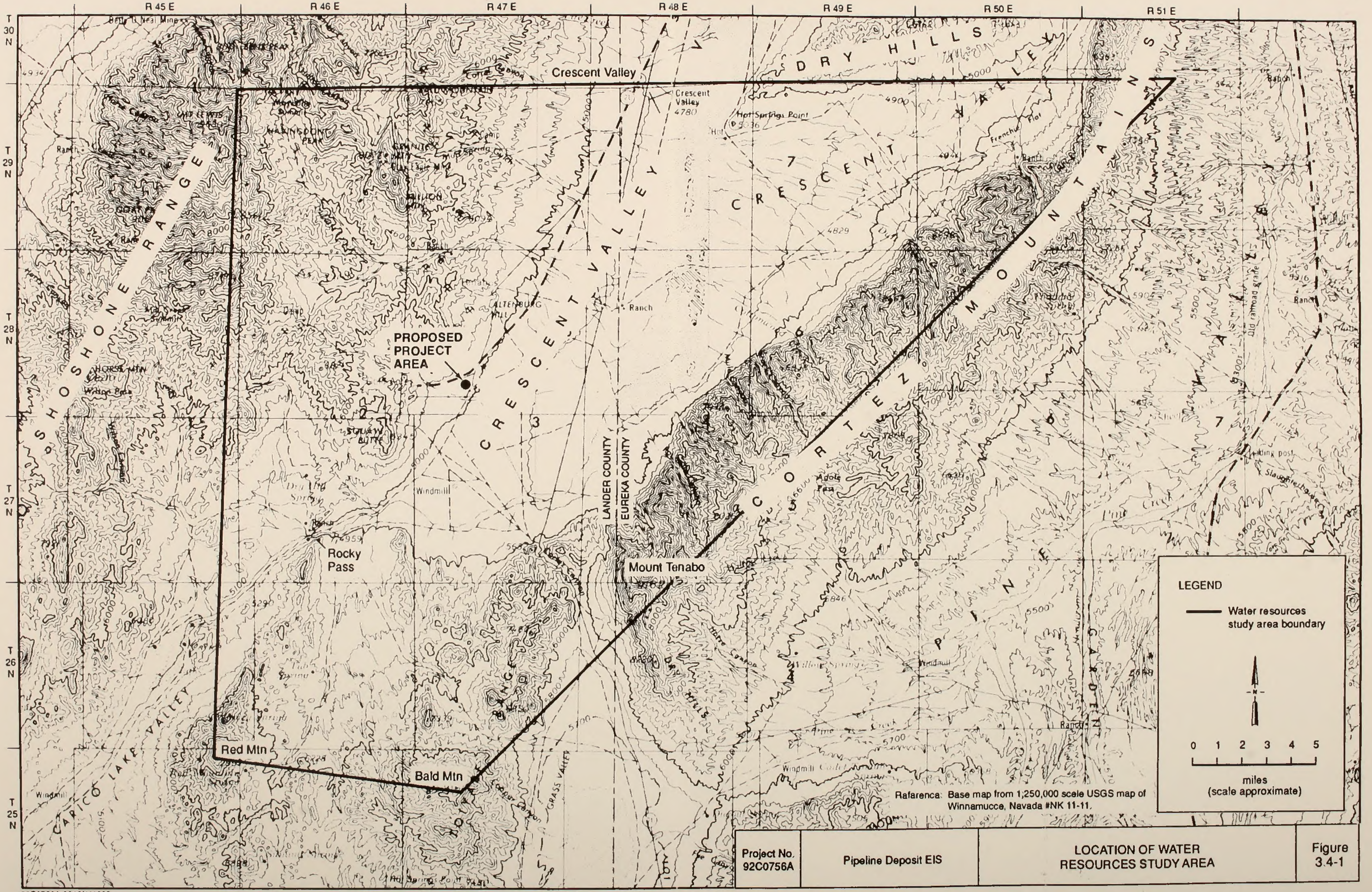
- **A** - Type A
- **B** - Type B
- **BK** - Beoska silt loam
- **Cr** - Creemon silt loam
- **Ju** - Jung very cobbly loam
- **Rf** - Redflame very gravelly loam
- **Rb** - Robson cobbly loam
- **Rs** - Rosney silt loam
- **Wr** - Whirlo gravelly loam
- **ML** - Mined land
- **1a** - Xerollic Haplargids
- **2a** - Lithic Xerollic Haplargids
- **2b** - Lithic Xerollic Haplargids
- **3a** - Duric Haplargids
- **5a** - Haplic Durargids
- **6a** - Haplic Nadurargrids



Reference: Base map from USGS provisional maps of Nevada, 7.5 minute series, Tenabo and Cortez, 1990.

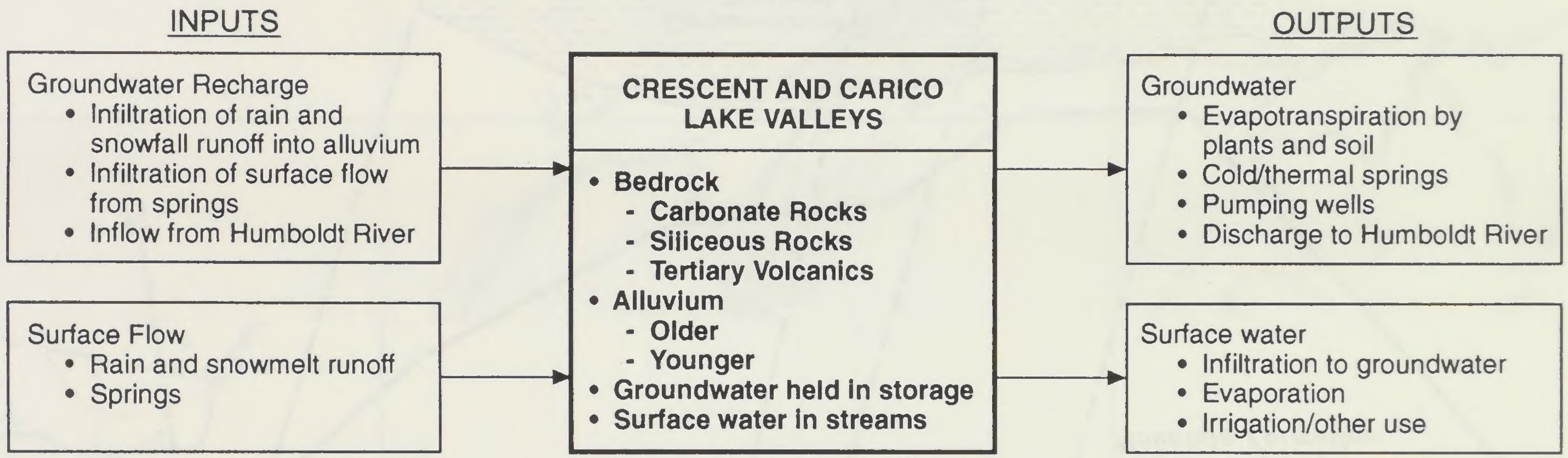
Source: Summerfield, H. 1991; Cortez Gold Mines; JBR Consultants, 1992.

ORDER II SOIL SURVEY FOR PROPOSED AREA OF DISTURBANCE	Figure 3.3-2
Project No. 92C0756A	Pipeline Deposit EIS



Project No. 92C0756A	Pipeline Deposit EIS	LOCATION OF WATER RESOURCES STUDY AREA	Figure 3.4-1

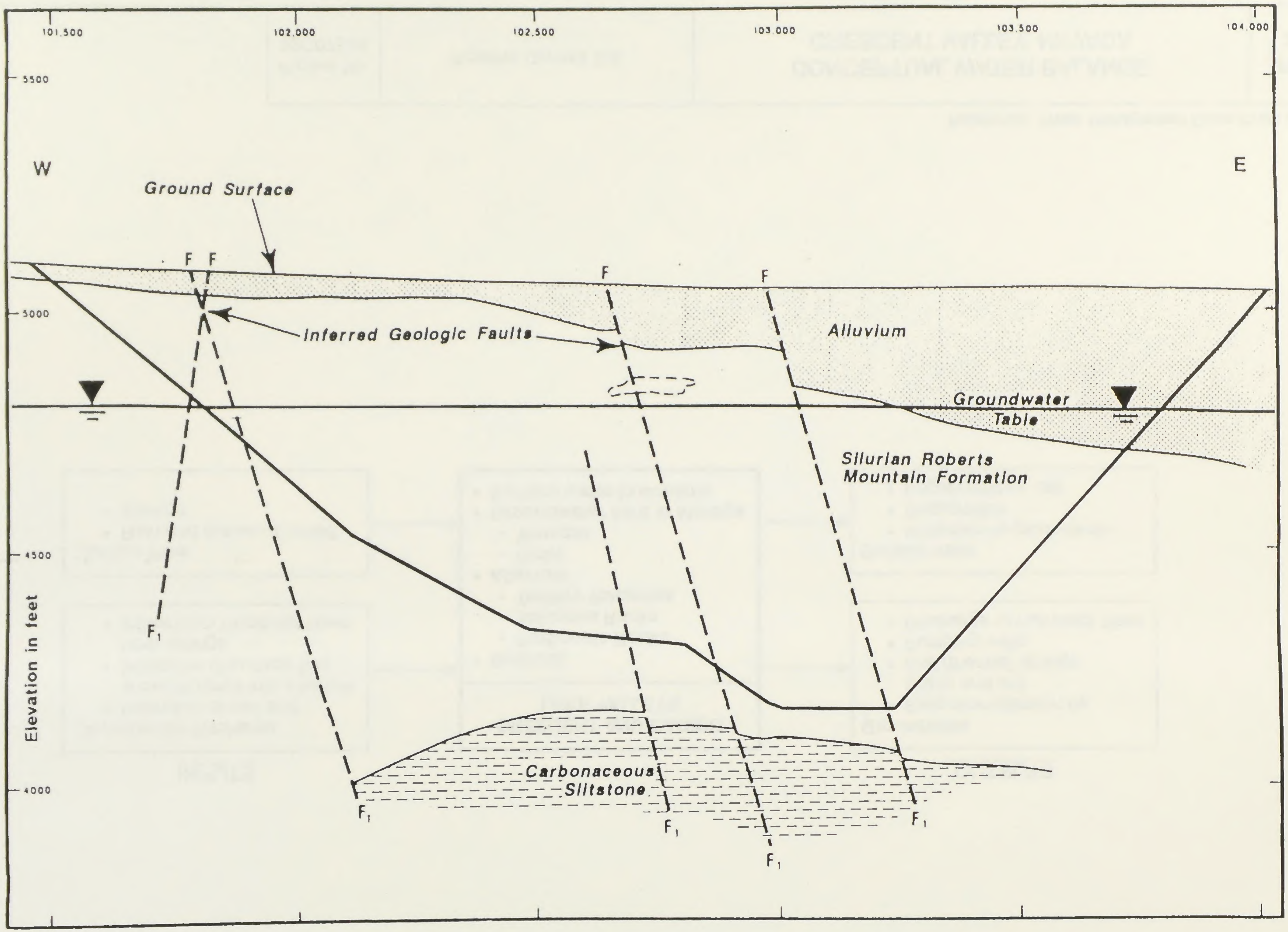
92C0756A-0010/111893



Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	CONCEPTUAL WATER BALANCE CRESCENT VALLEY, NEVADA	Figure 3.4-2

92C0756A-0010/111893



Reference: Water Management Consultants (1992a)

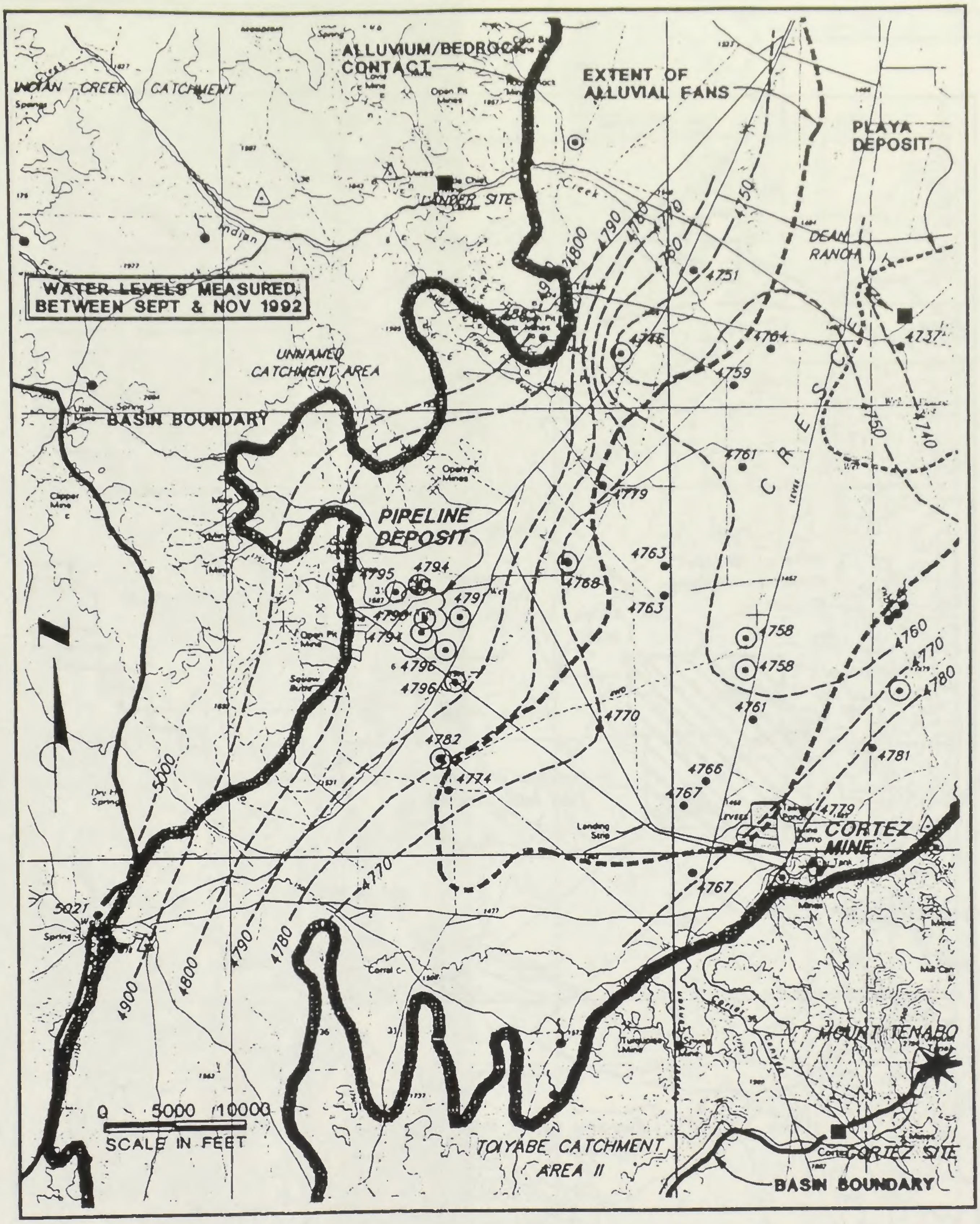
Project No. 92C0756A	Pipeline Deposit EIS	SCHEMATIC GEOLOGIC CROSS-SECTION THROUGH THE PIPELINE PROJECT AREA	Figure 3.4-3

92C0756A-0004/032693

Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	HYDROLOGIC MAP OF CRESCENT VALLEY, NEVADA	Figure 3.4-4

92C0756A-0004/032693



LEGEND

4800 - - - - Groundwater elevation contour based on September and November 1992 measurements

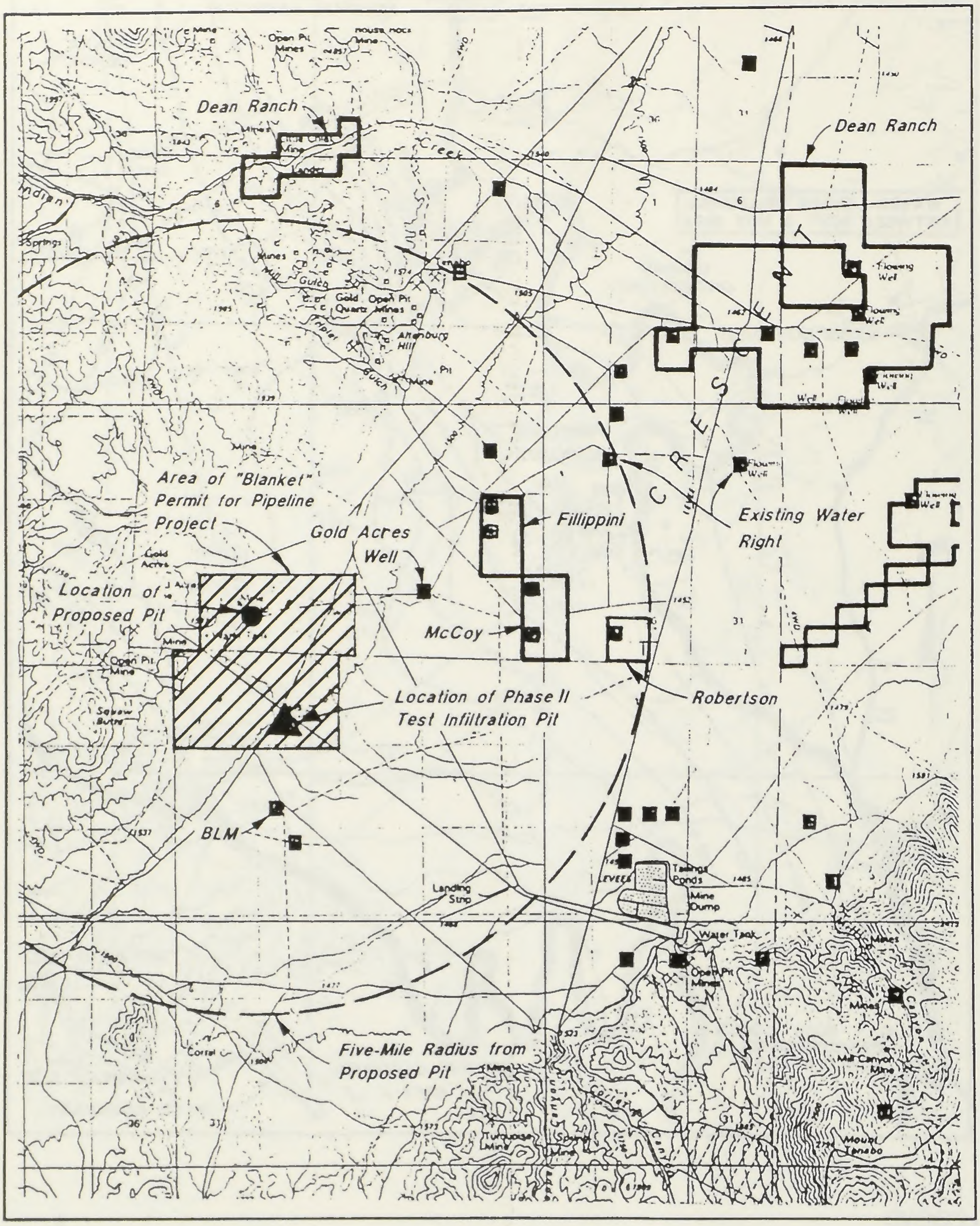
Hydrographic basin boundary

Alluvium/bedrock contact

4758 Well location with estimated groundwater elevation

Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	ESTIMATED GROUNDWATER ELEVATION CONTOURS AROUND THE PIPELINE DEPOSIT	Figure 3.4-5



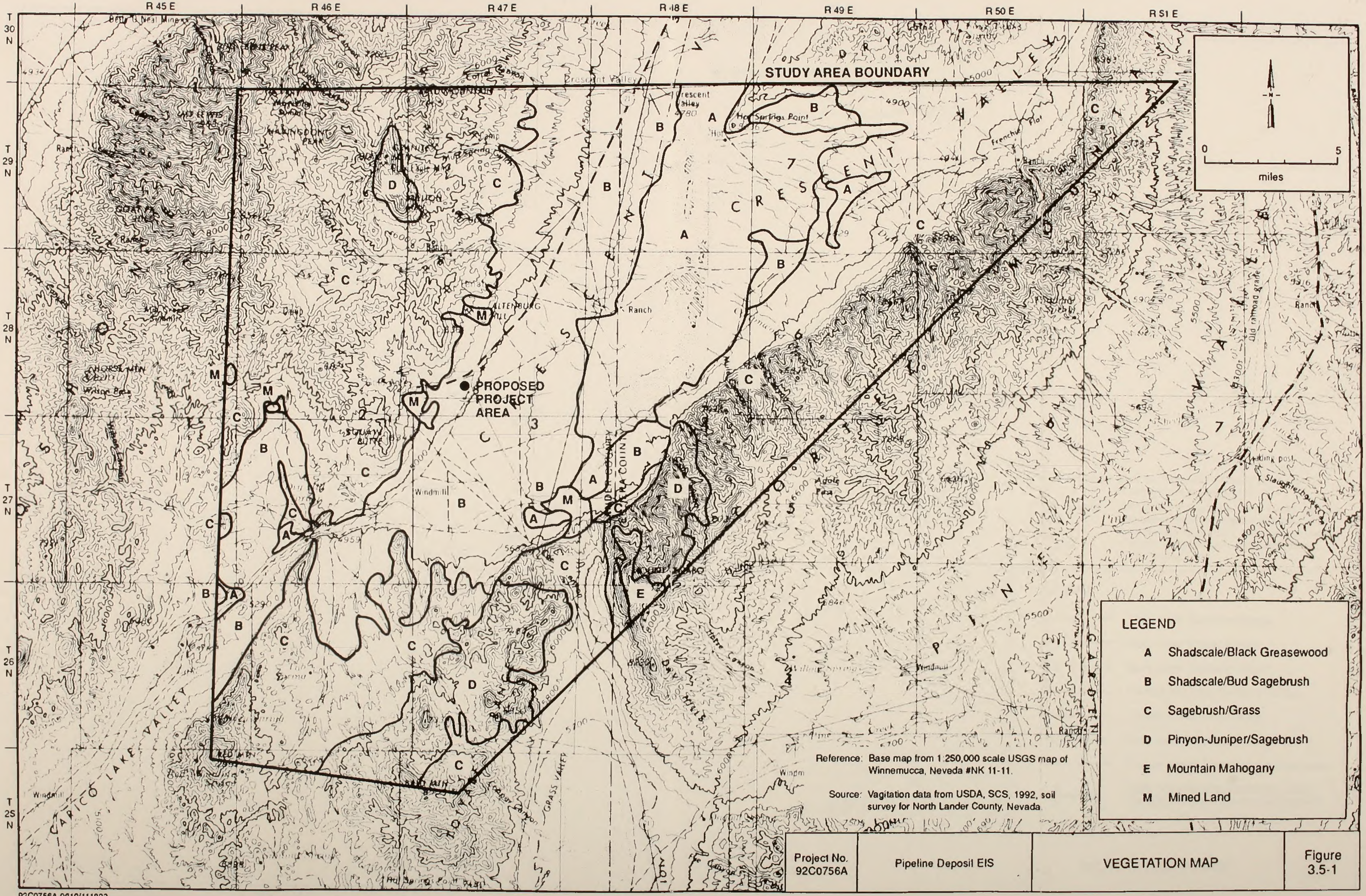
LEGEND

Blanket permit for pipeline project

Other water rights holdings

Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	SELECTED WATER RIGHTS IN THE PIPELINE DEPOSIT AREA	Figure 3.4-6



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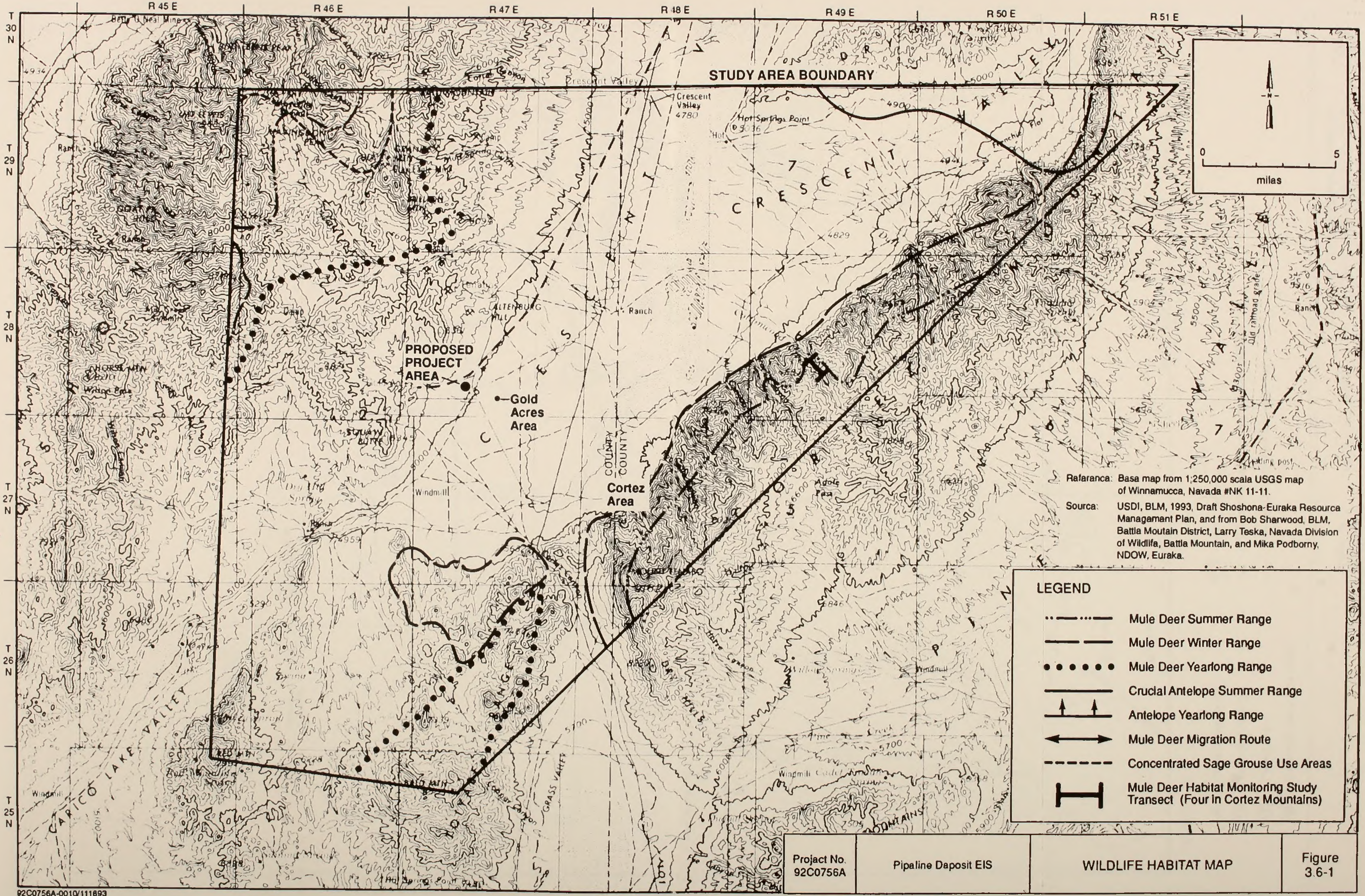
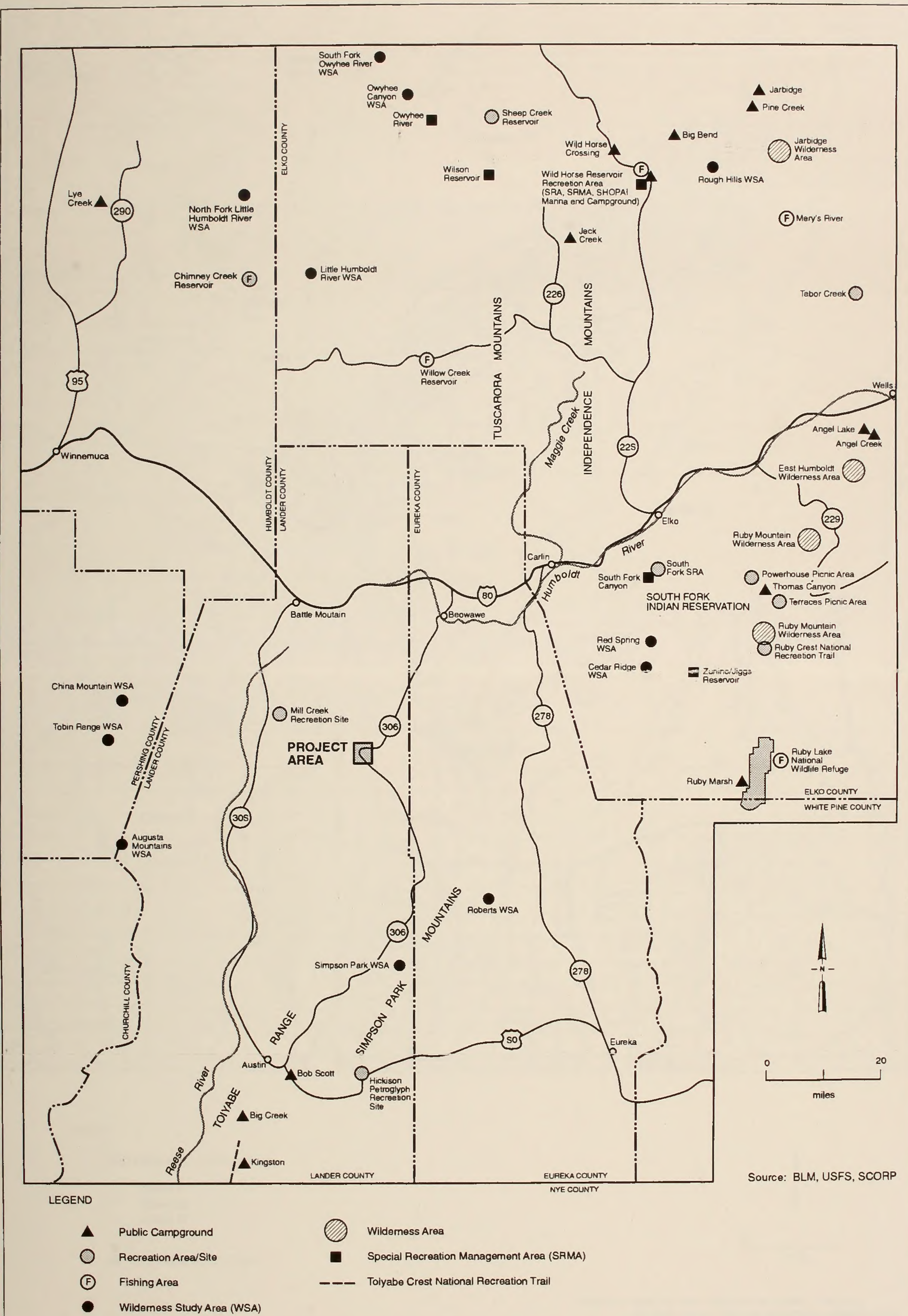


Project No. 92C0756A	Pipeline Deposit EIS	WILDLIFE HABITAT MAP	Figure 3.6-1



Project No. 92C0756A	Pipeline Deposit EIS	RECREATION AND WILDERNESS AREAS IN THE VICINITY OF THE PROJECT AREA	Figure 3.7-1

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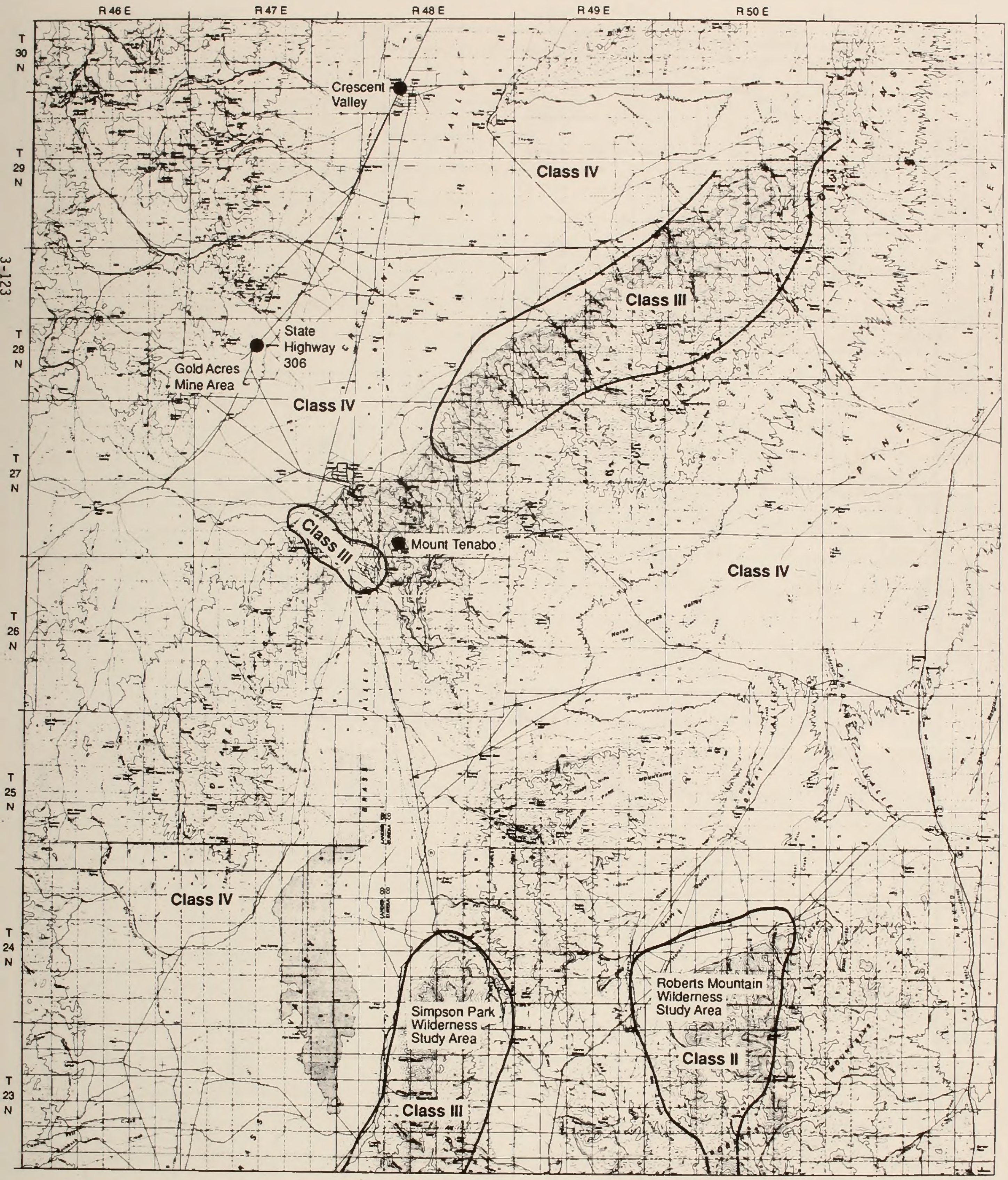


LEGEND

VRM Objectives Classification:

Class II
Class III
Class IV

● Key Observation Points

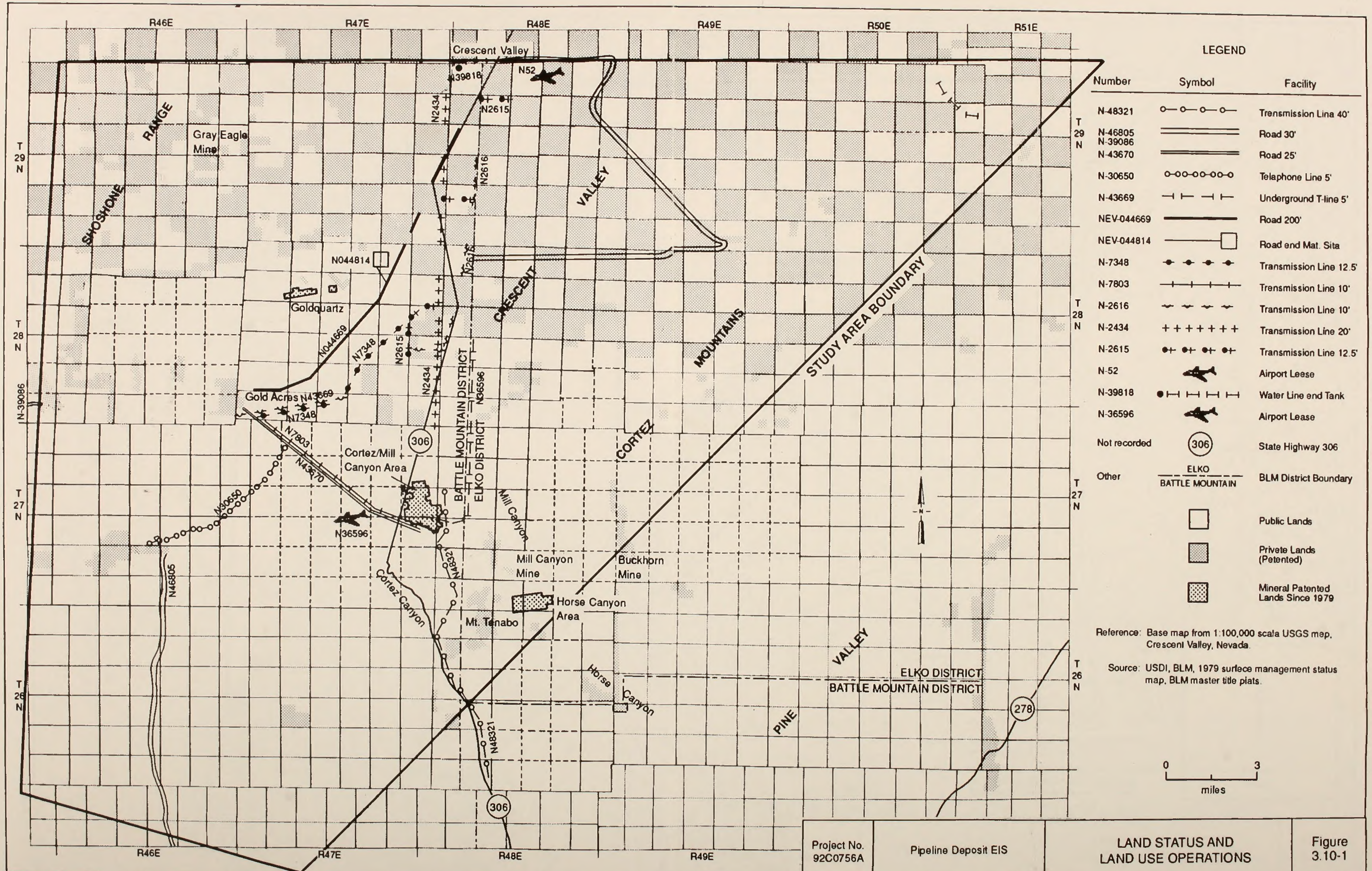
0 — 4 miles

Reference: Base map from USGS provisional maps of Nevada, 7.5 minute series, Cortez and all adjoining quadrangle maps.

Source: BLM

Project No. 92C0756A	Pipeline Deposit EIS	VISUAL RESOURCES MAP	Figure 3.8-1

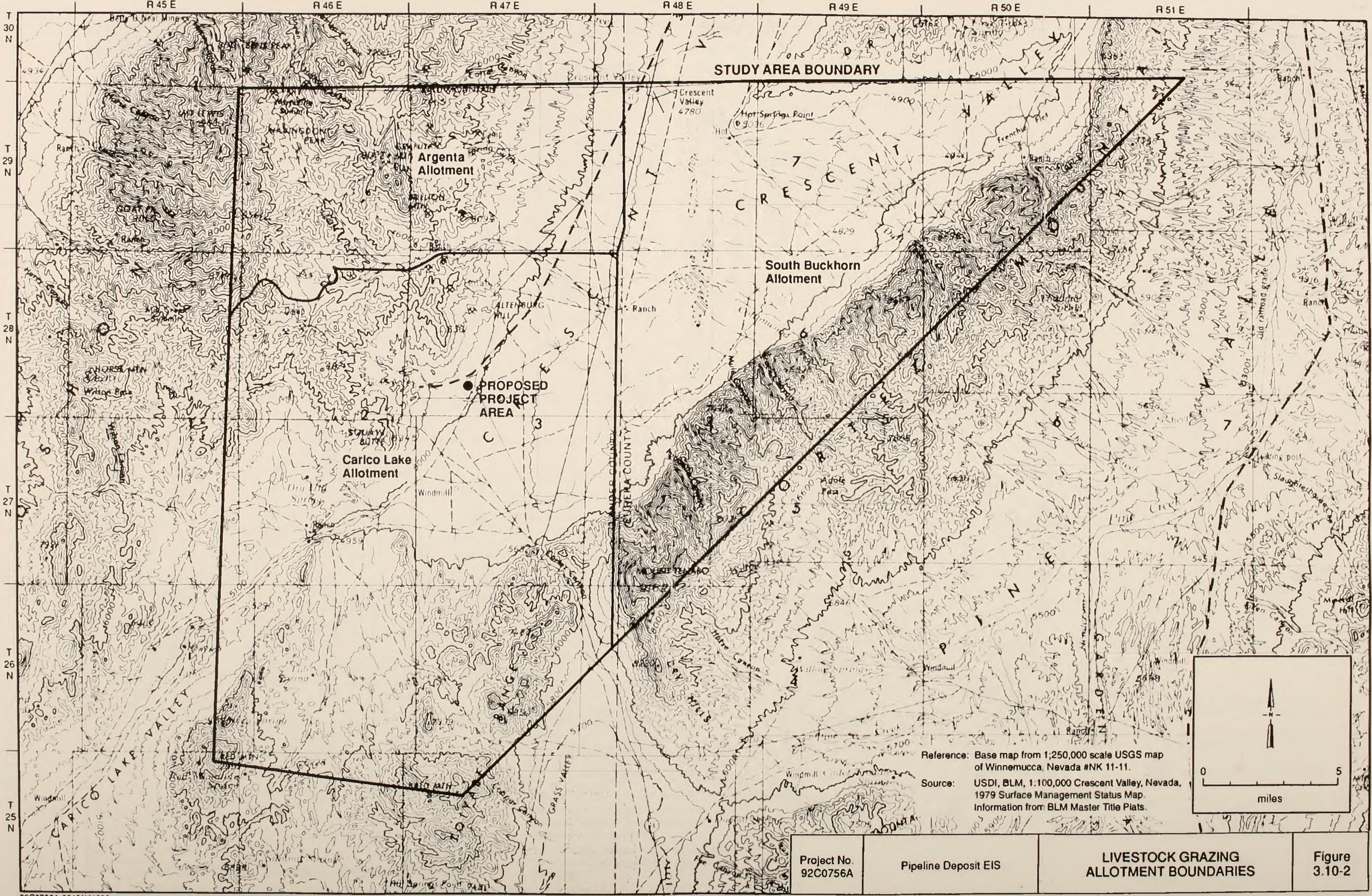
92C0756A-0010/111893



LAND STATUS AND LAND USE OPERATIONS

Figure 3.10-1

92C0756A-0010/032693



Project No. 92C0756A	Pipeline Deposit EIS	LIVESTOCK GRAZING ALLOTMENT BOUNDARIES	Figure 3.10-2

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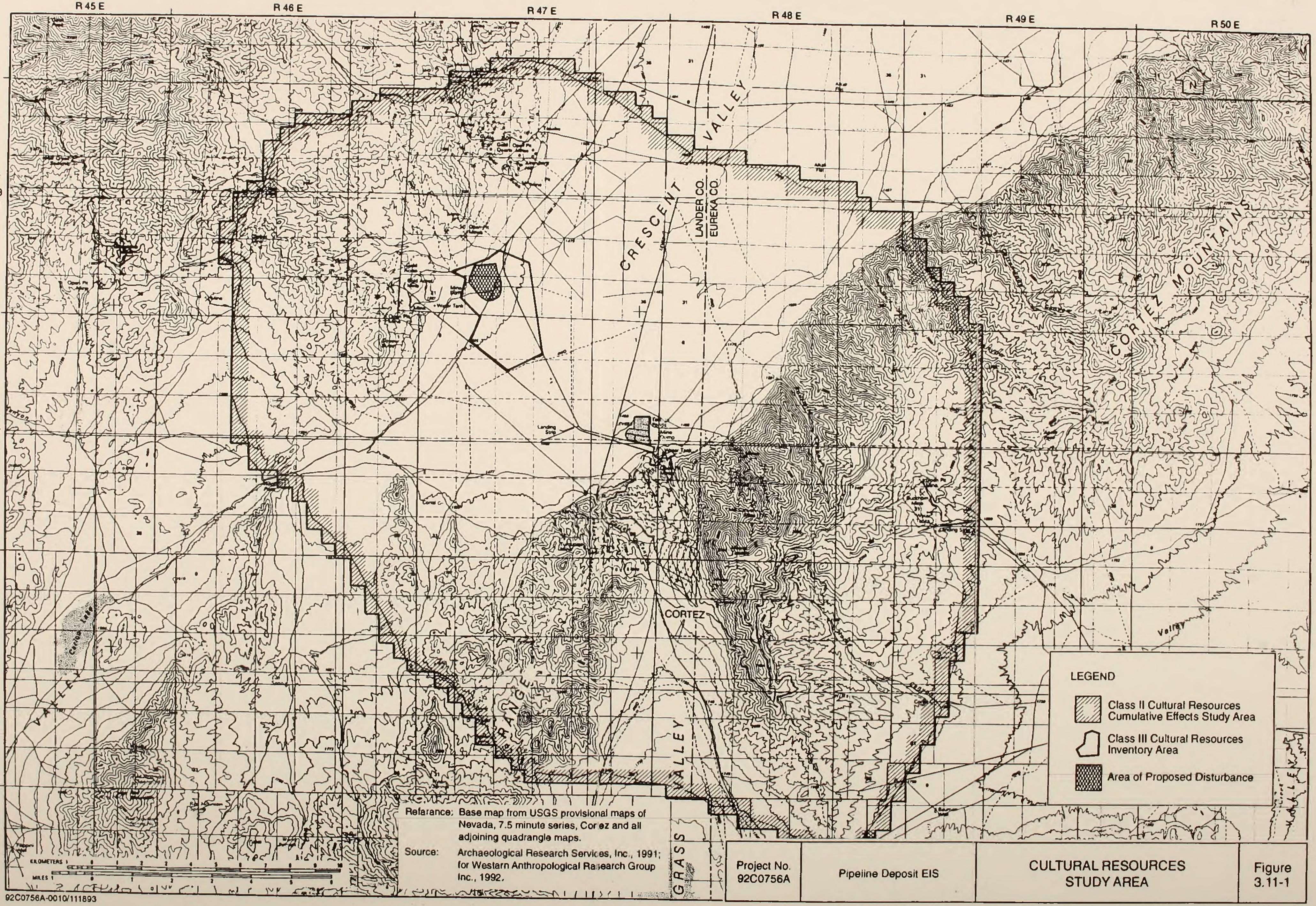


CULTURAL RESOURCES STUDY AREA

Figure 3.11-1

4.0
ENVIRONMENTAL CONSEQUENCES

The purpose of this section is to describe potential environmental impacts that would result from construction of the Proposed Action facilities, operation of those facilities, and reclamation. Impacts are evaluated based on an assumed project life of 12 years with 3 additional years required for reclamation. The No Action Alternative is also addressed.

This EIS is tiered to the Expansion EIS (BLM 1992b, 1993a). In some instances, data utilized and conclusions derived from analysis of such data in the Expansion EIS will be incorporated by reference.

The scope of the impact analysis includes evaluation of all impacts resulting from the Proposed Action but does not address impacts that are associated with current (i.e., already permitted) activities. The impact analysis for each resource area begins with a definition of significance criteria. These criteria are designed as threshold levels to indicate when a significant impact would occur. In some cases, established standards are used, e.g., water quality and air quality standards. In other cases, more qualitative criteria are used as general indicators of significance based on professional judgement and agency guidelines.

Assessment of impact significance is made after evaluation of the effectiveness of specific design or reclamation measures described in Section 2.0 and summarized in this section. When significant or potentially significant impacts would remain after design measures have been applied, mitigation measures are proposed.

Mitigation measures have been recommended in this Environmental Impact Statement which could avoid or reduce anticipated impacts. Residual impacts or unavoidable adverse impacts are identified which would remain after mitigation measures had been applied. After the public review period is complete, the Bureau of Land Management (BLM) will identify final mitigation measures in consultation with other agencies and the applicant and include these in the final Environmental Impact Statement.

The evaluation of impacts in this section is limited to those impacts that would result from the Proposed Action and the No Action Alternative. The incremental effect of these impacts added to other impacts resulting from past, present, or reasonably foreseeable projects are addressed in Section 5.0.

4.1 AIR QUALITY

4.1.1 Significance Criteria

Air emissions are compared to two types of standards to assess significance of impacts: those for criteria pollutants and those for toxic pollutants. Estimated emissions of criteria pollutants from the Proposed Action are compared to Nevada State Ambient Air Quality Standards (AAQS). Air quality impacts from toxic air pollutants are compared to the Nevada State Ambient Air Toxics Standard (Table 3.1-4). If emissions exceed the corresponding standard, then the impact is considered significant.

4.1.2 Impacts

Air quality in the local vicinity of the Proposed Action would be affected by the proposed construction and operation of the open pit mine with associated dewatering system and waste dumps, construction of a new combined heap leach and tailings disposal facility, and the construction and operation of a 5,000-ton-per-day ore processing facility. Additionally, cumulative effects on regional air quality could result from existing and proposed operations at the Cortez Gold Mine in conjunction with emissions from other permitted or planned sources in the Crescent Valley Air Basin (see Section 5.0).

Air pollutant emissions from the proposed operations are associated with a number of processes at the ore processing facility as well as from other mining activities. These pollutant emissions can be categorized as either point source (e.g., through a process stack or exhaust vent) or fugitive emissions (in particular, fugitive dust emissions). The term "fugitive dust" refers to particulate matter emitted from an open area (i.e., not through a stack or an exhaust vent), due to human activities or by the forces of wind acting on exposed material such as soil or storage piles.

The primary air pollutant of concern for the Proposed Action operations is PM_{10}. Fugitive dust emissions (i.e., PM_{10}) would result from various activities associated with the open-pit mine waste dumps, heap leach and tailing impoundment facilities, and ore processing facility construction. These activities include land clearing, earth moving, loading and unloading trucks with ore or overburden, vehicle travel on unpaved haul roads, and blasting. Point source emissions of PM_{10} would result from various ore processing and related operations at the mill facility. Pollutant sources at the mill facility include the following: the jaw crusher, the vibrating grizzly feeder, ore drop and transfer points, the lime silo, the carbon reactivation kiln, and the furnace.

Discussed below are the analyses of potential air quality effects from the proposed open-pit mining and ore processing operations for the Proposed Action. Cumulative air quality effects associated with the Cortez Pipeline mill, the existing Cortez mill, and other sources in the Crescent Valley Air Basin are discussed in Section 5.1. Mitigation measures are discussed in Section 4.1.

4.1.3 Fugitive Emissions

The Proposed Action would result in fugitive dust emissions from the following activities: earthmoving, blasting during construction of the open pit, haul truck travel on unpaved roads, and truck loading and unloading of ore and overburden. Fugitive dust emissions from each of these activities are discussed separately below. For the purposes of this evaluation it was assumed that PM_{10} emissions constitute 36 percent of TSP emissions (EPA 1985). TSP is generally considered as being all particles less than approximately 30 micrometers (μm) in diameter. PM_{10} emissions would be less than the TSP emissions, since PM_{10} generally represents only a fraction of fugitive TSP emissions. Emissions of PM_{10} from fugitive dust were estimated using projected ore reserves and surface area disturbed.

<u>Surface Disturbance</u>

To estimate PM_{10} emissions from surface disturbance during excavation of the open pit, heap leach/tailing area, and mill construction area, an emission factor of 1.2 tons of TSP per acre of excavation per month of activity was used (EPA 1985). This is a general emission factor for TSP that includes activities such as land clearing, earthmoving, truck haulage, and wind erosion. Estimated emissions are based on proposed acres of surface disturbance at each of the affected areas, and the duration of disturbance. PM_{10} emissions were derived from the TSP estimate by applying a 0.36 factor (assuming PM_{10} is 36 percent of TSP). Average annual emissions of PM_{10} from surface disturbance activities are presented in Table 4.1-1. It should be noted that these are estimates of uncontrolled emissions. Applicant-committed design measures discussed under mitigation (Section 4.1.5) would reduce fugitive dust impacts.

__Blasting__

Ore would be mined by conventional open-pit methods involving drilling, blasting, loading and hauling. Most of the overburden and ore would require drilling and blasting. Fugitive dust emissions would result from blasting during mine construction and operation activities.

Emissions from blasting were estimated using an EPA TSP emission factor for blasting (EPA 1985). Emissions were calculated based on the number of acres over which blasting would take place during pit construction and mining. PM_{10} emissions are assumed to be 36 percent of TSP calculated using this emission factor. As development of the pit proceeds, blasting will occur at each bench level. Uncontrolled emissions from blasting were conservatively estimated based on the estimated surface areas of each bench, down to an elevation of about 4,800 feet (350 feet below the top of the pit). Emissions from blasting at depths greater than 350 feet were assumed to be insignificant since this is the approximate depth of the natural groundwater table, and since it is unlikely that emissions from these levels would reach the pit surface. Table 4.1-2 provides fugitive dust emissions from blasting during construction and mining of the open pit mine. Emissions from drilling and blasting would be minimized by blast hole optimization and all drilling would be done wet.

__Haul Truck Travel on Unpaved Roads__

Fugitive dust emissions (PM_{10}) would result from haul trucks traveling on unpaved haul roads while hauling ore, waste rock, and overburden. The open pit will produce about 268 million tons of material over the life of the Proposed Action. Of this total amount of material, approximately 147 million tons would be waste rock material, and 86 million tons are alluvium waste materials. The remaining material, 35 million tons (portions of the ore), would be processed at the heap leach facilities, Proposed Action mill, or the existing Cortez roasting facility.

Heap leach ore would be processed on an as-mined basis. Carbonaceous ore mined from the Pipeline deposit would be stockpiled until a sufficient tonnage has been mined to sustain a constant 2,000-ton-per-day supply for the Cortez roasting facility. It is not expected that the carbonaceous ore would be transported to the Cortez facility until sufficient ore had been stockpiled. The schedule for hauling the ore to the Cortez facility, and its processing, is uncertain. It is likely that this would take place towards the end of the project lifetime. However, hauling of ore to the Cortez facility could occur over a period as short as 2 years or as long as 9 years. Therefore, only total project PM_{10} emissions from truck hauling, and not average annual emissions, were estimated.

After blasting, both overburden rock and run-of-pit ore would be loaded into haul trucks and hauled to the appropriate area. The ore would be hauled either to the mill or heap leach facilities, and the overburden would be hauled to the overburden disposal areas. The haulage distances to the mill plant site and overburden areas have been minimized. Eleven to 15 haul trucks would be used for this purpose. The trucks would have capacities ranging from 180 to 240 tons.

Three main haul roads would be used for this Proposed Action. One haul road, approximately one-half mile long, would be constructed between the mine and overburden disposal areas. Another haul road, approximately three-quarters of a mile long, would be constructed between the mine and the Pipeline mill. The third haul road, the existing Gold Acres haul road to Cortez, would be used for hauling carbonaceous ore from the Pipeline deposit to the existing Cortez roasting facility, located about 7 miles from the mine. This haul road is currently 50 feet wide and would have to be widened to 120 feet to accommodate the large haul trucks that would be used for this Proposed Action. Fugitive dust from these roads would be minimized with water and/or dust suppressant.

Emissions from trucks traveling on these haul roads were estimated using standard EPA emission factors (EPA 1988) for truck travel on unpaved roads. The number of truck trips and miles traveled per trip were based on the estimated tonnage of material being delivered to each different processing or disposal areas and the lengths of the associated haul roads.

For the purposes of these emission estimations, it was assumed that all of the mined material would be transported by 190-ton haul trucks. Use of the 190-ton haul trucks provides a conservative estimate of emissions since haul trucks with larger capacities would require fewer trips to haul the same amount of material. The results of these emission calculations are provided in Table 4.1-3.

Other roads for light-duty vehicle access to the mill and processing facilities would be constructed. Emissions from these roads were not estimated since it is expected that emissions from light-duty vehicle travel on these roads would be insignificant compared to those from the haul roads.

Dust control measures would be applied to unpaved haul roads as part of the requirements of a surface disturbance permit issued by the NDEP. Dust control measures currently in use at the Cortez facility include watering and chemical dust suppression. Control efficiencies from watering and chemical dust suppression for unpaved roads, using substances such as calcium chloride ($CaCl_2$) or magnesium chloride ($MgCl_2$), are about 75 percent. The fugitive dust emission estimates provided in Table 4.1-3 were computed assuming a minimum control efficiency of 50 percent. Therefore, depending on the type of dust-suppression method used, actual emissions should be lower.

Truck Loading and Unloading

In addition to emissions generated during truck travel over unpaved haul roads, fugitive dust (PM_{10}) emissions would result from loading of ore and overburden into haul trucks at the mine site, unloading (dumping) of ore at processing sites (proposed mill, heap leach facilities, or Cortez roaster), and unloading of overburden at the disposal area.

At the mine the primary loading machines would be electric shovels with approximately 30-yd^3 buckets. One or more hydraulic shovels or rubber-tired front-end loaders with a bucket size of 15 to 25 yd^3 would also be used. Mine material would be loaded into the haul trucks, which would then transport the material to the appropriate area and unload by end dumping.

Average annual PM_{10} emissions from truck loading and unloading were estimated based on the tonnage of material loaded at the mine and unloading areas, using an EPA emission factor for material handling (EPA 1988). Table 4.1-4 provides a summary of the estimated emissions from loading and unloading. As discussed for emissions from haul truck travel, transfer of carbonaceous ore to be processed at the Cortez facility will only occur during a portion of the project lifetime. Therefore, only total project PM_{10} emissions from loading and unloading operations, and not average annual emissions, were estimated.

Emissions from loading would be controlled by minimizing the drop height during ore and waste rock removal and transfer.

Fugitive Dust Impacts

Overall Proposed Action emissions and Proposed Action activity durations were used to calculate annual emissions. That is, estimates of total emissions of each pollutant occurring over the entire Proposed Action duration were initially computed, then based on these total emissions and expected activity durations, an average annual emission rate was computed. The assumption that particular activities occur each day of its scheduled duration results in calculations that are gross estimates of emissions from different activities. For example, earthmoving might be scheduled to be completed during a specified time period, but all equipment associated with earthmoving activities, quantities of materials moved, and locations of activities could be used to provide a more refined estimate of Proposed Action emissions, if such a schedule were available.

Effects of PM_{10} from construction activities would be highly variable because impacts would be a function of duration of the activity and existing site-specific meteorological conditions. For example, fugitive dust emissions would be greater during dry, windy periods. Locally elevated PM_{10} levels could result during some construction activities, but would be temporary and transient in nature. Construction and exploration activities, and the day-to-day mining operations of the Proposed Action, are similar to many of the other mining operations in the surrounding Proposed Action region. Particulate matter emission levels from mining-related activities, and their ensuing effects on air quality, are generally comparable from one mining operation to the next. Local variations do exist, however, depending on the specific level of activity in a particular area.

To assess the potential for significant air quality impacts from particulate matter emissions from the Proposed Action, ambient PM_{10} monitoring information from another ongoing similar mining operation was evaluated. PM_{10} monitoring data collected at the Newmont Gold Company's Gold Quarry site (BLM 1991) were used for this purpose. The Gold Quarry site is located approximately 7 miles northwest of the town of Carlin, Nevada, in Eureka County. Estimated acres of surface disturbance from current activities at Gold Quarry cover 2,310 acres (BLM 1991). Estimated acres of surface disturbance over 13 years of the Proposed Action at the Cortez Pipeline site would cover roughly 1,940 acres.

The Newmont Gold Company has been monitoring ambient PM_{10} near the Gold Quarry site, beginning in July 1989, to monitor the local effects of its mining operations. Results of the monitoring data (Table 3.1-5) show that federal and state PM_{10} standards were not violated during the monitoring period. Based on these data, it is concluded that the similar proposed operations at Cortez (based on total acreage of surface disturbance) would not result in violation of the state or federal ambient air quality PM_{10} standard. This assessment assumes that dust control measures in Section 2.2.8 are implemented.

4.1.4 Point Sources

<u>Emissions</u>

Point source emissions of PM_{10} would come from various processes at the proposed mill. These potential point sources of emissions include (1) ore drop and transfer points, (2) the lime silo, (3) the vibrating grizzly feeder, (4) the jaw crusher, (5) the carbon reactivation kiln, and (6) the furnace. Propane firing of the carbon reactivation kiln and two boilers would result in minor emissions of CO and NO_x. Operations in the grinding circuit would result in negligible PM_{10} emissions, because ore would be wetted during those operations.

PM_{10} emissions were estimated for the above sources based on material throughput, the efficiency of the pollution control devices, and emission factors which relate the amount of material processed (throughput) with the degree of PM_{10} emissions. Emissions from the ore drop and transfer points, lime silo, grizzly feeder, and jaw crusher were calculated using standard emission factors for mining and metallic minerals processing (EPA 1986, 1988). For these emissions estimates, an ore moisture content of 4 percent was used. The typical moisture content of the Pipeline ore is 11 percent. Emissions from crushing of ore of this high moisture would be negligible. However, some materials used for construction would be processed in the crushing circuit and would have a lower moisture content. This would be a short-term, temporary use of the crushing circuit. For the purposes of the emissions estimates, it was conservatively assumed that the moisture content of all materials processed in the crushing circuit, including Pipeline ore, was 4 percent.

Emissions from the carbon reactivation kiln and the furnace were calculated using an average value of emissions testing results obtained from the NDEP. Material throughput was used with these test results to calculate emissions. CO and NO_x emissions from the carbon reactivation kiln and the two boilers were calculated using heat input and standard emission factors for fuel-burning equipment (EPA 1986, 1988).

Adjustments to the resulting calculated emissions were made to account for the application of control devices on emission points. A low-energy wet scrubber would be placed on emissions points from the carbon reactivation kiln, with a control efficiency of 80 percent. A baghouse would be used for control on the lime silo, resulting in a control efficiency of 80 percent. For control of dust from the crushing circuit, a wet spray system would be used. Typical control efficiencies from wet spray range from 70 percent to 90 percent (EPA 1986, 1988). For these emissions calculations, a 70 percent control efficiency was assumed. Table 4.1-5 presents estimated emissions from point sources at the proposed mill.

Process Source Impacts

Air quality impacts from process sources were evaluated by comparing ground-level concentrations to ambient air quality standards. Ground-level concentrations from process sources at the mill were calculated using atmospheric dispersion models that are approved by NDEP and would be used by NDEP for permitting of sources at the proposed mill.

Dispersion Modeling

Topography near the proposed mill site ranges from simple terrain to complex terrain. Simple terrain is defined as any terrain that does not exceed the height of the stack. Complex terrain is defined as terrain whose elevation exceeds stack top. Two EPA-approved models were used to calculate impacts from the proposed mill in simple and complex terrain. The Industrial Source Complex Short Term version 2 (ISCST2) model was applied to areas of simple terrain, while the COMPLEX I model was applied to areas of complex terrain. Both of these are Gaussian models. Gaussian models are the most widely used techniques for estimating impacts of nonreactive pollutants in rural environments.

Modeling was performed in two phases. The first phase was to use the ISCST2 and COMPLEX I models to compute ground-level concentrations at receptors on a coarse grid array that surrounded both the proposed mill and the existing Cortez mill. For the purposes of modeling, receptors represent people that could be exposed to pollutants, and they are placed in locations where the public could have access. This was done to capture the location of maximum impacts from the proposed mill, as well as assess cumulative impacts from sources at both mills. Cumulative impacts are discussed in Section 5.0. In the second phase, both models were used again to estimate impacts from the proposed mill only, with a more dense array of receptors.

The receptor grids were based on a Cartesian coordinate system. The dimensions of the coarse grids was 15 km by 13 km around both of the proposed mill and the existing mill, with a 1-km spacing. The dense array formed a 3-km by 3-km grid around the proposed mill, at a 1/2-km spacing. In addition, receptors were placed along, but not inside, the property boundary of both the existing mill for cumulative impacts and the proposed mill.

One year of meteorological data (1989) from Elko (surface) and Winnemucca (upper air) was used in the dispersion modeling. Source information for emissions points at the proposed mill is summarized in Table 4.1-6.

$\underline{PM_{10}}$

The modeled ground-level concentrations resulting from PM_{10} emissions at the mill were added to background, or ambient, concentrations of PM_{10} to obtain the total ground-level PM_{10} concentration at the receptors in the Proposed Action vicinity. Twenty-four-hour background PM_{10} concentrations were obtained from monitoring conducted at the Proposed Action site since July 1992 (Table 3.1-5). Annual background PM_{10} values were obtained from TSP levels assumed by NDEP for modeling of permitted sources at the existing Cortez mill. It is conservatively assumed for this analysis that all annual background TSP is PM_{10}. The total PM_{10} concentration was then compared to the ambient air quality standards (AAQS) to assess significance of impacts.

Table 4.1-7 summarizes the air quality dispersion modeling results. The maximum total PM_{10} concentration (modeled concentration plus background) for a 24-hour averaging time was 102.0 $\mu g/m^3$, which is below the 24-hour AAQS for PM_{10}, resulting in no significant impact. The maximum total PM_{10} concentration for an annual average was 5.1 $\mu g/m^3$, which is below the annual PM_{10} AAQS, resulting in no significant impact.

Note that a full year of monitoring data is not yet available from the on-site station, so an annual background value of 9.0 $\mu g/m^3$ is used. This is the NDEP-assumed background value used in the Cortez mill permit modeling, as no representative background data exist.

Crystalline Silica

Emissions of crystalline silica would result from transfer and crushing of ore at the proposed mill, due to the presence of crystalline silica in the ore. During crushing, crystalline silica would potentially be released to the air. Quartz is the form of crystalline silica that is present in the ore. The current air toxic standard for quartz is 2.38 $\mu g/m^3$. This is an 8-hour average concentration. Concentrations of crystalline quartz resulting from operations at the mill could potentially exceed the standard of 2.38 $\mu g/m^3$, leading to a significant impact.

Mercury and Arsenic

Emissions of mercury and arsenic, also present in the ore, were estimated from crushing operations. Mercury would also be emitted from the carbon reactivation kiln and the furnace. Mercury and arsenic emissions were calculated as a percentage of PM_{10} emissions from the crushing circuit, based on the percentage of mercury and arsenic in ore samples. Mercury emissions from the kiln and furnace were obtained from NDEP emissions testing results and based on the throughput of material. Ground-level concentrations were calculated using dispersion modeling for the proposed mill, for comparison to mercury and arsenic air toxic standards. These 8-hour standards are 1.19 $\mu g/m^3$ for mercury and 4.76 $\mu g/m^3$ for arsenic.

The maximum modeled 8-hour concentrations of mercury and arsenic were estimated to be 0.5 $\mu g/m^3$ and 0.1 $\mu g/m^3$, respectively. These concentrations are below the applicable air toxic standard for these two toxic substances.

4.1.5 Mitigation

Project-related impacts are calculated assuming certain design features would be implemented. If the design features are not sufficient to avoid significant impacts, mitigation is proposed.

<u>**Fugitive Dust**</u>

<u>**Applicant-committed Design Measures**</u>. The general design measures described in Chapter 2.2.8 for dust control would include:

- Provide surface watering and/or chemical dust suppressant. Watering is estimated to reduce dust emissions by 50 to 75 percent (Bay Area Air Quality Management District 1985). Chemical dust suppression is through the use of dust palliatives (i.e., non-toxic, hydroscopic compounds such as $CaCl_2$ or $MgCl_2$) mixed with the water to increase moisture retention in the surface dust particles.

- Limit areas to be cleared to facility construction areas and necessary equipment and materials stockpile areas.

- Wet the area down sufficiently to form a compact surface upon completion of grading and earthmoving. Repeat wettings as necessary, to maintain this surface and prevent dust from being picked up by the wind.

- Concurrent reclamation would occur as proposed expansion takes place. This, in combination with the design measures discussed above, would sufficiently control fugitive dust emissions.

After application of design measures, impacts would be reduced to less than significant levels.

<u>**Mitigation**</u>. Mitigation beyond the above design measures would not be required.

Criteria Pollutants

Applicant-committed Design Measures. Design features to control point source emissions from sources at the mill would include a wet spray system for the crushing circuit, a baghouse for the lime silo, and wet scrubbers for the carbon reactivation kiln and furnace, or technology of equivalent control efficiency.

This would reduce impacts to less than significant levels.

Mitigation. No mitigation is necessary.

Toxic Pollutants

Applicant-committed Design Measures. Pending state legislation would remove crystalline silica from the state toxic list. Therefore, only if required by state legislation or regulations would ambient monitoring of crystalline silica be performed to quantify background (before project operation) levels and project-related (during project operation) levels.

The same design features that would be used for control of criteria pollutants would control mercury and arsenic emissions.

Mitigation. If the monitored crystalline silica concentrations attributable to the project operation exceed the 8-hour standard of 2.38 $\mu g/m^3$, a wet scrubber (or other technology with equivalent control efficiency) would be used to control emissions from the crushing circuit, resulting in 80 to 90 percent efficiency.

4.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

4.2.1 Significance Criteria

The movement of materials due to slope failures sufficient to breach the sediment control structures or block natural drainages would cause significant erosion and transport of sediments off site. Subsidence resulting in damage to structures or releases of hazardous materials to the environment would also be significant.

4.2.2 Geology and Minerals Impacts

Mineral Resources

The proposed mining activities would result in the mining of approximately 268,000,000 tons of ore and waste rock that would be permanently relocated. About 34,500,000 tons of this would be gold ore. Of this total, 16,680,000 tons are estimated as oxide ore, 16,380,000 tons as heap-leachable ore, and 1,413,000 tons as carbonaceous ore to be roasted. The oxide ore would be milled and would eventually be placed in tailings facilities. Carbonaceous ores would also be milled but require an additional roasting step prior to gold extraction and placing in the tailings impoundment. The ore to be heap-leached would be permanently placed on leach pads. The open pit has a waste-to-ore strip ratio of 5.17 to 1. The approximately 233,500,000 tons of waste rock would be placed in the proposed new waste rock dump. Exploration drilling has indicated that no mineral resources would be located beneath the proposed mine facilities.

Seismic Events

The proposed waste dumps and heap leach/tailings facilities have the potential to be impacted by seismic events if the events exceeded the design earthquake loadings. The faulted nature of the ore deposit suggests that subsurface pathways may be available to potential releases and subsequent migration of releases away from the proposed heap leach/tailings facilities. However, because the proposed facilities are designed as no-discharge systems, releases to the subsurface are not expected. In the event of an earthquake, rupturing of a liner may be possible; however, the facility has been designed according to appropriate design criteria.

The waste rock dumps, constructed at the angle of repose, could be expected to experience minor slope failures during an earthquake. Following reclamation and regrading to lower slope angles (design measures specified in Section 2.8.3), the dumps would be stable during the design earthquake. Waste dumps would also be designed to remain stable during a 100-year, 24-hour storm event.

The pit wall by design would be based on short-term safety factors including worker safety and would be consistent with the longevity of the proposed mining operations. Over the longer term, limited rock sloughing is expected from the pit walls due to wave action, precipitation, or other erosive factors but would be contained on the benches. None of the predicted slope failures would be of sufficient scale to significantly escalate sediment transport.

Land Subsidence

There would be potential for subsidence of the land surface to occur as groundwater is removed and the aquifer undergoes compression (or consolidation) from the loss of fluid. Subsidence could result in damage to mine facilities such as buildings or heap leach and tailing facilities. The most extensive subsidence occurs in unconsolidated or semiconsolidated sediments containing sand and gravel aquifers interbedded with clayey sediments. The amount of consolidation is greater in the fine grained sediments (clays) than in the coarser sand and gravel because the clays are much more porous and correspondingly contain more fluid per unit volume. When the pressure is reduced by withdrawal of the groundwater for dewatering, such materials undergo compaction which is often irreversible. Compression in sand and gravel layers is considered elastic because the compression is largely recoverable as expansion takes place as the groundwater level recovers. Subsidence is the resultant sum of the compression resulting from consolidation of each individual layer that is dewatered.

A computer model was used to estimate the amount of land subsidence from the mine dewatering for the Proposed Action (Cortez 1993). The Proposed Action is situated on the western margin of Crescent Valley and is underlain by a wedge of alluvium which overlies easterly dipping bedrock. Only a small portion of the alluvium is saturated with groundwater underneath the site, but this increases to the east toward the center of the valley. The saturated thickness of the alluvium (which has the greatest potential to compress and cause subsidence) increases from about 90 feet at the site to over 700 feet at a distance of 5000 feet to the east of the site. The alluvial aquifer which will become dewatered consists of silty sands and gravels, clayey sands, sandy clay and clayey sand. Using a subsidence based model, the maximum expected surface subsidence after 10 years of pumping is 20 inches in the area about 3,400 feet northeast of the center of the proposed pit area. The area of maximum predicted subsidence corresponds to the location of the proposed heap leach/tailings area. The predicted maximum subsidence diminishes to less than 4 inches 8,000 feet from the center of the pit. The potential impacts due to land subsidence are considered low.

4.2.3 Paleontology Impacts

An assessment of paleontological resources through the examination of inventories prepared by the BLM and review of the literature found no known vertebrate or invertebrate localities within the proposed mine area (Appendix A). Consequently, no impacts to paleontological resources would be expected as a result of the proposed activities.

4.2.4 Mitigation for Geologic Hazards

Geotechnical calculations (Cortez 1993b) indicate that land subsidence would not induce yielding or failure of the synthetic liner material specified for use in the proposed heap leach and tailing facility. Should actual settlement take place, additional fill material would be placed during grading operations to maintain the design grade and positive drainage of engineered facilities. Design of the heap leach and tailing facilities as zero discharge, the leak detection system and monitoring wells specified in Section 2.2.3 are considered adequate for protection against other releases to the environment. No further mitigation is proposed.

4.3 SOILS AND TOPOGRAPHY

4.3.1 Significance Criteria

The erosion of disturbed or reclaimed sites that would overwhelm sediment control structures, block natural drainages leading to perennial waters, or that could not support revegetation efforts would be significant. The loss of topsoil materials during stockpiling or reclamation that would in turn limit reclamation success would be significant.

4.3.2 Soils Impacts

The proposed mining operations would impact the soils within areas targeted for disturbance by the Proposed Action. The proposed mining activity would result in the alteration of land forms and soil formations as they now exist.

The proposed operations would result in disturbance to 1,880 acres of soils during the peak of mining activity, including 81 acres of soils disturbed during reclamation activities. Tables

4.3-1 and 4.3-2 outline the acres of disturbance by facility and by soil map unit. These tables indicate that approximately 7 acres of disturbance would occur within map unit Cr, which is a prime farmland when irrigated; however, since the soil is not now and has not historically been irrigated, this disturbance is insignificant (i.e., the soil is not considered a prime farmland).

Erosion of soil from disturbed areas, including growth medium stockpiles and roads, would be anticipated. In addition, sediments from mine dumps would add to the overall sediment loads moving from the site. It is important to note that the soils where the majority of the disturbance would take place have a slight to moderate hazard of erosion by water when disturbed. The open pit would not contribute to overall sediment lands moving from the site because no flow from the open pit to offsite areas would occur. Since no perennial waters would receive sediments, the impact is insignificant.

During reclamation, the stockpiled soils would be redistributed to a 12-inch depth in a random and unstratified manner. Disturbance caused by the construction of the open pit (241 acres, of which 52 acres are currently disturbed) would remain as a permanently disturbed soil site. As shown in Table 2.2-5, approximately 5.2 million cubic yards of growth-medium material would be available for salvage. A volume of 3.2 million cubic yards of growth medium would be required to topsoil 1,639 acres of reclaimed sites, an excess of 2.0 million cubic yards. Following reclamation of the disturbed surfaces, the potential for continued erosion and off-site transport of sediment from the project area would be greatly reduced. The proposed sediment-control facilities (silt fences and hay bales) would be maintained to control sediment produced during the reclamation period and until the reclamation work was deemed successful by the BLM.

The removal, stockpiling, and redistribution of the soils would disrupt the microbial systems and destroy the structure of the horizons, reducing the nutrient cycling capability and water-holding capacity of the developed soil profiles. The redistributed soils would exist as an undifferentiated composite material. Based on previous successful mine reclamation projects utilizing stockpiled and redistributed growth-medium materials, it is not expected that this would significantly decrease the effectiveness of the soil material to function as a growth medium.

Approximately 46,000 cubic yards of the excess topsoil materials would be hauled to the Cortez Mine Expansion reclamation project. This would be 2.5 percent of the excess volume available in the project area. The removal of this amount of soil materials would not be evident in the project area because the open pit would not be topsoiled or revegetated, contributing to the excess of topsoil materials. The hauling would require about 250 truck trips across the valley on the existing haul road.

4.3.3 Mitigation

Erosion and sedimentation impacts from soils not successfully reclaimed would require mitigation measures beyond the standard reclamation measures proposed in Section 2.0. Proposed mitigation is discussed below.

- Reclamation efforts would be monitored longer than the 3 years proposed as part of standard reclamation procedures in Section 2.0.

- If reclamation efforts were not successful during the extended monitoring period, additional seedbed preparation and reseeding would be implemented.

4.4 WATER RESOURCES

The Proposed Action has the potential to impact both water quality and quantity in the study area. Several potential impacts that may be associated with mining operations such as the Proposed Action are identified in this introduction. The magnitude and significance of these impacts are addressed in the remainder of this section. The pit dewatering system has the potential to affect the quantity of groundwater and surface water available in the study area. Construction and operation of new waste rock dumps, heap leach and tailing facilities, and stockpiled ore areas have potential to affect both groundwater and surface water quality through acid rock drainage and/or release of contaminants such as weak acid dissociable (WAD) cyanide.

The pit dewatering system is designed to lower (draw down) the natural groundwater level (water table) in the vicinity of the proposed pit in order to allow dry mining below the water table. The dewatering system would consist of a series of high-volume production wells that would draw down the water table in the pit area. The resulting water table drawdown in the area has been estimated using a computer model, but the actual extent would not be known until the dewatering system is operating. If the lateral extent of the water table drawdown includes areas occupied by producing water wells, water levels in wells within the affected area may be lowered. Flow from some springs, seeps, and surface drainages could also be reduced.

Mined ore and waste rock materials naturally contain trace concentrations of metals and other compounds that may leach from stockpiles. Metals or other compounds that leach may impact surface water quality through rainfall, runoff into nearby drainages, or potentially impact groundwater quality by infiltrating into the ground. Groundwater would flow (or seep) into the pit, creating a lake after mining activity stops and the dewatering system is shut down. The quality of the pit lake water is expected to be similar to natural groundwater quality in the area. Although the potential for affecting pit lake water quality is low, the relatively good groundwater quality may be impacted if the rocks exposed in the pit walls contain metals or other compounds which could dissolve in the pit lake water.

The following sections present the significance criteria for impact evaluation (Section 4.4.1) and evaluate potential impacts to the groundwater and surface water resources in the study area due to the Proposed Action (Sections 4.4.2 and 4.4.3, respectively). Because of the interrelated nature of groundwater and surface water, there is some overlap in these discussions. For example, a potential impact to surface water quality could eventually be transmitted to underlying groundwater. Conversely, significant drawdown of groundwater levels could eventually cause reduction in surface water flow from springs, seeps, or creeks.

Following the sections on potential impacts to groundwater and surface water, a summary of applicant-committed practices and mitigation measures is presented.

4.4.1 Groundwater Significance Criteria

Significance criteria for assessing qualitative and quantitative potential impacts to groundwater resources in the study area include:

- Lowering of the water table resulting in impacts to other groundwater users or surface water features such as springs/seeps and rivers/creeks. The threshold for significant impacts to wells, seeps, and springs is identified as the modeled 20-foot drawdown contour. This threshold was selected because the 20-foot contour interval is the limit for predicting drawdown in the basin-wide model. Therefore, for the purposes of this study, significant impacts are indicated where the 20-foot contour encompasses a well, spring, or seep and where the surface water feature is hydraulically connected to the aquifer affected by drawdown.

- Degradation of natural groundwater quality by chemicals such as WAD cyanide, arsenic, mercury, or other potentially toxic compounds commonly associated with Carlin-type gold deposits such that concentrations exceed NDEP maximum contaminant levels (MCLs) for drinking water, or existing (background) concentrations. Nevada Administrative Code (NAC) 445.24342 prohibits degradation of groundwater such that it does not meet state drinking water standards. Applicable groundwater quality standards are NDEP primary and secondary standards (Table C-5).

- Degradation of natural soil chemistry by such compounds as WAD cyanide, arsenic, mercury, or other compounds such that concentrations exceed NDEP guidance levels. Current NDEP guidance levels for soils and meteoric water mobility testing are 10 times the drinking water standard for each compound. This guidance is designed to protect groundwater from contamination by leachate from overlying soils.

4.4.2 Potential Impacts to Groundwater

Lowering of Water Table Due to Pit Dewatering

The mine dewatering plan has been designed and would be operated by Cortez to provide relatively dry pit conditions according to the mining schedule. Pit dewatering would be achieved by pumping groundwater from the alluvium and bedrock aquifers and thereby lowering the water table in the vicinity of the proposed pit. A cross section through the pit showing the schematic dewatering system design is provided in Figure 4.4-1. A maximum cumulative pumping rate of 30,000 gallons per minute (gpm) is expected to be reached within the first 2 years of mining and sustained throughout the life of the mine. As a result, drawdown of the water table is expected to extend beyond the 1,880-acre direct disturbance area. With the exception of about 2,000 gpm to be used for ore processing, the remaining pumped groundwater would be conveyed (by pipe or ditch) to the reinfiltration ponds. Most of the reinfiltrated water is expected to recharge the water table. Proposed locations of reinfiltration ponds are shown in Figure 4.4-2.

Pit inflow model predictions and dewatering pumping rate estimates have been developed for given conditions of hydrogeology, mine schedule, and mine geometry. Geologic and hydrogeologic conditions vary significantly between mines in Nevada. A particular mine dewatering program can vary from another (or from its initial design) depending on mine location, mine schedule, open pit geometry, and whether the mine needs to conduct open pit mine dewatering and/or underground mine groundwater control operations. Reasonably good estimates (within 25 percent or better) of dewatering rates can be made using current techniques; however, the estimates only apply to the circumstances modelled. If cases exist where operating pumping rates appear to grossly exceed the modelled estimates or design dewatering rates, it is likely that:

- the hydrogeologic system was not properly understood, or insufficient data were acquired to establish an adequate definition of the aquifer system and its hydraulic parameters;

- a critical error was made in selecting, conceptualizing, and/or applying the model; or

- the actual mine schedule and open pit or underground operation are significantly different than that considered in the dewatering model.

Hydrogeologic modelling has been performed to predict the amount and extent of drawdown after 10 years of mine operation and pit dewatering (WMC 1992b). Potential impacts to groundwater users within the area affected by drawdown are evaluated based on this modelling. Preliminary modelling results show that significant water table drawdowns (in excess of 20 feet) are limited to an area within 5 to 7 miles of the project site. Figures 4.4-3 through 4.4-5 show predicted basinwide water table drawdowns at pumping rates ranging from 25,600 to 32,700 to 56,500 gpm (worst case) with reinfiltration. These three rates represent three scenarios for dewatering the mine pit: a rate less than the anticipated maximum pumping rate of 30,000 gpm, slightly greater, and nearly twice (worst case). The water table drawdown shown on Figures 4.4-3 through 4.4-5 predicts regional effects for the entire southern half of Crescent Valley and therefore provides only minimal detail around the proposed pit area. Actual drawdown in pit area is expected to be about 700 feet.

A range of values has been estimated based on modelling performed to predict the rate of pumping required to dewater the pit. A comparison of the range is favorable with actual pumping rates for other mines in the vicinity. Pumping rates, obtained from the Nevada State Engineer's Office, include Echo Bay (15,000 gpm), Lone Tree Hill (15,000 gpm), Newmont (20,000 gpm), and Barrick (65,000 to 75,000 gpm). Although hydrogeologic conditions at these mines may vary slightly from those at the Proposed Action, the rates suggest that the worst case pumping rate of 59,000 gpm (WMC 1992b) would not be exceeded.

Effects of drawdown on shallow groundwater remediation currently ongoing at the Cortez Gold Mine could include lowering the effectiveness of the remediation pumpback system and inducing a hydraulic gradient which causes poor-quality groundwater to migrate away from the Cortez mine toward the center of the valley. The Cortez mine groundwater remediation system consists of up to 18 groundwater recovery wells which are operated cyclically such that pumping rates are increased during the period May through November and decreased during the period December through April. Pumped groundwater is used as makeup water for the process solutions. The purpose of the remediation is to clean up the shallow groundwater contamination and prevent further migration of impacted groundwater. The worst-case drawdown (Figure 4.4-5) is estimated to be between 40 and 60 feet, which could result in potentially significant impacts to the effectiveness of the remediation.

Modelling results indicate some potential for impacts to groundwater rights holders in the vicinity of the project site. It is estimated that 20 wells in the study area may be affected by water table drawdown. For 17 of these 20 wells, the drawdown is predicted to be less than significant (i.e., less than 20 feet) according to recent modelling studies (WMC 1992b). Drawdown was predicted to exceed 20 feet for three water rights holders (E. Filippini, BLM, and Consolidated Gold) (WMC 1992b). Based on the available information, it is not certain whether the Filippini or BLM wells would go dry. The wells are both reportedly about 100 feet deep, and drawdown is predicted to be as much as 60-80 feet, which could affect the pumping rate from the wells. The Consolidated Gold well is the current water supply well for the Gold Acres (Cortez) mining operation. It is anticipated that the well will be inactivated and water rights transferred to the Pipeline Project. Therefore, no impacts to this well are anticipated since it will be inactive. Potentially, impacts to the Filippini and BLM groundwater rights could be significant should the drawdown cause the wells to go dry.

Potential impacts to flow from springs, seeps, or creeks are discussed in Section 4.4.5.

Groundwater Inflow into Humboldt River

Some groundwater inflow into the Humboldt River is believed to occur in the northwestern portion of Crescent Valley (WMC 1992b). However, the anticipated worst-case extent of drawdown (Figure 4.4-5), shows that the effects would be limited to the southern portion of Crescent Valley and terminate more than 20 miles south of the Humboldt River. Therefore, potential reductions in groundwater flow to the Humboldt River are not anticipated. Since there are expected to be no direct or indirect impacts to the Humboldt River resulting from the Pipeline Project, the Pipeline Project would not contribute to any cumulative impacts on the Humboldt River.

Groundwater Quality Degradation in Proposed Pit Area due to Acid Rock Drainage

Impacts to groundwater quality could result due to acid rock drainage from stockpiled ore, waste rock, heap leach, and tailings piles. If acid rock drainage occurs and reaches the water table, concentrations of certain compounds in groundwater could increase, resulting in exceedances of NDEP standards. The standards used by NDEP for assessing water quality are EPA's primary and secondary drinking water standards (Table C-5).

The host rock, of which the orebody is a part, may also contain chemicals such as sulfides, and metals such as arsenic, antimony, mercury and zinc. Under conditions existing in the subsurface, these compounds are expected to be in chemical equilibrium (a stable state under which they are not likely to be subject to movement) with the groundwater and surrounding rock. Once the rock is mined and stockpiled, exposure to air and/or water of a different chemistry (e.g., rainwater) could cause sulfides to be oxidized into sulfate. Sulfate could then combine with the rainwater to yield sulfuric acid, which could leach or drain through the pile. Upon exposure to acidic runoff, trace metals contained in the host rock may be dissolved. If this scenario occurs and the acidic water containing dissolved metals leaches out, it is called acid rock drainage. Acid rock drainage may impact groundwater if it percolates through the soil down to the water table. In the immediate vicinity of the proposed pit, acid rock drainage containing dissolved metals would have to drain through approximately 300 to 400 feet of soil and bedrock before it would reach the water table.

NDEP mining permit regulations require that the potential for acid rock drainage be estimated by performing a chemical test that measures the potential for acid rock drainage to cause pollutants to be released from overburden, waste rock and ore. Six rock types were identified and tested for the Proposed Action, including alluvium, oxidized siltstone waste, oxidized siltstone heap leach ore, oxidized siltstone mill ore, oxidized/carbonaceous siltstone ore, and carbonaceous siltstone waste. Representative samples from each rock type are subjected to acid base accounting, which measures the maximum potential acidity (MPA) and the gross neutralization potential (GNP). The ratio of MPA to GNP, expressed as a percentage, represents the portion of the rock type's gross acid neutralization potential that is used to neutralize the rock type's measured maximum potential acidity. The different rock type samples are also subjected to a meteoric water mobility procedure (MWMP) which measures the potential for leaching of metals from the rock by meteoric (rain) water. The MWMP results are compared to drinking water standards according to NDEP guidance documents for mining.

Table 4.4-1 summarizes the acid base accounting results for the six rock types. In general, each of the six rock types tested showed excess neutralization capacity. Ratios of MPA to GNP less than 1 indicate that the neutralization potential is greater than the acid-forming potential. In the mining industry, these ratios are often expressed as percentages. Samples of the alluvial overburden and oxidized siltstone waste material had MPA/GNP ratios that averaged less than 1 percent (MPA/GNP <0.01). Carbonaceous siltstone waste demonstrated an average MPA/GNP ratio that was only 2 percent. Oxidized siltstone mill ore had the highest MPA/GNP ratio of 6.31 (single sample).

MWMP testing was performed on a total of 11 composited samples, including at least 1 sample from each of the six rock types (Table 4.4-1). MWMP results showed that only 3 samples exceeded one of the NDEP MWMP standards. As a general rule, NDEP guidance for interpreting MWMP data considers concentrations less than 10 times the drinking water standard not to be significant. Samples MW-8 and MW-11 (carbonaceous siltstone waste) had manganese concentrations of 3.17 and 5.25 mg/L, respectively (MWMP level 0.5 to 1.0 mg/L). Sample MW-10 (oxidized/carbonaceous siltstone ore) had a selenium concentration of 0.132 mg/L, exceeding the 0.1 mg/L MWMP level.

With respect to the potential for generation of acid rock drainage, it is also important to note that the Proposed Action is located in an arid environment that receives less than 10 inches of precipitation per year (WMC 1992). The relatively low precipitation rate reduces the amount of water available to cause acid rock drainage.

Based on the acid base accounting results (MPA/GNP ratios show excess neutralization capacity in the host rock) and MWMP testing that shows a relatively low leaching potential of metals and that the Proposed Action is located in an arid environment where the amount of rainfall is relatively low, degradation of groundwater quality due to acid rock drainage from mined materials is not expected to be significant.

<u>**Groundwater Quality Impacts Due to Poor Pit Lake Water Quality**</u>

Once the mining operations cease and the pit dewatering system is shut down, groundwater is expected to fill the mine pit to a level in equilibrium with the surrounding water table elevation. The water filling the pit is expected to be similar in quality to the groundwater surrounding the pit. The pit lake water quality may be degraded with time, however, if metals or other compounds in the rock wall dissolve into the water. Groundwater presently flows in an easterly or southeasterly direction in the proposed pit area. Some groundwater may enter the pit lake on the upgradient (west) side and leave the lake entering the groundwater system on the downgradient (east) side of the lake. To maintain a relatively static water elevation over time, the amount of groundwater flowing into the pit would equal the amount flowing out of the pit. If the trace metals in the pit's rock walls degrade the pit water quality (i.e., the pit water exceeds drinking water MCLs for some chemical compounds), then the groundwater quality downgradient or west of the pit may be degraded.

Acid base accounting results showed that samples of alluvium and bedrock from the proposed pit area have low acid-producing potential and moderate to high neutralization potential. Results of MWMP testing indicate that rock walls have low metals-leaching potential and good acid-buffering capacity (WMC 1993). Based on these results, pit lake water quality should not be degraded by acid-rock drainage from the pit walls and therefore groundwater quality should not be impacted. The potential impact to groundwater quality from poor pit lake water quality is not expected to be significant.

<u>Groundwater Quality in the Reinfiltration Area</u>

Potential impacts to groundwater quality could also result from poor-quality reinfiltration water (e.g., water that does not meet NDEP drinking water standards), or from reinfiltration water as it percolates through the alluvium to the water table. The dewatering system will remove groundwater from the proposed pit area and reinfiltrate it downslope near the basin floor. As discussed above, the quality of the reinfiltration water (i.e., groundwater pumped from the pit area) is not of poor quality and, therefore, should not degrade the groundwater quality in the reinfiltration area.

Based on water quality data collected to date, the baseline groundwater quality in the reinfiltration area appears to have a slightly higher TDS than the groundwater to be removed from the pit area during dewatering. Preliminary geochemical data (WMC 1992b) suggest that the water quality in the alluvium will not be impacted by the downward percolation of the reinfiltration water through the unsaturated zone. Reinfiltration of water that is of equal or possibly better quality than groundwater in the proposed reinfiltration areas should not adversely affect groundwater quality. Based on these data, impacts to water quality due to reinfiltration of water pumped from the pit are not expected to be significant.

<u>Spills of Chemicals, Lubricants, or Fuels</u>

Impacts to groundwater quality may potentially occur due to spills or long-term releases of chemicals, fuels, or lubricants during facility operation. Chemicals used for gold ore processing (e.g., sodium cyanide, caustic soda lime, and hydrochloric acid) along with fuels and lubricants needed for mining equipment will be stored on site. In the event of an accidental release or an undetected, long-term slow release, there is some potential for process chemicals and fuels to infiltrate through the soil and reach groundwater. Potential impacts from spills are considered to be low (1) because chemicals and fuels are stored in above ground tanks that provide for containment, control, and monitoring of potential spills, and (2) due to the depth to groundwater in the mine area (approximately 300 to 400 feet below ground surface during pit dewatering). Although the potential for spills occurring is low, spills which result in (1) chemical concentrations in soil greater than 10 times the MCL or (2) fuel resulting in total petroleum hydrocarbon (TPH) concentrations greater than 100 mg/kg in soil would be a significant impact and would require cleanup. A Spill Prevention and Contingency Plan for the Proposed Action is included in Appendix G to address responses regarding potential releases to the environment.

Potential Impacts to Aquifer Productivity Due to Subsidence

There is potential for subsidence of the land surface to occur when groundwater is removed and the aquifer undergoes compression (or consolidation) from the loss of fluid (see discussion under Geologic Hazards Impacts in Section 4.2.4). Subsidence could result in loss of aquifer productivity due to this compression. The most extensive subsidence occurs in unconsolidated or semiconsolidated sediments containing sand and gravel aquifers interbedded with clayey sediments. No subsidence would occur due to dewatering of the carbonate aquifer because the rock is considered competent (load bearing). The amount of consolidation is greater in the fine grained sediments (clays) than in the coarser sand and gravel because the clays are much more porous and correspondingly contain more fluid per unit volume. When the pressure is reduced by withdrawal of the groundwater for dewatering, such materials undergo compaction which is often irreversible. Compression in sand and gravel layers is considered elastic because the compression is largely recoverable as expansion takes place as the groundwater level recovers.

An analysis of the potential impacts to aquifer productivity was performed together with computer modelling to estimate the amount of land subsidence from the mine dewatering for the Proposed Action (Cortez 1993). The Proposed Action is situated on the western margin of Crescent Valley and is underlain by a wedge of alluvium which overlies easterly dipping bedrock. Only a small portion of the alluvium is saturated with groundwater underneath the site, but this increases to the east toward the center of the valley. The saturated thickness of the alluvium (which has the greatest potential to compress and cause subsidence) increases from about 90 feet at the site to over 700 feet at a distance of 5000 feet to the east of the site. The alluvial aquifer which will become dewatered consists of silty sands and gravel, clayey sands, sandy clay and clayey sand.

Using aquifer characteristics measured during pumping well tests conducted in 1992, the analytical model shows that potential effects to aquifer productivity will be limited to within a 6,000-foot radius of the proposed pit. The effect on a well installed after the groundwater levels recover when the dewatering system is shut off which fully penetrates the alluvial aquifer located in the zone of greatest subsidence (approximately 2,000 to 4,000 feet from the proposed pit) would be minimal. This is because the well would produce water from the coarse grained material which would have undergone only minor formation during dewatering and is not expected to be permanently compressed. The greatest permanent deformation would occur in the finer grained sediment (clays and silty clays) which are not the primary water bearing materials in the alluvial aquifer. The potential impacts to the aquifer are considered low.

4.4.3 Mitigation of Potential Impacts to Groundwater

The following sections begin with a summary of the applicant-committed practices that have been used as the basis for impact evaluation (see Section 2.0 for a full discussion of these measures). If the impact evaluation indicates that additional measures are required to reduce impacts to less than significant levels, mitigation has been proposed.

Lowering of Water Table Due to Pit Dewatering

Applicant-committed Design Measures. In addition to pumping wells, the pit dewatering system includes regional groundwater level monitoring and reinfiltration of pumped water. The reinfiltration is designed to conserve groundwater resources by returning an estimated 90+ percent of the pumped water to the Crescent Valley groundwater system (WMC 1992b). Reinfiltration also serves to reduce the amount and extent of drawdown due to the pit dewatering. Groundwater level monitoring in wells located near the Proposed Action and portions of the Crescent Valley (Figure 4.4-6) would provide information on the extent and magnitude of drawdown, and verify the adequacy in reducing drawdown effects.

The anticipated radius of pit dewatering effects (i.e., lowering of the water table) is 5 to 7 miles based on preliminary groundwater modelling. Reinfiltration has the objective of reducing the lateral extent of drawdown. Modelled contours around the reinfiltration area to the northeast of the Proposed Action show a negative drawdown (mounding) of the water table (Figures 4.4-3 through 4.4-5). It should, therefore, be possible to effectively reduce potential impacts associated with dewatering drawdown, such as affecting groundwater remediation at the Cortez Mine and flows from wells in the area, by optimizing the location and design of reinfiltration ponds.

The exact rate of pumping and extent of drawdown would not be known until the dewatering system is activated. The preliminary location and number of reinfiltration ponds are shown in Figure 4.4-2. One reinfiltration area capable of handling the anticipated 30,000 gpm pumping rate is proposed about 3 miles northeast of the Proposed Action site. The applicant-committed design calls for a stepped approach for reinfiltration. Monitoring of the water table elevation throughout the life of the operation would be performed.

Mitigation. If regional monitoring shows impacts on water users other than the applicant, impacts should be mitigated by optimizing dewatering well pumping rates and relocation or addition of reinfiltration ponds. The area that would be considered for relocation or addition of ponds is shown in Figure 4.4-2. In the unlikely event that drawdown effects on water rights users other than the applicant cannot be mitigated using applicable Nevada water laws and regulations, the applicant would supplement these users' needs with water from the dewatering system before reinfiltration. With proposed monitoring, implementation of the above mitigation measures would reduce potential impacts to less than significant levels.

Depending on the needs of water rights holders, potential effects to water quality or quantity could be mitigated by supplementing the users' deficit with composite water from the dewatering system before reinfiltration. The Nevada State Engineer's office has reviewed the modelling results and based on its assessment of potential impacts has approved the blanket water rights appropriation permit.

Groundwater Inflow into the Humboldt River

Applicant-committed Design Measures. The small amount of groundwater flow from Crescent Valley into the Humboldt River is not anticipated to be affected by localized pit dewatering and associated lowering of the water table. The river is located about 24 miles north of the proposed pit location and the anticipated extent of water table drawdown is 5 to 7 miles based on the preliminary location and number of reinfiltration ponds.

Mitigation. No measures are required to mitigate potential impacts because no direct, indirect, or cumulative impacts to groundwater flow into the Humboldt River are expected.

Groundwater Quality Degradation in Proposed Pit Area due to Acid Rock Drainage

Applicant-committed Design Measures. As discussed above (Section 4.4.2), laboratory testing of composite samples indicates a low potential for the formation of acid rock drainage. Primary protection measures for groundwater resources are the NDEP permit requirements to construct and operate all facilities as zero-discharge units. The heap leach/tailings units would consist of an arrangement of cells containing either heap leach material, tailings, or both in some cells. A continuous synthetic liner would underlie the entire facility, but cells would be hydraulically isolated from adjacent cells. This liner system is designed to prevent any acid rock drainage from the units. A plan for monitoring background groundwater quality around the proposed pit area, monitoring of the leachate leak detection system, and assessment of chemical stability of mined materials is proposed by the applicant and will be a part of the NDEP operating and discharge permits. Figure 4.4-6 shows the proposed groundwater quality sampling points. Applicant-committed practices for monitoring heap leach and tailings containment areas, groundwater quality, and pit lake water quality should provide verification that waters of the state are not degraded. Waste rock stockpiles which do not require engineered containment would be evaluated for their potential to mobilize potential pollutants and would be monitored regularly.

Mitigation. If groundwater monitoring detects concentrations of chemical compounds in excess of drinking water MCLs, then a plan for remediating groundwater should be implemented. Cleanup goals established by NDEP are the primary and secondary drinking water standards and/or existing background groundwater quality. Remediation could include a pumpback system similar to the existing system at the Cortez facility. Wells installed for the pit dewatering system could be used to remove and prevent migration of contaminated groundwater. Poor-quality pumped water could then be segregated from good-quality water and used as makeup water for mining process operations, with good-quality water used for reinfiltration. Implementation of applicant-committed monitoring and the above mitigation measures will reduce potential impacts to less than significant levels.

Groundwater Quality Impacts due to Poor Pit Lake Water Quality

Applicant-committed Design Measures. NDEP regulations prohibit degradation of waters of the state by mining activities. Degradation is defined as exceedence of NDEP maximum contaminant levels for drinking water (primary and secondary standards) or exceedence of background levels. Compliance with these standards would be demonstrated and enforced through facility operating and closure monitoring programs required by NDEP regulations. As described above (Section 4.4.2), the potential for degradation of groundwater due to poor water quality in the eventual pit lake is low. Although some interflow between the groundwater system and the pit lake is expected, pit lake water quality is anticipated to be good. Therefore, adverse effects to groundwater quality are not anticipated and impacts are not considered significant.

Mitigation. No further mitigation is required.

Groundwater Quality in Reinfiltration Area

Applicant-committed Design Measures. Applicant-committed practices include evaluation of geochemical data. Geochemical analyses and ongoing monitoring of infiltration water quality and groundwater quality would be performed to verify that the preliminary assessments are correct. Locations of monitoring wells for both the mining operations area and the dewatering system reinfiltration area are shown in Figure 4.4-6.

Mitigation. Potential for impacts to groundwater quality is considered to be low because the quality of the water to be infiltrated is expected to be good. In the event monitoring shows that reinfiltration water is of sufficiently poor quality to degrade groundwater beneath the ponds (e.g., raise TDS levels to greater than 500 mg/L [MCL]), then mitigation measures would include chemical pretreatment (if natural precipitation of dissolved compounds is insufficient) such as flocculation basins to reduce TDS in water flowing into infiltration areas. In addition, if groundwater quality was degraded (e.g., increased chloride concentrations greater than MCL) then mitigation measures should include investigation for alternative reinfiltration areas. Implementation of mitigation measures will reduce potential impacts to less than significant levels.

Spills of Chemicals, Fuels, and Lubricants

Applicant-committed Design Practices. Process chemicals and fuels would be stored in aboveground tanks and containers. Storage areas would be surrounded by lined berms sized to contain the contents of the largest tank or container in the event of spillage or tank failure. Potential spills will be addressed according to the Hazardous Materials Spill and Emergency Response Plan (Appendix G).

Mitigation. It is proposed that soil contaminated by leaked or spilled fuel would be disposed of by burning in the Cortez roaster, for which a permit application has been initiated. If such disposal is not permitted, it is proposed to treat the contaminated soil on site with a biopile. A biopile is a soil pile that relies on microorganisms to degrade contaminants into carbon dioxide and water. A liner would be placed underneath and around the biopile to avoid exposure to air and completely contain contamination within the biopile. Spills of chemicals that cannot be treated as above will be disposed of at an appropriate off-site disposal facility. Implementation of mitigation measures will reduce potential impacts to less than significant levels.

Impacts to Aquifer Productivity Due to Subsidence

Potential impacts to the alluvial aquifer are predicted to be localized to within 6,000 feet of the proposed pit and would be negligible because the water bearing materials (sands and gravels) would not be permanently compressed by the dewatering activities. No mitigation is required.

4.4.4 Surface Water Significance Criteria

Significance criteria for assessing qualitative and quantitative potential impacts to surface water resources in the vicinity of the Pipeline deposit are listed below:

- Reduction in carrying capacity of natural drainages or pit dewatering conveyance system due to modification or siltation thereby resulting in flooding
- Reduction in flow of springs, seeps, or creeks. Threshold criterion is the modelled 20-foot drawdown contour (Section 4.4.1). Significant impacts are indicated where the 20-foot drawdown contour encompasses a spring, seep, or creek and where the surface water feature is hydraulically connected to the aquifer affected by drawdown. The 20-foot contour is the minimum drawdown discernable by the regional groundwater model.
- Diversion and/or consumptive use of surface water which adversely affects other rights holders
- Transport of mining-related contaminants such as cyanide, or metals such as arsenic and lead, into drainages by spills or flooding resulting in soil contamination in excess of NDEP guidance levels (10 times any applicable MCL), or fuels and lubricants into drainages resulting in soil contamination exceeding NDEP guidance levels (100 mg/kg TPH)
- Exceedance of NDEP aquatic toxicity standards (Table C-5) in perennial streams (e.g., Indian Creek and Cooks Creek)
- Evaporative losses from pit lake and reinfiltration basin water surfaces

4.4.5 Potential Impacts to Surface Water

Potential impacts from the Proposed Action on surface water resources (perennial streams, ephemeral drainages, springs, and the eventual pit lake) are identified and discussed below.

These potential impacts were identified based on the significance criteria listed above and consider both water quantity and quality issues.

Erosion and Sedimentation Within Rerouted Drainages and Resulting Flooding

The project disturbance area is located at the base of an unnamed drainage on the southern flank of the Shoshone Range. The project would require the alteration or diversion of existing natural drainages and washes that contain surface flow during periods of infrequent high rainfall and/or snowmelt from the Shoshone Range. Erosion generally occurs with an increase of surface disturbance. Therefore, sediment from increased erosion may be transported to and accumulate in the local surface drainages. Since surface flow is not constant, significant sedimentation problems are not expected to occur. During rainfall and subsequent runoff events, any accumulated sediment is often remobilized and transported further downstream. Potential impacts from sediment deposition may include the temporary addition of nutrients such as nitrogen and phosphorus to the flowing water that were previously bound to the soil. Flooding could occur when sedimentation reduces the carrying capacity of the drainage and a high-runoff event occurs. Another potential impact might be the accumulation of sediment behind silt fences, which could reduce their effectiveness. Topsoil and waste rock stockpiles could be susceptible to erosion from overland rainfall run-on and rainfall runoff. Sediment transported by runoff may accumulate at the bases of slopes of the stockpiles. Potential impacts are similar to those described above for rerouting surface drainages. No significant impacts are anticipated after implementation of applicant-committed practices.

Flooding of Pit Dewatering Reinfiltration Facilities

Most of the groundwater removed during pit dewatering would be returned to the Crescent Valley groundwater basin by reinfiltration. The reinfiltration system would consist of a bermed conveyance channel (or pipe), a series of bermed infiltration ponds, and access roads. The proposed location of infiltration ponds is shown in Figure 4.4-2. Potential impacts from flooding of these facilities by surface runoff during periods of high snowmelt or heavy rainfall could interrupt the reinfiltration process. However, surface drainages which could impact the infiltration ponds as well as the conveyance channel would be rerouted around the facilities. Significant impacts to the reinfiltration facilities are, therefore, not anticipated.

Effects of Lowering Water Table on Surface Drainage Infiltration and Springs

The pit dewatering system is expected to lower (draw down) the groundwater table in an area surrounding the proposed pit. Computer modelling shows the predicted extent of this draw-down after introduction of reinfiltration water (Figures 4.4-3 through 4.4-5). Lowering of the water table could affect surface water flow in certain drainages, as well as springs which may feed some drainages.

A small amount of surface water flow from Carico Lake Valley enters Crescent Valley via Cooks Creek at Rocky Pass, located about 6 miles south of the project site (Figure 4.4-7). The flow in Cooks Creek (1 to 200 gpm) usually is a result of heavy precipitation or snow-melt runoff. The flow has been observed to completely infiltrate into the alluvium within a mile of entering Crescent Valley (WMC 1992b). The depth to groundwater at Rocky Pass has been measured at less than 10 feet. Lowering the water table as a result of pit dewatering may cause surface water flow in Cooks Creek to infiltrate over a shorter distance. This would result in a greater section of Cooks Creek being dry, making less water available in the reach of the stream that currently flows. The length of Cooks Creek potentially impacted is based upon flow (which varies seasonally), the permeability of the creek bed, and the degree to which the water table is drawn down. This is considered a potentially significant impact.

Indian Creek is the only other nearby perennial stream which could be impacted by reduced flows resulting from water table drawdown. Surface water flow in Indian Creek, located about 5 miles north of the Proposed Action, is primarily from springs which flow into it or its tributaries. The spring water is believed to originate in areas of siliceous rock aquifers which are unlikely to be affected by the dewatering operation (WMC 1992b).

Springs which have the potential to be impacted by the lowering of the water table are shown in Figure 4.4-7 and listed in Table 3.5-2 and include:

- Eight springs that issue from the alluvium located 5 to 7 miles east of the Proposed Action

- Eleven springs located within the unnamed catchment 4 miles west of the Proposed Action

- Several springs located 8 miles to the southeast in the Cortez Range and near the Toiyabe Catchment area

- One thermal spring (Chillis Hot Spring) and three cool springs located near Rocky Pass about 6 miles south of the Proposed Action

Figure 4.4-7 also shows estimated drawdown contours resulting from the highest (worst-case) pumping rate of 56,500 gpm. Considering the worst-case pumping rates, it appears that the springs with the highest potential to be impacted are those in the Rocky Pass area. As shown on Figure 4.4-7, the water table may be drawn down as much as 100 feet or more in this area, depending upon the rate of dewatering, hydrological conditions in the subsurface, and location of reinfiltration areas. Three of the four springs identified are cool water springs which may issue from the relatively thin alluvium at Rocky Pass (estimated to be 100 feet thick or less from well logs) (WMC 1992b). Water flowing through the alluvium in Carico Lake Valley and Rocky Pass may rise to the surface as springs when it contacts impermeable bedrock that is relatively shallow at the pass. Two of the springs are located in Carico Lake Valley. Because of the narrowness of the pass and thin alluvium, these are not expected to be impacted by the effects of water table drawdown. The third cool water spring, however, is located on the Crescent Valley side of Rocky Pass, and a 100-foot decrease in the water table at the pass could dewater the alluvium and reduce the flow from the spring. The impact to this spring could potentially be significant. The fourth spring identified at Rocky Pass is a thermal spring (known as Chillis Hot Spring). The flow from this spring is not anticipated to be affected since the source is believed to be a deeper volcanic aquifer.

Other springs nearest the area of greatest drawdown are those located in the unnamed catchment west of the proposed pit. The aquifer source for these springs is believed to be in carbonate rocks (WMC 1992b). The water issuing from these springs probably originates as snowmelt and/or precipitation at higher elevations in the Shoshone Range. It is therefore not anticipated that a drawdown in the water table would have a significant impact on the flow from these springs.

Estimated drawdown is expected to be as great as 60 feet near springs issuing from the bedrock southeast of the proposed open pit at the foot of the Cortez Mountains near the Toiyabe Catchment area. The source of the springs is believed to be the carbonate rocks which receive recharge from the higher elevations as snowmelt and precipitation. Groundwater flow is known to occur mainly along faults and along fracture zones within the carbonate aquifer. Aquifer testing at the Proposed Action site (WMC 1992b) revealed that flow within the aquifer unit is compartmentalized (occurs almost independently in separate cells) due the presence of faults and fractures, particularly due to the presence of the Cortez Mountains range front fault. This separation, along with the fact that the recharge areas are at higher elevations than the drawdown area, is expected to isolate these springs from effects of drawdown. Therefore, potential impacts to flow from these springs may occur but are not expected to be significant.

The springs issuing from the alluvium east of the proposed site appear to be situated outside the expected area of influence of drawdown effects (Figure 4.4-7). The flow to these springs also probably originates from the higher elevations in the Cortez Mountains which would not be expected to be impacted by pit dewatering drawdown.

<u>**Acid Rock Drainage and Associated Metals Contamination from Heap Leach and Tailings Facilities**</u>

Potential impacts to surface water resources from acid rock drainage are similar to those discussed for groundwater resources above. Sulfuric acid is produced by the interaction of unoxidized sulfur in rock with oxygen from the atmosphere and water. If sulfuric acid mixes with surface runoff, the pH of the water is reduced and may dissolve trace metals from rock with which it comes in contact. Acid rock drainage can impact surface water drainages by transporting and depositing trace metals in near-surface sediments within the drainages in the immediate vicinity of the project site.

As discussed above, preliminary acid base accounting and meteoric water mobility potential testing show that the rock mined from the Proposed Action site should neutralize acidic water with which it comes in contact. Therefore the potential for impacts to surface water quality due to acid rock drainage is considered to be low.

NDEP aquatic toxicity standards (Table C-5), which apply to classified surface waters, are applicable to Indian Creek and Cooks Creek. These perennial creeks are located about 5 miles north and 6 miles south, respectively, of the Proposed Action. No water quality impacts to these creeks are anticipated, because of the lack of any mining activities associated with the Proposed Action in the watershed for these creeks.

<u>Acid Rock Drainage from Existing Gold Acres Heap Leach and Tailings Materials</u>

The Gold Acres area consists of two areas of existing disturbance that would be affected by the development of the Proposed Action. These areas consist of (1) spent heap leach ore piles and associated liner and pad material, and (2) the mill tailings wash area. With the development of the proposed mine pit, a portion of the stockpiled material at Gold Acres will have to be moved. NDEP regulations require that such materials be characterized for acid rock drainage potential prior to rehandling to prevent discharges of contaminants to the environment. Management of the Old Gold Acres mined materials which will be disturbed by the Proposed Action is discussed under the project description. Under NDEP Pollution Prevention permit requirements, these materials have been characterized to evaluate their acid rock drainage potential. The characterization results showed that most of the material does not pose a pollution threat and that no special handling of the material will be required. Only the material from the former solution pond liners contained elevated levels of arsenic so that material will be isolated in the Proposed Action tailing zero discharge facility to prevent potential impacts to the environment. Therefore, the potential for impacts to surface water is considered low.

<u>Spills of Chemicals, Lubricants, and Fuels into Drainages or Flooding of Storage Areas</u>

Potential impacts associated with spills or leakage of chemicals (including solvents, cyanide, acids, and caustics), fuels, and lubricants during facility operation are expected to be minimal and limited to small areas. The potential for inundation of chemical storage areas by rainfall runoff would be minimized by directing runoff around the facility. Implementation of the Spill Prevention and Containment Plan (summarized in Section 2.0) is expected to further reduce the significance of these potential impacts. A copy of the plan is provided as Appendix E. Therefore, the potential for impacts from spills or leakage of chemicals or flooding of chemical storage areas is expected to be low. However, if a spill does occur of sufficient size to result in chemical soil contamination in excess of 10 times an applicable MCL, or fuels and lubricants in excess of NDEP guidance levels (100 mg/kg TPH), the impact would be considered significant.

Initial and Long-Term Pit Lake Water Quality

The pit dewatering system would be shut down after the orebody has been exhausted and mining operations cease. Groundwater would eventually fill the mine pit to the surrounding water table elevation, thus forming a pit lake. Figure 4.4-1 is a schematic cross section of the pit dewatering system design, and shows the approximate final pit outline and groundwater and pit lake levels. The rate at which the pit lake forms has been simulated using an analytical model (WMC 1993). During the initial post closure period, the water table in the Roberts Mountain formation around the pit area will recover rapidly towards the base of the alluvium (100 to 120 feet below original water level). From that point on, the rise in water levels will be much slower, reflecting the sub-regional recovery in the alluvial aquifer over the entire area of influence of dewatering. The model predicts that recovery of the groundwater table will be 94 percent complete (approximately 41 feet below pre-mining water level) within 25 years, and will be 97 percent complete (approximately 20 feet below pre-mining water level) within 50 years. The initial inflow calculations do not consider the effects of the re-infiltration areas, which are likely to be located in the alluvium some 3-4 miles to the north, east, and south of the pit. Since most of the water to be pumped during the dewatering operations will be returned directly to the groundwater basin, the actual rate of recovery is likely to be somewhat higher than estimated.

The quality of the pit lake water is difficult to predict, but because it would be filled by groundwater inflow, it would likely be similar in quality to the groundwater in the adjacent bedrock and alluvial aquifers. Based on the known aquifer characteristics in the vicinity of the Proposed Action, the majority of the inflow is expected to be from the alluvium. The alluvial aquifer is believed to have a higher storage capacity than the bedrock aquifer, as well as an overall greater transmissivity. Therefore, the alluvial aquifer is expected to contribute the greater portion of the water in the pit lake.

Potential impacts include degradation of the pit lake water quality by inflow of poor-quality groundwater into the pit. Evaporation losses from the pit lake may tend to concentrate salts, such as calcium carbonate, from the host rock, transported into the lake and thus may reduce the long-term water quality. NDEP regulations prohibit creation of an impoundment which has the potential to degrade groundwater as a result of mining below the water table.

Hydrochemical modelling was performed (WMC 1993) to help predict near-term and long-term post-closure pit lake water quality. The geochemical model PHREEQE was used to help determine the neutralization potential of the water which would flow into the pit and its potential to leach major minerals such as pyrite. PHREEQE computes equilibrium among the dissolved, absorbed, solid and gas phases in an environmental setting, and includes an extensive thermodynamic database. The results of the model showed that post-closure pit water quality would be controlled by two overall factors:

- Near-term water quality would largely be controlled by groundwater inflow quality
- Long-term water quality would be controlled more by physical processes (such as interaction with the rock wall, water temperature, biological activity, and concentration of minerals by evaporation) occurring in the lake rather than inflow water quality

Near-term water quality is expected to be good based on the modelling results, which include the known good quality of groundwater in the area of the Proposed Action. Long-term water quality is also expected to be good, particularly because of the excess neutralization capacity of the rock material, the low acid-producing potential, and the overall good quality of the inflow water.

Pit lake water quality may also be affected by the water contacting the exposed mine wall and minerals or other compounds dissolving from the rock into the water. Chemical analyses for acid rock drainage potential performed on ore samples thus far do not indicate that their would be significant impacts on the pit lake water quality. NDEP regulations (NAC 445.24386) limit post-operations monitoring to 30 years or less. NDEP staff currently consider 5-year plans with annual assessment of monitoring needs. Groundwater in the alluvial and bedrock aquifers around the proposed pit area is of good quality. Therefore significant impacts due to poor pit lake water quality are not anticipated.

Evaporative Losses

After mining operations cease and the pit lake has formed, some lake water will be lost due to evaporation. WMC (1992b) estimated evaporative losses to be about 155 to 200 million gallons per year (480 to 620 acre-feet per year) based on extrapolation of pan evaporation data. (The amount of evaporation from standing water at a given geographic location can be estimated by measuring the losses from pans of water placed in the ground at the surface at that location. Pan evaporation rates tend to be higher than actual rates from lakes or other water bodies.) This estimated loss is equal to about 300 to 380 gpm. For comparison purposes, agricultural irrigation wells in Crescent Valley may use 300 to 900 gpm (500 to 1,500 acre-feet annually) (Table C-4).

Evaporative losses may be less than predicted values because the surface of the pit lake will be about 250 feet below the surrounding ground surface, which would protect it from surface winds that have a very large effect on evaporation rates. In addition, the pit lake would also receive surface water runoff from the unnamed catchment west of the Proposed Action unless the drainage was routed around the lake. WMC (1993) estimated the total annual amount to be about 330 gpm (500 acre-feet per year), occurring mainly during seasonal runoff periods. Precipitation falling on the lake and rock walls could amount to an additional 80 gpm (130 acre-feet per year).

Evaporative losses would remain roughly constant from year to year, while precipitation and surface runoff would probably vary significantly seasonally and annually. A net loss is anticipated and is considered potentially significant.

Crescent Valley Hydrographic Basin is classified as a designated basin by the Nevada State Engineer. As such, the withdrawal and use of groundwater is regulated. Whether or not evaporative losses would be treated as a consumptive use to be accounted for by water right is the decision of the Nevada State Engineer. The actual evaporative loss of water from the proposed open pit would be less than 3.5 feet per year applied over the pit lake surface area. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. This situation has been discussed by Cortez with the State Engineer's Office and would be further analyzed upon mine closure and pit lake formation. Because Cortez holds senior certificated water rights for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted groundwater withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to account for evaporative losses would be a decision made by the Nevada State Engineer.

Some evaporative losses will also occur from the surface of the proposed reinfiltration ponds. The amount of evaporation is expected to be about 2.5 million gallons (50 acre-feet) per year, which is small compared to the amount of reinfiltration, and total loss should be small compared to the pit lake. The losses will occur over the life of the mine only, rather than indefinitely with the pit lake. Evaporative losses from reinfiltration ponds are not expected to be a significant impact.

4.4.6 Mitigation of Potential Impacts to Surface Water

Design measures identified by the applicant are summarized in order to evaluate whether additional mitigation measures are necessary. Mitigation measures are proposed if design measures would not adequately mitigate potential impacts.

Erosion and Sedimentation Within Rerouted Drainages and Resulting Flooding

Applicant-committed Design Measures. As discussed above, no year-round surface water flow exists on or in the immediate vicinity of the Proposed Action. Drainages are present as a result of erosion by spring snowmelt and storm runoff. Minor impacts due to alteration and diversion of these drainages are expected. Small drainages affected by roads and small facility structures would be returned to their natural condition during reclamation. Permanent drainage alterations around the pit and heap leach piles would consist of open channels and berms. Such features would be left in place and reclaimed using vegetated stock or rock lining for stability and elimination of long-term maintenance under long-term conditions. To control erosion of topsoil and mined materials stockpiles, such piles will be located away from mining operations and marked to prevent disturbance. Surfaces of stockpiles will be constructed with shallow slopes and vegetated to reduce erosion. Diversion channels would be constructed to direct rainfall runon and runoff around stockpiles to protect them from erosion. Applicant-committed design measures will reduce potential impacts to less than significant levels.

Mitigation. No mitigation is needed beyond design measures.

Flooding of Pit Dewatering Reinfiltration Facilities

Applicant-committed Design Measures. Reduction of impacts to the reinfiltration ponds and conveyance channels by flooding would be achieved by constructing berms and diversions for surface rainfall runoff.

Mitigation. The conveyance system between the proposed pit location and the reinfiltration area would be protected by using a pipeline rather than an open channel, or a combination pipeline/channel with a pipeline utilized in areas sensitive to flooding. This would prevent potential impacts from erosion/siltation and livestock and/or wildlife injuries. No other mitigation measures are required. Implementation of mitigation measures will reduce potential impacts to less than significant levels.

Effects of Lowering Water Table on Surface Drainage Infiltration and Springs

Applicant-committed Design Measures. The extent and magnitude of water table drawdown anticipated from the pit dewatering is shown in Figures 4.4-3 through 4.4-5. About 90 percent of the water produced during pit dewatering will be reinfiltrated to return it to the Crescent Valley groundwater system and to reduce the effects of drawdown on surface water infiltration and springs. The proposed reinfiltration areas are shown in Figure 4.4-2 as a 1-mile-wide band with a radius of 3.5 miles from the Proposed Action site. Reinfiltration is initially proposed at a location within this band to the northeast of the site which is included in the predicted drawdown contours in Figures 4.4-3 through 4.4-5. The effects of drawdown are mitigated in the area to the north and northeast as a result of reinfiltration. Drawdown effects will be monitored as dewatering progresses in selected wells located around the project site and portions of Crescent Valley (Figure 4.4-6).

Mitigation. The single proposed reinfiltration area described above may not be adequate to mitigate potential impacts to infiltration of flow along Cooks Creek near Rocky Pass or springs at Rocky Pass and east of the Proposed Action. Based on the worst-case scenario (Figure 4.4-5), estimated contours show about 60 feet of drawdown east of the proposed site along the edge of the Cortez Range and 80 to 100 feet of drawdown at Rocky Pass, which may affect the flow from springs and cause Cooks Creek to go dry more quickly. Monitoring of spring and creek flows (Section 2.2.8 and Appendix D) would be performed as dewatering progresses to assess whether the proposed reinfiltration area is adequate to mitigate potential impacts.

Model simulations have indicated the ability to control the extent of drawdown in the Crescent Valley alluvial aquifer through spatial variation of infiltration sites. Over time, the actual effectiveness of infiltration in recharging the alluvial aquifer as simulated will depend, in part, on the local hydraulic characteristics of the intervening soil sequences between the individual infiltration site and the aquifer area targeted for recharge. Should seepage faces begin to form at the ground surface downgradient from an individual infiltration site or should actual local recharge rates be less than planned, the proposed infiltration site would be enhanced or relocated. Enhancement may consist of installing trenches or borings below the bottom elevation of the constructed infiltration pond(s) into more permeable soil sequences which would increase the hydraulic loading rate by which the aquifer is recharged. Relocation sites would be located within the general area shown on Figure 4.4-2.

Acid Rock Drainage and Associated Metals Contamination from Heap Leach and Tailings Piles

Applicant-committed Design Measure. Acid rock drainage impacts would be minimized by the zero-discharge design of processing facilities and by monitoring the acid-generating potential of waste rock and overburden to verify excess neutralizing capacity. Preliminary data indicate that the Pipeline deposit ore appears to have excess acid rock drainage neutralization capacity. Tailings ponds and heap leach piles are designed for zero discharge, so no releases of process solutions to surface water drainages are anticipated. During the life of the mine, heap leach facilities would be double-lined and surrounded by berms to prevent storm water runon, store process solutions, and contain runoff from the 100-year, 24-hour storm event. Upslope portions of waste rock dumps (tailings and spent heap leach piles) would be graded back to prevent runon of snowmelt or storm water carrying any trace metals and/or low-pH water into drainages. Once waste rock dumps would be covered during post-closure reclamation to prevent infiltration of incident precipitation into waste rock piles. The pile slopes would be graded to encourage runoff, discourage infiltration of incident precipitation, and minimize erosion of cover soils. Revegetation of cover soils would help prevent erosion of pile caps. Therefore, storm-water runoff would not be in contact with spent mining materials.

Samples of rock from the Proposed Action area have been collected and tested for acid rock drainage potential and meteoric water mobility potential (MWMP). Based on these results (discussed in Section 4.4.2 above), the acid base accounting shows excess acid neutralization capacity and the MWMP shows relatively low leaching potential of metals. Therefore, potential impacts to surface water are not considered significant.

Mitigation. Mitigation beyond design measures would not be required unless a release occurs. However, if monitoring detected a release, current NDEP soil cleanup level guidelines for groundwater protection would apply. Based on site-specific conditions such as depth to groundwater, type of compound released, and magnitude of release, NDEP guidance requires more cleanup standards, i.e., residual levels of cyanide to less than 10 times the MCL. Although none is required now, in the event a release is detected, NDEP would require a remediation plan for acid rock drainage from process facilities.

Acid Rock Drainage from Existing Gold Acres Heap Leach and Tailings Material

Applicant-committed Design Measure. Spent heap leach ore and mill tailings material from the Gold Acres area has been characterized for acid rock drainage and metals leaching potential in accordance with NDEP regulations. Material from the former Gold Acres pregnant solution pond liner that shows metals leaching potential would be placed in the proposed new heap leach/tailings facility. As described above, the facility is designed as a fully lined zero-discharge system which would be designed to meet NDEP minimum requirements and the design approved by NDEP. Implementation of applicant-committed practices would reduce potential impacts to less than significant levels.

Mitigation. No mitigation beyond design measures are required.

Spills of Chemicals, Lubricants, and Fuels into Drainages or Flooding of Storage Areas

Applicant-committed Design Measures. The applicant-committed Spill Prevention and Containment Plan (Appendix G) address potential impacts. NDEP regulations require mine operators to develop an emergency response plan which assigns responsibility and describes the actions to be taken in the event of a spill or release of pollutants. The plan also demonstrates containment provisions and identifies practices which minimize the environmental impact resulting from the release of process solutions. A spill prevention and containment plan would be prepared specifically for the proposed Pipeline operation and submitted with the NDEP Water Pollution Control Permit application. Containment to prevent or control mitigation of releases followed by remediation of contaminants would be the basis of the plan. The process plantsite would be designed to have secondary containment and/or drainage control in areas where chemicals and hazardous substances could potentially be released. NDEP cleanup standards (10 times drinking water MCL) would apply to remediation of any chemically contaminated soil, or NDEP guidance levels for petroleum hydrocarbons (100 mg/kg in soil).

Mitigation. Mitigation measures are the same as those described for potential groundwater impacts in Section 4.4.3, above. Implementation of these mitigation measures would reduce potential impacts to less than significant levels.

Initial and Long-Term Pit Lake Water Quality

Applicant-committed Design Measure. The Plan of Operations (POO) (Cortez 1992) provides for an evaluation of pit lake water quality and monitoring of groundwater quality in the vicinity of the pit. Samples of pit lake water and groundwater samples in monitoring wells surrounding the proposed pit lake would be collected and analyzed for NDEP Profile 1 parameters, 36 metals plus total suspended solids and turbidity, at least quarterly to document water quality. NDEP aquatic toxicity standards apply only to classified surface waters (i.e., perennial streams) and would not be applicable to the pit lake water quality. According to NDEP guidance, aquatic standards are not applied to mining project waters; therefore, standards for human health (drinking water [NDEP Profile 1]) and avian and terrestrial water quality standards would be applicable. Implementation of these measures would reduce potential impacts to less than significant levels.

Mitigation. No mitigation beyond monitoring pit water quality is required.

Evaporative Losses

Mitigation. Evaporative losses from the pit lake have been estimated to be about 155 to 200 million gallons per year or about 300 to 380 gpm (WMC 1992b, 1993). Although these losses may be small in comparison to the certificated consumptive use volume (2,000 gpm or 1 billion gallons per year), they are considered significant because they would persist for the life of the pit lake. Anticipated losses may be offset slightly by water received as precipitation on the lake and pit rock walls and runoff from precipitation and snowmelt accumulated in the unnamed catchment west of the Proposed Action area. A transfer of senior certificated water rights for both agriculture and mining/milling uses held by Cortez to account for evaporative pit lake losses would result in a no-net gain in permitted consumptive use in Crescent Valley. However, a net loss in water balance would still occur.

Allowing or redirecting surface water runoff into the pit lake would not mitigate the net evaporative losses to the hydrologic basin as a whole. If not redirected into the pit lake, a portion of the runoff would infiltrate the ground surface as groundwater recharge, with the balance lost to evaporation. All runoff directed into the pit lake would be subject to evaporative loss, with little opportunity to become recharge, resulting in a net loss of water to the basin. Therefore, the evaporative loss from the pit lake is considered significant and there are no feasible mitigation measures.

Evaporative losses from the reinfiltration ponds are smaller compared to the pit lake losses because of the smaller surface water area exposed to evaporation and the shorter time period for evaporative losses to occur (i.e., project life). They are also small compared to the quantity of water to be reinfiltrated. Evaporative losses from reinfiltration ponds are not considered significant.

4.5 VEGETATION

4.5.1 Significance Criteria

The loss of a majority of a plant community within the study area is considered significant. The loss of any threatened and endangered species is significant and requires mitigation under the Endangered Species Act. The failure of reclamation to re-establish a diverse, perennial plant community similar to the undisturbed community is significant due to the requirement of stability under the Nevada Reclamation Act.

Any direct loss of wetlands is considered significant. The loss of riparian communities violates the BLM Riparian Initiative and is significant.

4.5.2 Project Impacts

Approximately 1,880 acres of the shadscale/bud sagebrush community would be directly impacted by the Proposed Action, including that acreage disturbed by reclamation activities. Of this disturbance, 1,639 acres would be reclaimed. Residual impacts in the vicinity of the open pit would encompass 241 acres of disturbance to the shadscale/bud sagebrush community. Where revegetation is successful, a diverse and perennial shrub and grass community would become established and would provide wildlife habitat and livestock forage similar to the adjacent terrain. However, due to the inherent low annual precipitation in the Proposed Action area, standard revegetation efforts may be unsuccessful except in years of above-normal precipitation.

No threatened or endangered species would be impacted.

There would be no impacts to riparian areas or wetlands directly or indirectly due to the drawdown of the aquifers. The proposed infiltration system (described in Section 4.4) would provide for the continuation of the plant communities associated with surface waters or high groundwater tables. There may be short-term impacts due to the time required for detection and adjustment of infiltration to sustain surface discharges, but this should not permanently damage riparian areas or wetlands.

4.5.3 Mitigation

Refer to mitigation in Section 4.4.6 for a discussion of the infiltration design and how the system would replenish groundwater that supports wetland vegetation.

If standard revegetation efforts are unsuccessful, additional measures may be required, such as supplemental irrigation. Monitoring the results of standard methods will determine if additional measures are necessary.

4.6 WILDLIFE RESOURCES

4.6.1 Significance Criteria

The disturbance of over 10 percent of critical wildlife habitats would be considered significant. The loss of any threatened and endangered species habitat is significant and requires mitigation under the Endangered Species Act. The loss of species protected by the Migratory Bird Treaty Act is significant and requires mitigation to prevent the loss.

4.6.2 Impacts

<u>Direct Disturbance</u>

Habitat that would be directly disturbed by the Proposed Action is not classified as either mule deer or antelope range by the BLM (Figure 3.6-1, BLM 1983), though small numbers of either species may occur in the area. Mule deer have been recorded in the general area, particularly in winter and during migration, while antelope were recently recorded in the immediate Proposed Action area on a single occasion (March 1992). The proximity of this area to existing disturbance limits the use of the Proposed Action area by the more wary wildlife species.

The loss of acres of previously undisturbed habitat in the Proposed Action area represents a potential loss of 412 mule deer AUMs or 515 antelope AUMs (as calculated in part from the loss to livestock AUMs). In the past, the Proposed Action area has received little use by these big game species, as noted above.

The nearest recorded sage grouse lek is located approximately 3 miles northwest of the Proposed Action area. No riparian or wet meadow areas occur within the area of direct disturbance. Since sage grouse make little or no use of the valley floor habitats in Crescent Valley, no direct impacts are expected. The higher-elevation mountain springs, the principal sage grouse brood-rearing habitats in the study area, are not expected to be impacted by project activities.

Chukar and Hungarian partridge use of the area of direct disturbance is minimal, due both to the lack of suitable habitat and the extensive existing habitat modification in the Gold Acres area immediately to the west. Chukar, particularly, tend to remain in steeper, more rocky terrain, seldom utilizing the shadscale/budsage flats. Management practices that result in impacts to these steeper habitats or to riparian areas would adversely affect chukar populations. Because most springs in these mountainous habitats are fed by perched aquifers, impacts resulting from dewatering activities on the valley floor would have limited impacts on chukar populations. Mourning doves may utilize valley floor and foothill habitats as foraging areas and fly to any nearby ponds or tanks to obtain water. The Proposed Action would result in a small amount of direct reduction in the amount of potential mourning dove habitat, relative to that available nearby.

Ravens and raptors, principally northern harriers, red-tailed and possibly Swainson's hawks, utilize the area as hunting and foraging territory. The Proposed Action would reduce or eliminate the suitability of the disturbed lands as raptor hunting territory, at least in the short run. Ravens may continue to utilize the area to a degree, and successful reclamation would result in resumed use by some species. Affected acreage would also no longer be available as nesting and foraging habitats for several of the nongame avian species listed below. While dewatering would have minimal direct impacts on ravens or raptors, populations of some prey species, such as ground squirrels or cottontail rabbits, may be reduced in affected areas. This in turn would reduce the prey base available to raptors.

The proposed disturbance would result in the elimination of 1,880 acres of shadscale/budsage habitat. A variety of small game and nongame species and small- to medium-sized carnivores currently utilize these habitats. These species include coyotes, badgers, and possibly kit foxes, as well as small mammals and a variety of birds. Avian species occurring in the Proposed Action area include horned larks, sage thrashers, western meadowlarks, Brewer's blackbirds, sage and Brewer's sparrows, and possibly black-throated sparrows. These species would be displaced at least in the short term by planned operations. Successful reclamation would again restore habitat suitable for many current resident species.

Short-term disturbance to wildlife habitat would be partially offset by beneficial impacts related to increased availability of surface water provided by infiltration ponds. Although these infiltration sites would be fenced with four-strand barbed wire, species such as small, medium, and large mammals, avian species, and other mobile species would be able to gain access to these water sources.

Special Status Species

Two Candidate, Category 2 species occur in the study area. The pygmy rabbit, while not observed during field surveys, may occur in denser shrub (particularly rabbitbrush) habitats, particularly in floodplain habitats, or in sage habitats in rocky areas within the study area. BLM biologists have noted that the destruction of a part of a habitat unit utilized by this species may result in the elimination of a local population (Sherwood 1991). No known pygmy rabbit colonies would be directly affected by the Proposed Action.

The loggerhead shrike occurs in shrub habitats both on the flats and in foothill and mountain habitats. Loggerhead shrikes are fairly common in the Great Basin. That part of the Proposed Action area which would be directly disturbed supports at most only a few pairs of shrikes. As discussed for other mobile species, shrikes may benefit from an increase in water sources provided by infiltration ponds as well as increases in insects attracted to surface water.

Exposure to Toxic Substances

WAD cyanide concentrations in the proposed tailings pond at the Pipeline Mill would be maintained at concentrations below acute lethal levels, as required by the NDOW. This has been interpreted by NDOW and industry to be WAD levels below 50 ppm. Leach solution ponds would be fenced and netted to exclude terrestrial wildlife. Heap surfaces would either be scarified to prevent pooling of leach solution, or a drip system would be utilized to accomplish this same end. The Industrial Pond System permit, administered by the NDOW, requires the reporting of wildlife mortalities and monitoring by the Department to correct acute toxic environments. Since the design and operation of cyanide ponds would be closely monitored in accordance with permit conditions, acute toxicity problems would be quickly corrected to minimize wildlife mortality, and are considered an insignificant impact.

The potential for chronic toxicity resulting from WAD cyanide in the tailings ponds is uncertain. Potential impacts would not be readily ascertained because wildlife suffering from chronic toxicity may not suffer mortality in areas that could be monitored. Several factors would affect chronic toxicity, including concentrations of cyanide in upper levels of the food chain, sensitivity of life stages exposed (e.g., egg, larval, or adult forms), and longevity of cyanide in the environment. Due to the uncertainty associated with these factors, impact significance is unknown but could be potentially significant.

Cyanide occurs in several forms and its toxicity varies with the form in which it occurs. Cyanide is toxic to most forms of life above varying threshold concentrations. Free cyanide is the most toxic form but is short-lived in the environment. Free cyanide readily breaks down into less toxic forms when exposed to air or organic matter. A release of cyanide at any of the proposed cyanide facilities would not directly impact any aquatic environments near the project area. The impact to the arid environments would be expected to be local and short-lived.

Indirect Impacts

Most larger and more easily disturbed wildlife species would be expected to avoid areas of active disturbance. Generally, the larger and more wary species, including mule deer, antelope, game birds, and most large carnivores, would be expected to avoid active disturbance by a distance of 1/4 mile or more, effectively increasing the impact area of active disturbance. Approximately 1,880 acres would be affected by direct disturbance as a result of the Proposed Action. Including a 1/4-mile-wide disturbance zone surrounding this area, a total of approximately 3,075 acres would be affected by indirect disturbance (including the 1,880 acres of direct disturbance). This is not expected to be a significant impact because habitat value is low and no critical range or migration corridors would be affected. Wildlife species residing near the Proposed Action area may be subject to a higher degree of road kill by mine-related traffic.

4.6.3 Mitigation

Potential impacts to wildlife water supplies resulting from drawdown will require implementation of feasible mitigation measures if monitoring shows reduction in water supply. As described in the Proposed Action, springs in the study area would be monitored to determine the effects of drawdown. If monitoring shows flow reduction, enhancement or relocation of infiltration ponds would be the mitigation measure implemented (see Section 4.4).

4.7 RECREATION AND WILDERNESS

4.7.1 Impact Significance Criteria

Direct effects to recreational resources would occur if construction or operation of the Proposed Action resulted in the termination of use or modification of recreational resources within the study area. Indirect effects would occur if construction and operation activities altered recreation use patterns, recreation demand, or access to use areas near the Proposed Action.

The following considerations were used to identify effects to recreational resources: (1) Proposed-Action-related changes that alter or otherwise physically affect established, designated, or planned recreation or wilderness areas or activities; (2) Proposed-Action-related changes that affect officially adopted policies or goals for recreational or wilderness land management of recognized organizations or agencies; (3) Proposed-Action-related changes that increase or decrease accessibility to areas established, designated, or planned for recreational or wilderness use; (4) Proposed-Action-related changes that affect duration, quantity, and quality of impact to recreational and wilderness resources.

4.7.2 Impacts of the Proposed Action

The Proposed Action would have a moderate, incremental impact on the recreational resources found within the study area. Developed recreational facilities would not be directly impacted. Since the Proposed Action would cause an average increase in the workforce of 70 jobs (see Section 4.9, Socioeconomics), the demand for both dispersed and developed recreation should increase accordingly. Recreational opportunities are already limited in many of the communities where the new workers are likely to live. An increase in the population would increase the demand of an already inadequate supply of developed recreation opportunities.

The Proposed Action would result in a loss of approximately 1,880 acres of previously undisturbed land that could be used for dispersed activities such as hunting, off-road vehicle use, and rockhounding. This acreage is adjacent to existing mining operations where recreational opportunities are limited. The increased area of mining disturbance would, however, cause a corresponding increase in the amount of adjacent land affected by mining operations. This would not have a significant effect on the amount of land available for dispersed recreation activities within the resource area. In the future, reclamation efforts would restore some of the existing recreational opportunities, especially hunting. The restoration of recreational opportunities within the Proposed Action area would depend on both the successful reclamation of the land, and the status of other mining activities that may exist at that time.

When the mining pit is eventually abandoned, it would fill with groundwater inflow until hydrostatically stable. The BLM has no plans to develop this water-filled pit for recreational purposes (Pharo 1993).

Roberts Mountain Wilderness Study Area is located approximately 18 miles to the south-southeast of the Proposed Action area. Hunting of big game would be the highest seasonal use. Although this WSA would experience an increase in wilderness use, this would not be a significant increase. No impacts are anticipated for this WSA.

4.7.3 Mitigation

Feasible mitigation would include applicant-sponsored periodic environmental education/ training for off-road vehicle use, firearms safety, hunting regulations, developed recreation site use, and dispersed recreation ethics. In addition Cortez Gold Mines would provide support in developing or improving recreational opportunities in the area.

4.8 VISUAL RESOURCES

4.8.1 Impact Significance Criteria

The assessment of visual impacts is based upon impact criteria and methodology described in the BLM Visual Contrast Rating System (BLM Manual Handbook, Section 8431-1).

Effects to visual resources are assessed for the construction, operation, and closure of the Proposed Action. Quality of the visual environment is defined by BLM Visual Resource Management (VRM) classes. Two issues are addressed in determining impacts: (1) the type and extent of actual physical contrast resulting from the Proposed Action and related activities, and (2) the level of visibility of a facility, activity, or structure. Impacts are considered high if visual contrasts which result from landscape modifications affect: the quality of any scenic resources; scenic resources having rare or unique values; views from, or the visual setting of, designated or planned parks, wilderness areas, natural areas, or other visually sensitive land uses; views from, or the visual setting of, travel routes; and/or views from, or the visual setting of, established, designated, or planned recreational, educational, or scientific facilities, use areas, activities, viewpoints, or vistas.

The extent to which the Proposed Action would affect the visual quality of its viewshed 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 magnitude of change relates to the contrast between each of the basic landscape elements and each of the features. Assessing the Proposed Action's contrast in this manner indicates the severity of potential impacts and guides the development of mitigation measures which fulfill the VRM objectives.

4.8.2 Impacts of the Proposed Action

<u>Construction and Operation</u>

Landscape modifications resulting from the construction and operation of the Proposed Action would be within the BLM VRM Class IV objectives. The Proposed Action site is located on VRM Class IV lands, where changes to the characteristic landscape can be high and be the major focus of viewer attention. Although the proposed activity involves expansion of existing mining sites, as well as the construction of new facilities, the additive increase in visual contrast would not draw significant visual attention.

Potentially sensitive viewing locations (places where people travel, recreate, or reside) were examined. From these, three key observation points (KOPs) were identified and evaluated. The KOPs were located in the town of Crescent Valley, along State Highway 306 and on

Mount Tenabo (Figure 3.8-1). While the Proposed Action activities would be visible from the State Highway 306 and Mount Tenabo KOPs, they would not be visible from the town of Crescent Valley.

Proposed development at the Gold Acres site would entail the development of an open pit-mine approximately 800 feet deep, covering approximately 200 acres, with an associated dewatering system and several waste rock dumps; the construction of a combined heap leach/tailing impoundment facility covering approximately 480 acres; the construction of a 5,000-ton-per-day ore processing facility with support facilities which include an administration office, a safety/change house, an assay lab, a shop/warehouse, a read line/tire shop, a diesel storage facility, a gas storage facility, a parking lot, a fresh water pond and a barren pond. The waste rock dumps would reach a maximum height of 200 feet, at the downslope position. The heap leach/tailings facility would reach a maximum height of 100 feet. The heap leach/tailings facility would attain a maximum height of 100 feet. Support buildings would be a maximum of 60 feet high and would be located west of the waste dumps, where they would not be visible from State Highway 306. The Gold Acres haul road would be widened from 50 feet to 120 feet, in order to accommodate the increased truck traffic necessary to carry ore to the existing Roaster/CIL processing plant located at Cortez.

The proposed mining activities would be visible from the State Highway 306 KOP. This KOP is approximately 2 miles northeast of the Gold Acres site and represents the view of the majority of viewers traveling through this portion of the study area. Within this distance zone, particularly during midday light conditions, color, form and line contrasts created by the Proposed Action would be evident. However, the Proposed Action would represent an additive change to an already highly modified landscape and would not draw strong visual attention.

The proposed mining activities would also be visible from Mount Tenabo. The Mount Tenabo KOP is located on the crest of the mountain, in the northwest portion from which the Gold Acres area is visible. Due to its proximity to the open vistas of the Crescent Valley, an expansive viewshed, incorporating hundreds of miles of landscape, is visible from the crest of Mount Tenabo. This viewshed includes the diversity of landscape features which characterize the Basin and Range Physiographic Province. Within the context of this expansive vista, the Proposed Action would display some new facilities and expansion of other activities which would create additive visual contrast. The visual contrast of the Proposed Action would be seen in terms of colors, textures, land forms, and lines. Although the introduction of the angular, pyramidal form of the heap leach/tailings facility would constitute a variation in form, and the surface disturbance resulting from the creation of the waste rock dumps and the heap leach/tailings facility would change the surface colors, these changes would exist within the context of the scale of natural landscape features and adjacent to land previously disturbed by mining activities. While shadow colors would accentuate the appearance of the pit, the visual change created by the pit would be negligible from this viewpoint. The Proposed Action would therefore represent an additive change to an existing and partially disturbed landscape which would not draw strong visual attention.

Visual impacts resulting from the proposed activities would be similar to those which already exist from past and ongoing mining activities. The heap leach/tailings facility would create strong horizontal lines, broad flat pyramidal forms, lighter colors and finer texture in contrast to the surrounding landforms and vegetation. As the size and scale of the facility is enlarged, the facility would become more prominent within the viewshed. Similar changes to the landscape would result from the phased construction of the waste dumps. The additional contrast to the landscape elements of form, line, color and texture resulting from the introduction of geometric form, medium to strong lines, light color and finer texture, would be evident within the visual landscape. These modifications would be additive to the existing mining disturbance within and adjacent to the Proposed Action. The pit development would create a negligible increase in visual change over the existing mine pit disturbance.

Exploration activity is also included in the Proposed Action. This activity would disturb approximately 12 acres per year, and would include sites for exploration and development drill holes, construction of new access roads and improvement of existing access roads. These activities, especially the building of new access roads, would create additional visual contrast in the landscape, but would occur on a relatively small scale and would be within VRM Class IV objectives.

Closure and Abandonment

Reclamation practices would consist of recontouring and revegetating waste dump and heap leach/tailings facility slopes; recontouring and revegetating exploration roads; and removing all buildings, structures and equipment brought to the site. Following successful reclamation, the visual contrast of the Proposed Action would be slightly reduced. Revegetation would reduce the existing strong color contrasts; over the long term, natural vegetation would begin to blend with the color and texture of the existing natural landscape. Although recontouring and revegetation of the disposal and heap leach/tailings areas would help to reduce the color and form contrasts, the scale of visual disturbance of these modified pyramidal landforms would remain visually evident.

4.8.3 Mitigation

For reducing visual contrast, minimization of disturbance is the most effective mitigation technique. Where disturbance is proposed, repetition of the basic landscape elements (form, line, color, and texture), would minimize visual change. Additionally, the use of surrounding landscape colors and native plant materials are appropriate means of reducing visual contrast. Described below are feasible measures that would effectively reduce visual change.

- During construction, clearing of land for waste rock dumps and facility construction would create curvilinear boundaries instead of straight lines to minimize disturbance of the landscape. Grade in a manner which would minimize erosion and conform to the natural topography.

- To the extent possible, retain foliage adjacent to the site in order to minimize visual change to the landscape.

- Paint all buildings and structures to match or blend harmoniously with the surrounding soil and vegetation types.

- Minimize the visibility of mining activities by using strategic location techniques.

4.9 SOCIAL AND ECONOMIC IMPACTS

This section describes potential impacts to population, employment, housing, community services and facilities, and public finance in the study area. The description of the potential consequences of the construction and operation components of the Proposed Action is combined because of the overlapping construction and operation schedules. The analysis focuses on Proposed Action impacts associated with the construction workforce, impacts from the combined construction plus operation workforce in 1994, and from an average permanent workforce of 265 persons.

Adverse socioeconomic impacts are indicated if the capacity of existing and planned housing and community services and facilities is insufficient to meet the anticipated demand associated with projected Proposed-Action-related population increase. The issue of capacity is particularly critical in an area that is already experiencing increased demand on its services for reasons other than a proposed future project. The study area is currently experiencing service demand associated with increased gold production in the area. Adequate housing supply, particularly of temporary housing units, is necessary to support immigrating workers and their families. A potential constraint to an increase in housing supply can occur if adequate sewer and water capacity do not exist. For any one of these interdependent issues, including housing, community services and facilities (schools, law enforcement, fire protection, medical care, wastewater treatment, water supply, and solid waste disposal) the threshold indicator of a significant impact is an anticipated demand greater than projected supply.

Estimates of the increase in direct and indirect employment and population are based on the anticipated workforce and construction schedule, as well as assumptions concerning worker marital status and family size.

4.9.1 Workforce Requirements

Table 4.9-1 reports the manpower loading for the construction and operation of the Proposed Action. Construction of the new facilities is anticipated to begin early 1994, and is expected to be completed in about 15 months in early to mid-1995. A construction workforce of about 185 is anticipated to work on the Proposed Action during this period. Early mine development activities such as overburden removal also are anticipated to commence in early 1994 with an initial workforce of about 181 employees. These employees would continue developing the mine along with other additional hires in 1995. By 1996, the total permanent employees for this Proposed Action would be around 269 which would be close to the average workforce (265 employees) for the life of the Proposed Action, although as Table

4.9-1 indicates, there would be small fluctuations in the number of permanent mine employees from year to year. The permanent workforce would peak slightly in 2003 when the processing of roaster ore begins. All milling would be completed by 2006.

Table 4.9-1 also presents information on the existing Cortez operations. Currently about 195 employees are employed at Cortez mine. These persons would continue at the mine through 1994. Over 1995-1996, the current mine operations would be phased out, with most of these employees absorbed by the new Pipeline Mine or transferred to other Placer Dome operations. The table therefore reports the total construction and operation workforce that would be employed on both Cortez projects over 1993-2008.

4.9.2 Assumptions Used for Socioeconomic Analysis

As noted earlier, construction of the Proposed Action would occur over a 15-month period, from early 1994 through mid-1995. The construction would be conducted by contractors who would be hired by Cortez on the basis of competitive bids. The construction contract could go to a local or a non-local contractor (non-local contractor/worker, for the purposes of this analysis, is defined as a person located outside of the Elko-Carlin-Battle Mountain study area who would move into the area for Pipeline Mine construction or operation). Proposed Action impacts from construction would vary depending on whether the construction contractor and the crew are local or non-local in origin. The analysis of construction employment, population, and housing impacts was conducted for the worst-case scenario -- i.e., on the assumption that the construction contractor and crew would be non-local. Consultations were held with the human resources department at Cortez, and the Newmont Gold Mines because there is an ongoing construction project at Newmont Gold. In addition, environmental documents for other gold mining projects, including the DEIS for Barrick's Betze Project, Robinson Project EA and the Mount Hamilton EA were examined for the assumptions used for impact evaluation. Based on these consultations and studies, the following assumptions were utilized for estimating construction-phase impacts:

- 10 percent of the non-local contractors' crew would be locally hired.
- 80 percent of the non-local workers would be single or married but not accompanied by families.

- Non-local workers accompanied by families would have an average family size of 3.52 persons.
- There would be 1.00 school-age child per non-local family household.

With respect to the permanent mine employees, consultations were held with the human resources department at Cortez and the Nevada Employment Division, Elko, to determine what proportion of the new permanent employees would be hired out of the regional labor pool and what proportion would likely be hired from outside the study area. Based on the skills/trades in which the new hires would be needed, it was estimated that about 20 to 25 percent would be non-local (53 out of 265 operations jobs), and 75 to 80 percent of the permanent employees would be locally hired. In addition, the following assumptions were utilized:

- About 25 percent of the operations employees would be single and 75 percent married with families.

- There would be one person per single worker household and 4.05 to 5 persons per married worker household.

- There would be 1.43 to 2.6 school-age children per non-local family household.

To estimate family size, composition, and school-age children of the permanent mine employees, demographic data from the 1990 Census for the community of Spring Creek near Elko was examined. Spring Creek was originally developed as a retirement community. However, over the past few years, mining families moved into the community in large numbers. It was considered that an examination of demographic data for married-couple families in this community could provide a fairly reliable profile of a typical mining family. The 1990 census reveals that there are a total of 992 married-couple families in Spring Creek, with a total population of 3,723, including 1,888 persons under 18 years of age. Of these persons, 1,322 persons are in 5 - 17 years age group, i.e., school-aged. These data yield an average family size of 4.05 and an average of 1.43 school-aged persons per family for a married-couple family in Spring Creek. These averages were used to estimate the number of dependents and school-aged children that would accompany non-local operations employees.

In addition, Elko County School District was consulted to determine a realistic number of school-aged children likely to accompany the non-local employees. According to the School District, an analysis of school registration forms at Mountain View Elementary School was conducted. This school has one of the highest enrollment levels in the District, and its attendance area includes areas that developed in the last 5 years where a large number of mining families were noted to move in. The study revealed that there were about 2.6 school-aged children per family (Billings 1993, Ridgeway 1993). Therefore, to provide the upper estimate of population and school impacts, a household size of 5 persons with 2.6 school-aged children for each non-local family household was also utilized.

The Proposed Action would result in "direct" jobs -- i.e., jobs for the construction and operation of the new mine. These direct jobs at Cortez and the additional income in the area from these jobs would generate a demand for service or support jobs or "indirect" jobs. To estimate the indirect employment and population impacts of the Proposed Action, a construction local employment multiplier of 1.2, and an operations local employment multiplier of 1.74 was utilized (Dobra 1988). While some immigration into study area communities could occur due to the indirect jobs, for this analysis it is assumed that these would be filled by local persons who are unemployed at the time of creation of these jobs. This assumption is reasonable in that indirect jobs are typically low paying and tend to be filled by local persons or spouses of immigrating direct workers.

The impacts described below are expected to occur in the study area based on the best information available as of March 1993 from local sources and on assumptions noted above. However, several changes are currently affecting the region in terms of mine closures and construction of new mines or expansion of some operations. It is possible that by 1994 a construction crew currently working in the area could become available to work on mill construction at Cortez. Similarly, employees of closed mines could move into the new positions created by the Proposed Action. Therefore it is likely that the analysis below represents a worst-case analysis.

4.9.3 Employment Impacts

The Proposed Action would result in an increase in the number of jobs in the study area. These jobs would include direct employment in the construction and operation of the new mine, and indirect or support jobs. Based on assumptions outlined above, the Proposed Action would create 366 new direct jobs in 1994. These would be additional to the current 195 mining jobs at Cortez. By early to mid-1995, construction would be complete, and there would be about 282 direct mining jobs at Cortez. However, as phasing out of current Cortez operations would have begun, 73 current jobs at Cortez would be eliminated, so that the net Cortez plus new mine employees in 1995 would be around 404. Over the next two years the remaining current Cortez jobs would be phased out, with most of the current employees either absorbed at the new mine or transferred to other U.S. Placer Dome operations. In the long run, there would be a net increase of about 70 jobs over current employment levels at Cortez.

Table 4.9-2 reports the direct and indirect employment generated by the Proposed Action, based on employment multipliers listed earlier. Typically, there would be a time lag of about 2 to 3 years before a new indirect job would come into existence. This table does not allow for the time lag and therefore overstates the impacts in the first 2 years. In the long run, the 70 new jobs at Cortez would result in 52 indirect jobs, so that the overall employment impact of the Proposed Action in the study area would be 142 new jobs.

Table 4.9-3 presents number of these direct jobs that would likely accrue to local workers and those that would be filled by non-local workers, and is based on assumptions noted earlier. From the table, it is noted that in 1994 with a non-local contractor, there could be a possible immigration of as many as 201 non-local workers in the study area. However, after the construction is over, over the longer run, there would be no more than 60 non-local persons (53 on an average) working at the new mine. Note that the non-local workers under operations in the table are not additional new workers each year but represent the persons that would come to the study area in 1994 and 1995 and continue to work in the following years.

4.9.4 Population Impacts

<u>Construction Phase</u>

If the Proposed Action construction contract is awarded to a non-local contractor, there would be an influx of about 165 non-local construction workers and their dependents into the study area for most of 1994 and early 1995. Most of these construction workers would be either single or married but not accompanied by families. An estimated 33 non-local workers could be accompanied by families. Assuming a mining construction worker family is composed of 3.52 persons, these married non-local workers would bring into the study area about 83 dependents. Therefore, there would be an influx of about 248 non-local persons into the study area (Table 4.9-4).

Communities likely to be affected by these workers would be Elko, Carlin, Battle Mountain, Beowawe, and Crescent Valley. A simple gravity model described in Appendix I was used to estimate where these non-local single and married workers with families would locate. Table 4.9-5 presents the likely distribution of non-local construction workers among study area communities. Given its size and the availability of amenities, the city of Elko would likely attract the bulk of the non-local construction workers and these workers along with their dependents would in 1994 cause an increase of about 1 percent in the city's population. Other communities would be relatively less affected.

Operations Phase

As noted earlier, Proposed Action operations in 1994 would require 181 new workers, with this number increasing to 282 in 1995. Of the 282, 181 workers would be those from the previous year, 73 workers would likely move over from current Cortez operations so that in effect in 1995, there would be 28 new jobs created. The next year, 1996, the Pipeline operations workforce would be around 269, which would include 48 persons moved over from current Cortez operations. By the year 1998, there would be about 70 new jobs created (in excess of the existing 195 jobs at Cortez currently) and 53 of these would likely be filled by non-local workers. Table 4.9-4 presents the total population increase that would result as these non-local employees and families move into the study area. With Proposed Action operation, 175 to 213 new residents (employees and dependents) would move into the study area.

Table 4.9-6 presents the distribution of these non-local workers by community based both on current Cortez employee distribution and based on a gravity model described in Appendix I. The total population increase (employees and dependents) for each community is also reported, in terms of a lower estimate based on a family size of 4.05 and an upper estimate based on a family size of 5 persons. If the new workers reside in a pattern similar to that of current Cortez employees, Elko would record an increase of 75 to about 91 new persons.

Other communities would record smaller increases. If, on the other hand, the new workers chose to reside in a manner reflected by the gravity model results, Elko would record an influx in the 97 to 117 persons range, and Battle Mountain could receive 30 to 37 new residents.

Construction Plus Operations (1994)

Approximately 165 non-local construction workers and about 36 non-local operations employees would affect the study area in 1994. Table 4.9-5 presents an estimate of impacts during this year. There would be an increase in the study area population by about 350 to 400 residents. Almost 60 percent of this population would likely move into Elko, and about 15 percent into Battle Mountain. Other communities would be less affected. Once construction is complete, the number of immigrants would likely decrease to levels described under the Operations Phase above.

4.9.5 Housing Impacts

About 201 housing units in 1994 would be needed for Proposed Action construction and operations employees. The community likely to be most affected is Elko. Approximately 107 housing units for a 15-month period would be needed during Proposed Action construction in Elko (Table 4.9-7). If single workers chose to double up or share accommodations, this number would be lower. Another 15 units would also be needed for the incoming non-local operations employees in 1994.

Due to the boom of gold mining in the Carlin Trend district, the City of Elko is currently experiencing a housing shortage. The number of permanent housing units in Elko is 5880. Demand for this housing is presently high and availability of this housing at the time of Proposed Action construction is difficult to predict. As noted in Section 3.9.4, the availability of rental housing in Elko and Carlin is close to nil. While some hotel/motel rooms would be available, given that the construction workers would likely reside in the study area for about 15 months, they may not choose to use hotel/motel rooms. RV spaces are also not available. Proposed Action impacts on rental housing during construction could potentially be significant as the construction workers would have to compete with others in Elko and Carlin for both the few rental housing units and RV spaces.

In the long run, about 53 housing units would be needed for the non-local permanent employees (Table 4.9-7). If the new employees choose to live in a manner similar to the current Cortez employees, about 23 of these units would be needed in Elko, 9 in Carlin, and the balance in other communities. This housing should not pose a problem because housing units for sale are available in the affected communities. Besides, as noted in Section 3.9.4, the City of Carlin is looking to develop additional housing, and if necessary Cortez could develop the approved 27-lot subdivision in Carlin. Lots for construction of new homes are also available in Crescent Valley.

4.9.6 Schools

Based on assumptions noted in Section 4.9.2, and the likely pattern of residence of both construction and operations employees, an estimate of the number of new school-age children by community was prepared, and is presented in Table 4.9-8. During construction, approximately 60 new school-age children would enter the study area (33 of which would be associated with married non-local construction workers, and 27 associated with married non-local new operations employees). Almost 70 percent of these students would reside in Elko and Carlin, and thereby affect the Elko County School District. It is also likely that some of the new students in Crescent Valley would also utilize Elko County schools.

Once the operations workforce is in place, with an average increase of 70 new employees and about 40 of these being non-local new employees with families (the remaining would be single or hired out of the local labor pool), the study area schools would see an increase of 56 to 104 new students. Using the higher estimate of 104, it is likely that the Proposed Action would add 62 new students to the Elko County School District (note that some of these students would have joined the schools in 1994 because some of the non-local employees would be hired in that year), and it is likely that the bulk of 34 students who live in Crescent Valley and Beowawe would also utilize Elko County schools.

As noted in Section 3.9.5, Elko County School District enrollment has been increasing since the boom in mining in the region, and several schools in Elko and Carlin are operating well over their capacities. The increase in the number of school-age children in the study area due to the Proposed Action would represent about four new classes (with 25 students per class) and would impact the already overburdened school facilities.

4.9.7 Law Enforcement

The demand for law enforcement in the affected communities would increase because of the increase in population caused by the Proposed Action. The City of Elko would experience the largest increase in population in the range of 75 to 117 new residents (depending on the pattern of employee residence). This would not represent a significant change over current population levels to result in an impact on law enforcement services, and the ratio of law enforcement officers for every 1000 resident would remain unchanged.

However, in the short term (construction phase), the Proposed Action would (under the worst-case scenario) cause an influx of a construction workforce of about 165 non-local workers. Almost 80 percent of these workers are expected to be single or married but not accompanied by families. The introduction of these persons for a 15-month period could increase the burden on law enforcement services, especially affecting Elko County Sheriff's Department and the City of Elko Police Department.

4.9.8 Utilities (Including Water Supply, Solid Waste, and Wastewater)

The Proposed Action would not cause a large enough increase in the study area population to result in impacts to utilities. As seen in Section 3.9.6, more than adequate water and wastewater capacity is available in the study area communities. The future growth of housing in Carlin would not be constrained because excess sewage capacity is available at the sewage treatment plant. Solid waste generated by the Proposed Action employee households would not be large enough to adversely affect landfill capacity in the study area because no more than 53 new households would move into the study area in the long run.

4.9.9 Fire Protection and Emergency Services

Potential law enforcement impacts have been reported earlier. The Proposed Action would not result in a significant additional demand on other emergency services due to the small number of new households that would locate into the study area communities.

4.9.10 Social Conditions

Project-related changes were assessed for potential impacts on social organization, community resources, and indicators of well-being. Impact to social organization in the study area communities would not likely occur because the project does not introduce any new power or social groups into the area. The types of persons that the Proposed Action would add, mainly construction workers and miners, are already well represented in the study area, and the long-term residents are familiar with these type of newcomers. Based on the survey conducted for the Gold Quarry Project by Huntington, it appears that mining-related newcomers would generally be welcome in the study area communities. Only a few respondents have indicated some problems to be related to the influx of new people into the study area.

There could be some strain on community resources, and consequent diminution of individual and community well-being, especially during 1994, when the workforce associated with the Proposed Action would be large. When queried about the effects of an influx of 500 new workers into area, a majority of the respondents of the Huntingdon survey noted that immigration of new workers would adversely affect police services, schools, water supply, and the conditions of the local streets. On the other hand, retail stores would benefit. It was felt that services such as fire protection, parks, and city and county governments would be unaffected. One respondent noted the need for better planning by the community officials to deal with the growth.

In general, the study area communities appear to have become accustomed to the growth associated with mining, given the changes that have occurred over the past 5 to 8 years. Overall the residents view growth in mining as a positive change because it would bring more jobs to the area. Survey respondents also noted that population growth would attract more businesses, and an increase in diversity of shopping opportunities could result.

4.9.11 Public Finance

In 1991-92, Cortez operations accounted for approximately 15 percent of the property tax revenues for Lander County. Fiscal benefits to Eureka County were relatively smaller, with 1.2 percent of county property tax revenues accruing from Cortez properties. Elko County received a small amount in property tax revenues. No net proceeds from mines taxes were paid because these are assessed on net profits from mining operations, and Cortez did not record a profit in 1991-92.

The Proposed Action would be located in Lander County. Additional property tax revenues would accrue to the county because of an increase in assessed value attributable to the proposed facilities. Table 4.9-9 reports estimated annual taxes from the Proposed Action. Net proceeds from mines tax revenues would accrue to Lander County. Some of the ore would also be milled at the existing Cortez facilities, and net proceeds from mines tax revenue would accrue to Eureka County. There would be no addition to Elko County revenues, other than property tax revenues associated with ownership of homes in Elko and Carlin by the new permanent employees.

Other fiscal impacts for all study area communities would be associated with the sales tax revenues from the spending of the increased payroll on taxable goods in the long term and construction payroll in 1994. With a construction schedule of 15 months, an average hourly rate of $24.25, and a construction workforce which would vary from 75 in the first month to a peak of 225 in months 9 through 11, a construction payroll of about $12.2 million would be paid. A portion of this income would be spent in the study area communities, generating sales tax revenues for the state and the local jurisdictions.

Given that 39 percent of the average household income is typically spent on taxable goods, and the sales tax rate in the study area is 6 percent, the estimated annual operations payroll of $9 million would generate about $211,000 in sales tax revenues annually.

4.10 LAND USE/LIVESTOCK GRAZING

4.10.1 Significance Criteria

The loss of forage and water or undue harassment sufficient to adversely affect normal livestock operations would be significant. Statute 43 CFR 4110.4-2 (Public Range Improvement Act regulations) requires that when reductions in forage due to industrial development or other permitted actions occur, the permittees must be notified by a 2-year notice of reduction in the grazing permits. The suspension of use, equal to the lost forage, must then be instigated at the conclusion of the 2-year period.

4.10.2 Land Use Impacts

Activities in the area may affect existing ROW NEV-0446699 for old State Highway 306. It is likely that plantsite, fire reserve water line, and storm water division structures would involve disturbance within the granted corridor. However, old Highway 306 terminates at the now abandoned townsite of Gold Acres and is primarily used for access to mining claims. The rerouted highway would not be impacted directly by the Proposed Action.

A portion of Lander County Road 225 would require relocation. Apparently, no ROW has been granted for this road. It is anticipated that a ROW would have to be granted for the proposed relocation corridor.

The proposed upgrade of the Gold Acres haul road may require amendment of N-43670 to allow the increase of road width from 50 feet to 120 feet. Proposed mine dewatering activities may require an additional ROW through public lands for the conveyance of water to the point of discharge. The disposition of existing ROWs granted to Cortez Gold Mines which are affected by proposed mine development would be determined by the grantor.

Sierra Pacific Power Company (SPPCo) has applied for a right-of-way (ROW) across BLM lands on the western edge of Crescent Valley, to the proposed plantsite just south of the Gold Acres highway. The BLM has approved the Environmental Assessment for the proposed ROW but will not issue the ROW until the Proposed Action is approved. No significant impacts are associated with the proposed transmission line.

Due to the location of the proposed activity in the valley and lower foothills, potential impacts to other resource values are limited except for livestock grazing and cultural resources, as addressed in Sections 4.10.3 and 4.11.

4.10.3 Livestock Grazing

The amount of disturbance required to mine and process the ore is approximately 1,880 acres within the Proposed Action boundary, of which 52 acres are existing disturbance. Based on the 1964-1967 BLM range survey of the Cortez Planning Unit (BLM 1967), approximately 98 AUMs of direct livestock forage loss would result from the Proposed Action, all on federal lands within the Proposed Action area. Another 7 AUMs would be lost from private lands in W1/2 Section 35. The area is part of the Carico Lake Grazing Allotment. Consequently, the 98 AUMs lost represent 0.3 percent of the active grazing preference (36,958 AUMs) in the allotment. However, mining activity associated with the Cortez area would tend to restrict livestock from forage resources immediately adjacent to the disturbed areas. The potential indirect impact is not quantifiable, but is estimated to be comparable to the direct forage lost due to the haul roads and other service roads that transverse undisturbed portions within the Proposed Action area. Also, the potential exists for livestock mortality in the vicinity of haul roads and existing access roads as a result of traffic to and from the Proposed Action area. Based on records of existing operations, this would be a rare occurrence.

The natural drift of livestock in Crescent Valley in the vicinity of Cortez and Gold Acres would be affected by the increased haul road traffic between Gold Acres and Cortez, a distance of 8 miles.

The dewatering impact to groundwater, as discussed in Section 4.4, could result in a loss of, or a diminished water supply for, the Filippini Well #2. Consequently livestock would not have access to water at this facility. This could lead to heavier grazing at another location, or cattle would have to travel further for water.

4.11 CULTURAL RESOURCES

4.11.1 Potential Impacts

No NRHP-eligible properties or areas of traditional or religious importance to Native Americans would be affected by the Pipeline Project.

4.11.2 Mitigation

No mitigation for archaeological or ethnographic resources is required because the Proposed Action would not result in new significant impacts to these resources.

4.12 NO ACTION

As described in Section 2.4.1.2, the No Action Alternative would result in a continuance of mining ore from various existing pits as authorized under existing approvals. This would also include the mining activities described in the Expansion EIS which would result in mining activity affecting an additional 428 acres. A closure of operations from these activities is anticipated sometime in 1999.

The objective of the No Action Alternative analysis is to describe environmental consequences that would result if the Proposed Action is not implemented in order to provide a comparison to the consequences of the Proposed Action. In general, the No Action Alternative would result in continuation of impacts associated with expansion of an existing open pit mine and waste rock dumps, construction of new heap leach facilities, rock dumps, construction of new heap leach facilities, waste rock dumps, and exploration drilling discussed in the Cortez Expansion EIS. In contrast to the No Action Alternative, the Proposed Action would have potential new impacts associated with development of a new open pit mine with associated dewatering system and waste dumps, construction of a new combined heap leach/tailing impoundment facility and construction of a 5,000-ton-per-day ore-processing facility complete with appurtenant facilities. It is anticipated that activities associated with the Proposed Action would continue for at least 12 years after plant commissioning.

New disturbance from the Proposed Action (e.g., to soils, vegetation, and wildlife habitat) would total approximately 1,880 acres. This would not occur with the No Action Alternative.

Reclamation requirements would be greater with the Proposed Action because of the additional disturbance and need for additional topsoil. In addition, reclamation of haul roads and other sites of ancillary facilities could occur earlier with the No Action Alternative than with the Proposed Action.

4.12.1 Air Quality

Levels of SO_2, TSP, and PM_{10} emissions from mining and processing associated with Cortez Expansion activities would continue until about 1999, when operations would cease. At this time reclamation would continue but air emissions associated with ore processing would cease. Air quality in the Crescent Valley air basin could still be affected by other reasonably foreseeable activities in the air basin.

4.12.2 Geology and Minerals

Under the No Action Alternative, Cortez would continue to mine existing pits, operate processing facilities (including new Tailings Pond Number 7), and conduct Cortez Expansion activities until ore was depleted. The ore proposed for development would remain unmined.

4.12.3 Soils and Topography

The No Action Alternative would restrict soil disturbance to the 428 acres of surface soil disturbance associated with Cortez Expansion activities. Reclamation would be conducted in accordance with existing approvals and the Reclamation Plan for Cortez Expansion activities. Reclamation of haul roads and processing facilities would begin much sooner than with the Proposed Action.

The No Action Alternative would, however, prevent the surplus of growth medium available from the Proposed Action from use for Cortez Expansion activities. There would be approximately 5 million cubic yards of growth medium available from the Proposed Action. Since only about 3 million cubic yards would be required for reclamation of the proposed project, about 2 million cubic yards would be available for Cortez Expansion reclamation. About 46,000 cubic yards would be hauled from the topsoil storage piles to the Cortez Expansion to fulfill a shortage for reclamation of those facilities (Cortez Mine Expansion FEIS 1993). The topsoil materials would be hauled to the Cortez Mine Expansion in mine trucks on the existing haul road. Under the No Action Alternative, this would not occur and topsoil shortage would remain.

4.12.4 Water Resources

Other than water requirements for reclamation, water use would cease at the end of Cortez Expansion activities in about the year 1999. Risk of release of hazardous materials would also cease. The existing groundwater plume containing cyanide at the Cortez site would continue to be remediated (if still required) under the direction of NDEP. Remediation requirements and groundwater monitoring of the existing plume would not differ between the No Action Alternative and the Proposed Action.

The dewatering system for the Proposed Action would not be needed. Infiltration ponds would not need to be constructed and reclaimed. A pit lake would not be formed, and long-term evaporative loss from the pit lake would not occur. Mitigation that could be required as a result of dewatering of springs and seeps would not be implemented. Thus, improvements to these areas would not occur.

The potential for groundwater contamination from proposed facilities would not be present with the No Action Alternative. Protective measures required by NDEP for existing tailings and stockpiled material near Gold Acres would still be required with the No Action Alternative.

4.12.5 Vegetation

Additional disturbance to common vegetation types (1,880 acres and additional exploration disturbance of 60 acres) would not occur. Potential dewatering impacts to riparian and wetland vegetation associated with springs and seeps would not occur. Improvements to spring and seep vegetation complexes would not occur.

4.12.6 Wildlife Resources

Wildlife habitat associated with 1,880 acres of disturbance and 60 acres of exploration disturbance would not occur.

4.12.7 Recreation and Wilderness

Increased demand for recreation facilities would not occur. Dispersed recreation in the area of the project would decrease.

4.12.8 Visual Resources

Reclamation of existing facilities would proceed and reduce visual contrasts sooner than with the Proposed Action. The pit lake would not remain as a permanent visual feature in the Crescent Valley Basin.

4.12.9 Social and Economic

Under the No Action Alternative, existing milling operations at Cortez would cease sometime in 1994. The closure would result in unemployment of up to 195 direct employees and possible termination of some of an estimated 143 indirect jobs supported by the direct mining jobs in the regional economy. If the closure of the mine does not coincide with the expansion or opening of other mining operations in the study area, Cortez employees and their dependents would be forced to move out of the area in search of employment. Persons holding indirect jobs would not necessarily move out of the area if laid off, but would add to the number of persons applying for unemployment benefits in the three counties.

It is estimated that about 532 persons including 117 school-aged children would be displaced. This displacement, and possibly the displacement of some of the households of the indirect job-holders, would result in a decrease in demand for housing, school services, utilities, and other municipal services.

Mine closure would also result in loss of the property tax and net proceeds-from-mines taxes revenues that result from current operations. Additionally, the study area would lose sales tax revenues and other income resulting from the working of the income multiplier based on the spending of Cortez payroll, and other spending by Cortez in the regional economy. Should the cessation of current Cortez operations coincide with other mine closures, the region would experience a mining bust which would render surplus community services and resources such as housing, schools, utilities, and services. As people left the area during the "bust," facilities would be unused and there would be a reduction in property tax revenues. The Elko County School District has a construction program based on a pay-as-you-go tax levy, and currently there is only a small school debt outstanding which will be paid off by 1997-98 (Salicchi 1993). Therefore mine closures would result in a slow-down of the pay-as-you-go accrual for the school district but would not result in unmet school bond obligations (if the bust occurred after 1998).

4.12.10 Land Use/Livestock Grazing

Approximately 100 AUMs would be preserved with the No Action Alternative.

4.12.11 Cultural Resources

Disturbance to seven historic and prehistoric sites (none eligible for the National Register of Historic Places) would not occur. The Proposed Action would not result in new impacts to traditional or religious values, so there would be no reduction of impact under the No Action Alternative.

4.13 UNAVOIDABLE ADVERSE EFFECTS

After implementation of the mitigation measures proposed in this section, most impacts resulting from the Proposed Project would be reduced to levels which are no longer considered significant. However, some adverse impacts would remain that cannot be entirely mitigated. These impacts are considered unavoidable. Unavoidable adverse impacts may be short term or long term and may vary in significance. A listing of unavoidable adverse impacts is given below.

- Control measures on processing facilities and land disturbing activities would limit point source emissions such as particulates as well as fugitive dust. Although these emissions would be below Nevada and/or federal air quality standards, control measures would not totally eliminate emissions. These remaining emissions are considered unavoidable adverse impacts.

- Short-term consumptive use of groundwater due to mine processing requirements (about 2,000 gpm). This amount of consumptive use is identified in the permitting process required by the Nevada State Engineer's Office. This use is therefore considered a permitted use and an unavoidable impact.

- Evaporative losses from the pit lake that will remain after mining activity ceases. The evaporative losses are considered significant because they will continue as long as the pit lake exists.

- The proposed erosion control program and reclamation design would minimize soil erosion from wind and water. However, soil erosion cannot be completely eliminated. Loss of soils after mitigation is considered unavoidable.

- There would be minor short-term and long-term alterations of landform and surface drainage patterns after reclamation.

- Loss of vegetation communities and wildlife habitat from approximately 1,880 acres is considered a short-term (life of the project) unavoidable adverse impact. After self-sustaining vegetation is reestablished by reclamation activities and mining activities are ended, the impacts to vegetative communities and wildlife habitat would be reduced. However, the resulting vegetative communities and wildlife habitat are likely to be different from the original communities for the long term. The degree to which vegetation and wildlife habitat do not recover to predisturbance habitat value is considered an unavoidable adverse impact.

- There would be a long-term modification of viewsheds in Crescent Valley caused by remaining project features after reclamation. This is considered unavoidable but insignificant because the project is located in a Class IV visual resource management area.

4.14 SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY

This section addresses the balance between the short-term use of the project area and the long-term productivity that the project area would provide if the Proposed Action did not occur. Short-term is defined as the life of the project including reclamation activities. Long-term is defined as the period following final reclamation activities.

Currently, the project area is used for mining, milling, waste rock disposal, cattle grazing, and wildlife habitat. Productivity from the site includes production of gold, approximately 193 jobs, and approximately one million dollars in annual taxes (property tax, mines tax, and sales tax). If the Proposed Action were not implemented, these uses of levels of productivity would continue until sometime about 1999 when mining would cease.

If the Proposed Action is implemented, the types of short-term uses of the site would be similar to current uses but would be extended over 1,880 additional acres. Productivity in terms of jobs and revenue generated would average approximately 265 jobs over the life of the project, and annual taxes (property tax, mines tax, and sales tax) of approximately 4.1 million dollars.

Over the long term, i.e., after closure and reclamation, land use and productivity would be returned as closely as possible to pre-project levels. Depending on the species reestablished by reclamations efforts, it is possible that vegetative productivity could exceed current conditions. However, there is also potential that while the seed mix and species established may be productive for domestic livestock, reestablished vegetation may not be as diverse and/or productive for native wildlife species.

4.15 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources occurs when an action alters the resource so that it cannot be restored or returned to its original or predisturbance condition. An irretrievable commitment of resources occurs when a resource is removed or consumed.

The mining of waste rock and ore would be an irreversible commitment of resources. Although the precious metals contained in ore would be irreversibly committed from geologic formations, they would be retrieved and placed in long-term economic circulation.

Soil losses from handling, erosion losses from topsoil stockpiles, and other unavoidable erosion losses would be irreversible. Erosion control, stabilization of stockpiles, and other handling procedures would limit but not eliminate these losses.

Waste rock disposal areas, heap leach pads, and other disturbed areas would be reclaimed but would still represent an irreversible alteration of land form, lines, and (in the short term) color of the landscape. The mine pit would represent an irreversible loss of vegetation and wildlife habitat.

Evaporative losses of water from the pit lake would be an irretrievable commitment of resources. Consumptive use of process water would also be an irretrievable commitment of resources.

With the No-Action Alternative the commitment of resources would be less extensive because mining and processing would end sooner and consume less natural resources. Resources that would be consumed by the project such as water and electricity would not be consumed. Waste rock and ore would not be irreversibly committed and would remain available for future use.

TABLE 4.1-1

ESTIMATED UNCONTROLLED FUGITIVE DUST (PM_{10}) EMISSIONS FROM SURFACE DISTURBANCE FOR THE PROPOSED PROJECT

Area	Acres Disturbed	Estimated Average Annual Emissions (tons)[a]
Long-term Disturbance[b]		
Waste Disposal Area	586	19.5
Disposal Area Reclamation	81	2.7
Open Pit	241	8.0
Carbonaceous Stockpile	8	0.3
Dewatering Infiltration Ponds	126	4.2
Exploration	60	2.0
Tailing/Heap Leach Facility	440	14.6
Soil Stockpiles	20	0.7
CIL Stockpiles	82	2.7
Total	1,644	51.2
Short-term Disturbance/Construction[c]		
Plantsite	80	34.6
Public Road Relocation	72	31.1
Haul Roads	41	17.7
Runoff Diversion	33	14.3
Light-Vehicle Access	24	10.4
Gold Acres Haul Road Expansion	46	19.9
Total	296	127.9
Reclamation	1,636	708.0[d]

[a]A 1.2-ton-per-acre-disturbed emission factor for TSP was used. PM_{10} is assumed to constitute 36 percent of TSP emissions.

[b]Surface disturbance assumed to occur over a 13-year period (1 year during construction and 12 years during operation).

[c]Surface disturbance assumed to occur over a 1-year period.

[d]This represents emissions over the duration of reclamation activities.

TABLE 4.1-2

FUGITIVE DUST (PM_{10}) EMISSIONS FROM BLASTING DURING PIT EXPANSION

Pit Blast Area[a] (ft^2)	Area per Blast (ft^2)	Emission per Blast[b] (tons)	Estimated Total Project Emissions (tons)
50,003,284	87,000	2.3	1,327

[a]Based on total surface area of each ore bench down to a depth of 350 feet below the pit surface.

[b]TSP Emission factor: $0.0005A^{1.5}$ lb/area blasted; where A is the area blasted (sq. feet) over which blasting occurs (EPA 1986). PM_{10} emissions were derived assuming PM_{10} constitutes 36 percent of total TSP emissions.

TABLE 4.1-3

ESTIMATED ANNUAL FUGITIVE DUST EMISSIONS FROM HAUL TRUCK TRAVEL ON UNPAVED ROADS OVER THE LIFE OF THE PROJECT

Location	Round Trip Length (miles)	Total Ore/Overburden Transferred (million tons)	Total[a] Number of Truck Trips	Total[b] Project PM_{10} Emissions (tons)	Annual[c] Number of Truck Trips	Estimated[b] Annual PM_{10} Emissions (tons)
Mine to Overburden Disposal Area	1.0	233	1,226,316	4,594[d]	94,332	353
Mine to Pipeline Mill	1.5	26.3	138,421	778[d]	10,648	60
Mine Area to Cortez Roasting Facility	14	8.7	45,789	3,202[e]	--[f]	--

[a]Based on 190-ton-capacity haul truck.
[b]Estimated emissions assume a minimum of 50 percent fugitive dust control from watering.
[c]Material hauling assumed to occur over a 13-year period (1 year during construction and 12 years during operation)
[d]Based on estimated vehicle speed of 15 mph.
[e]Based on estimated vehicle speed of 20 mph.
[f]Duration of truck hauling to Cortez facility is uncertain. It could occur over a period as short as 2 years or as long as 9 years.

TABLE 4.1-4

ESTIMATED ANNUAL FUGITIVE DUST EMISSIONS FROM TRUCK LOADING AND UNLOADING

Location	Total Ore/Overburden Loaded/Unloaded (million tons)	Estimated Total Project PM_{10} Emissions (tons)	Ore/Overburden[a] Loaded/Unloaded Annually (millions of tons)	Estimated Annual PM_{10} Emissions (tons)
Mine to Overburden Disposal Area	233	69.0	17.9	5.3
Mine to Pipeline Mill	26.3	5.0	2.0	0.4
Mine to Cortez Facility	17.4[b]	3.3	--[c]	--

[a] Material loading/unloading assumed to occur over a 13-year period (1 year during construction and 12 years during operation).
[b] Carbonaceous ore assumed to be loaded/unloaded twice, once during stockpiling and once during transfer to Cortez facility.
[c] Duration of ore transfer to Cortez facility is uncertain. It could occur over a period as short as 2 years or as long as 9 years.

TABLE 4.1-5

EMISSIONS FROM SOURCES AT THE PROPOSED PIPELINE MILL

Source	Emissions (lb/day)	Emissions (tons/year)
$\underline{PM_{10}}$		
Jaw Crusher[a]	64.8	11.8
Ore Drop and Transfer Points[a]	24.0	4.38
Vibrating Grizzly Feeder[a]	864.0	157.7
Lime Silo[a]	0.04	--[c]
Carbon Reactivation Kiln[b]	4.8	0.9
Furnace[b]	2.4	0.4
CO		
Carbon Reactivation Kiln	0.7	0.1
Boilers	4.9	0.9
$\underline{NO_x}$		
Carbon Reactivation Kiln	3.4	0.6
Boilers	19.7	3.6
Mercury		
Crushing Circuit[d]	0.06	0.01
Carbon Reactivation Kiln	2.1	0.4
Furnace	3.0	0.5
Arsenic		
Crushing Circuit[d]	0.6	0.1

[a]Source for emission factors: EPA (1988).
[b]Source for emissions factors: NDEP Source test results.
[c]Negligible.
[d]Includes the jaw crusher, ore drop and transfer points, and vibrating grizzly feeder.

TABLE 4.1-6

SOURCE PARAMETERS FOR SOURCES AT THE PROPOSED MILL

Source	Stack Height (m)	Stack Diameter (m)	Exhaust Temperature (deg. K)	Exhaust Exit Velocity (m/s)	UTM Location		
					Easting (km)	Northing (km)	Elevation (ft)
Crushing Circuit	10	12.19 x 12.19[a]	293	1	524.500	4456.800	5140
	10	1	293	1	524.500	4456.800	5140
Lime Silo	10	1	293	1	524.500	4456.800	5140
Carbon Reactivation Kiln	9	0.3	700	6.5	524.500	4456.800	5140
Furnace	11	0.3	323	19.4	524.500	4456.800	5140

[a] The crushing circuit is modeled as a 12.19-meter-square, or 40-foot-square, area source.

TABLE 4.1-7

MAXIMUM MODELED PM_{10} CONCENTRATIONS FROM SOURCES AT THE PROPOSED ORE PROCESSING FACILITY

Averaging Time	Modeled Concentration (μg/m³)	Ambient Background (μg/m³)	Total Concentration (μg/m³)
24-hour	57.0	45.0[a]	102.0
Annual	5.1	9.0[b]	14.1

[a]Ambient PM_{10} levels have not yet been monitored at the proposed site for a full year. This is an NDEP assumed value for annual background PM_{10} concentration.

[b]This is the highest measured value at the Cortez monitoring station to date.

TABLE 4.3-1

DISTURBANCE TO SOIL MAP UNITS BY FACILITY
(Page 1 of 2)

Facility	Soil Map Unit	Acres Disturbed (incl. reclamation)
Pit	5a	23
	Bk	77
	ML	141
Waste Dumps	Bk	574
	Wr	12
Waste Dumps Reclamation	Bk	68
	Wr	8
	A	5
Tailings/Heap Leach	Bk	200
	Wr	220
Process Pond	Bk	20
Dewatering Infiltration Ponds	Wr	126
Plant Site	Bk	72
	Wr	8
Public Road Relocation	A	10
	Bk	30
	Ox	3
	Cr	7
	290	7
	2060	15
Haul Roads	Bk	41
Runoff Diversion	Wr	8
	Bk	25
Light Vehicle Access	Wr	8

TABLE 4.3-1

DISTURBANCE TO SOIL MAP UNITS BY FACILITY
(Page 2 of 2)

Facility	Soil Map Unit	Acres Disturbed (incl. reclamation)
	Bk	16
Gold Acres Haul Road Expansion	Bk	35
	Wr	1
	ML	10
Carbonaceous Ore Stockpile	Bk	8
CIL Stockpile	Bk	42
	6a	20
	5a	17
	ML	3
Topsoil Stockpiles	Bk	13
	ML	7
TOTAL		1,880

ML = Mined Land, from Order III Soil Survey (USDA, SCS, 1992).

TABLE 4.3-2

ACRES OF DISTURBANCE BY SOIL MAP UNIT

Soil Map Unit	Acres Disturbed (Direct Impacts)
5a	40
6a	20
A	15
Bk	1,224
Cr	7
Wr	391
290	7
2060	15
ML	161
TOTAL	1,880

TABLE 4.4-1

SUMMARY OF ACID BASE ACCOUNTING RESULTS
(Page 1 of 2)

Sample	MWMP Composite	GNP 5/1000t	MPA t/1000t	Paste pH	MPA/GNP %
Alluvium					
PG91-7 0-100		675	2.19	8.3	.32
PG92-4 230-330	MW-1	132	1.25	8.91	.95
PL91-14 0-100		330	1.25	8.6	.38
DP-110 100-200	MW-2	264	.63	9.08	.24
Oxidized Siltstone Waste					
DP-94 300-400		403	.63	9.02	.16
PL-45 300-400		210	.94	8.87	.45
PG91-7 200-300		489	.94	8.71	.19
DP-45 300-400		227	1.25	8.83	.55
DP-34 200-300		488	.63	8.81	.13
PL91-19 60-160	MW-3	661	.63	8.92	.10
PL91-18 400-500		534	.94	8.93	.18
PL92-1 300-400		511	2.5	8.82	.49
DP-17 500-600		285	.63	8.91	.22
PL91-15 200-300		248	1.88	8.98	.76
DP-42 430-530	MW-4	217	.94	8.71	.43
DP-87 300-400		310	.63	8.7	.20
PL91-10 400-500		226	.94	8.83	.42
DP-38 450-550		283	2.19	9.1	.77
PL-32 200-300		305	.63	8.94	.21
PL91-22 300-400	MW-5	96.6	1.25	8.99	1.29
Oxidized Siltstone Heap Leach Ore					
DP-24 400-500		188	.63	9.01	.34
PL91-15 420-520		338	19.7	8.49	5.83
PL91-24 210-310	MW-6	645	.63	8.96	.10
Oxidized Siltstone Mill Ore					
PL91-14 495-585	MW-7	54.5	3.44	8.45	6.31

TABLE 4.4-1

SUMMARY OF ACID BASE ACCOUNTING RESULTS
(Page 2 of 2)

Sample	MWMP Composite	GNP 5/1000t	MPA t/1000t	Paste pH	MPA/GNP %
Oxidized/Carbonaceous Siltstone Ore					
PL91-2 730-800		149	.63	8.82	.42
PL91-16 585-655	MW-9	460	13.8	8.88	3.00
DP-23 710-760	M-10	647	10.9	8.39	1.68
Carbonaceous Siltstone Waste					
DP-23 740-840		625	3.13	9.01	.50
DP-44 200-300		551	.63	8.8	.11
DP-43 720-820	MW-11	325	18.1	8.35	5.57
DP-25 460-560		228	3.44	8.52	1.51
DP-6 750-850	MW-8	420	10.3	8.62	2.45

Notes: MWMP = meteoric water mobility procedure.
GNP = gross neutralization potential.
MPA = maximum potential acidity.

TABLE 4.9-1

COMBINED CORTEZ AND PIPELINE PROJECT MANPOWER LOADING

Year	Cortez	Pipeline Construction	Pipeline Operations	Total	Comment
1993	195	—	9	204	
1994	195	185	181	561	
1995	122	—	282	404	Pipeline in Production
1996	74	—	269	343	Cortez Operations Cease
1997			274	274	
1998			272	272	
1999			266	266	
2000			261	261	
2001			257	257	
2002			215	215	
2003			301	301	Process Pipeline Roast Ore
2004			210	210	
2005			208	208	
2006			119	119	Pipeline Milling Complete
2007			6	6	
2008			6	6	

TABLE 4.9-2

PROJECT EMPLOYMENT IMPACTS

Year	Construction Direct	Construction Indirect	Operations Direct	Operations Indirect	Total Direct	Total Indirect	Net New Jobs[a]
1993			9	7	9	7	16
1994	185	37	181	134	366	171	537
1995			282	209	282	209	364
1996			269	199	269	199	384
1997			274	203	274	203	348
Average Long-run			70[b]	52	70	52	142

[a] Net new jobs refer to direct and indirect jobs minus the current Cortez jobs (which would be phased out over 1995-1997) and existing indirect job supported by the current employment at Cortez.

[b] Net new direct jobs at Cortez (265 new jobs minus 195 existing jobs at Cortez which will be phased out).

TABLE 4.9-3

LOCAL EMPLOYMENT IMPACTS

Year	Construction		Operations	
	Local	Non-local	Local	Non-local
1993	-	-	9	-
1994	20	165	145	36
1995	-	-	225	57
1996	-	-	215	54
1997	-	-	219	55
1998	-	-	-	-
Average Operation (265)	-	-	212	53
Peak Operation (300)	-	-	240	60

Note: Based on the assumption that 80 percent of operations employees would be local; table represents the scenario that the construction contractor is non-local.

TABLE 4.9-4

POPULATION CHANGES RELATED TO THE PROPOSED ACTION

Year	Non-Local Workers	Single	Married	Dependents (Lower Estimate)	Dependents (Upper Estimate)	Total Population (Lower Estimate)	Total Population (Upper Estimate)
CONSTRUCTION PHASE POPULATION CHANGES							
1994	165	132	33	83	132	248	297
CONSTRUCTION PLUS OPERATIONS POPULATION CHANGES							
1994	201	141	60	165	240	366	441
OPERATIONS PHASE POPULATION CHANGES							
1994 Workforce (181)	36	9	27	73	108	109	144
Average Workforce (265)	53	13	40	122	160	175	213
Peak Workforce (300)	60	15	45	136	180	196	240

Note: Based on assumptions noted in Section 4.9.2.

TABLE 4.9-5

CONSTRUCTION PLUS OPERATIONS POPULATION CHANGES IN 1994 BY COMMUNITY

Community	Non-Local Construction Workers (185) and Dependents[a]	Non-Local Operations Workers (36) and Dependents (Lower Estimate)[b]	Non-Local Operations Workers (36) and Dependents (Upper Estimate)	Total Increase (Lower Estimate)	Total Increase (Upper Estimate)
Elko	162	40	60	202	222
Carlin	17	21	27	35	44
Battle Mountain	50	9	12	59	62
Crescent Valley	11	35	40	46	51
Beowawe	8	4	5	12	13
	248	109	144	354	392

[a]Distribution based on gravity model results.
[b]Distribution based on current Cortez employee residence pattern.

TABLE 4.9-6

LONG-RUN POPULATION CHANGES BY COMMUNITIES (DIRECT IMPACTS ONLY)

Community	No. of Non-Local Workers[a]	Workers and Dependents (Lower Estimate)	Workers and Dependents (Upper Estimate)	Modelled No. of Non-Local Workers[b]	Workers and Dependents (Lower Estimate)	Workers and Dependents (Upper Estimate)
Elko	23	75	91	29	97	117
Carlin	9	30	37	7	22	27
Battle Mountain	4	13	16	9	30	37
Crescent Valley	16	53	64	5	17	21
Beowawe	1	4	5	3	9	11
	53	175	213	53	175	213

[a] Based on current Cortez employee residence pattern.

[b] Based on potential residence pattern using gravity model (see Appendix F for details).

TABLE 4.9-7

HOUSING IMPACTS

Community	Housing Units Needed Construction Phase (1994)	Operations 1994[a]	Operations 1995-2008[a]
Elko	107 (81)[b]	15	23
Carlin	17 (17)	7	9
Battle Mountain	29 (22)	3	4
Crescent Valley	7 (7)	10	16
Beowawe	5 (5)	1	1
	165 (132)	36	53

[a] Based on current Cortez employee residence pattern.

[b] Numbers reported in parentheses are the number of units for single workers.

TABLE 4.9-8

ESTIMATED NUMBER OF SCHOOL-AGED CHILDREN BY COMMUNITY

		1995-2006[b]	
Community	1994[a]	Lower Estimate	Upper Estimate
Elko	36	24	44
Carlin	5	10	18
Battle Mountain	10	4	8
Crescent Valley	8	17	31
Beowawe	1	1	3
	60	56	104

[a1] Includes school-aged children from construction worker and permanent employee households.

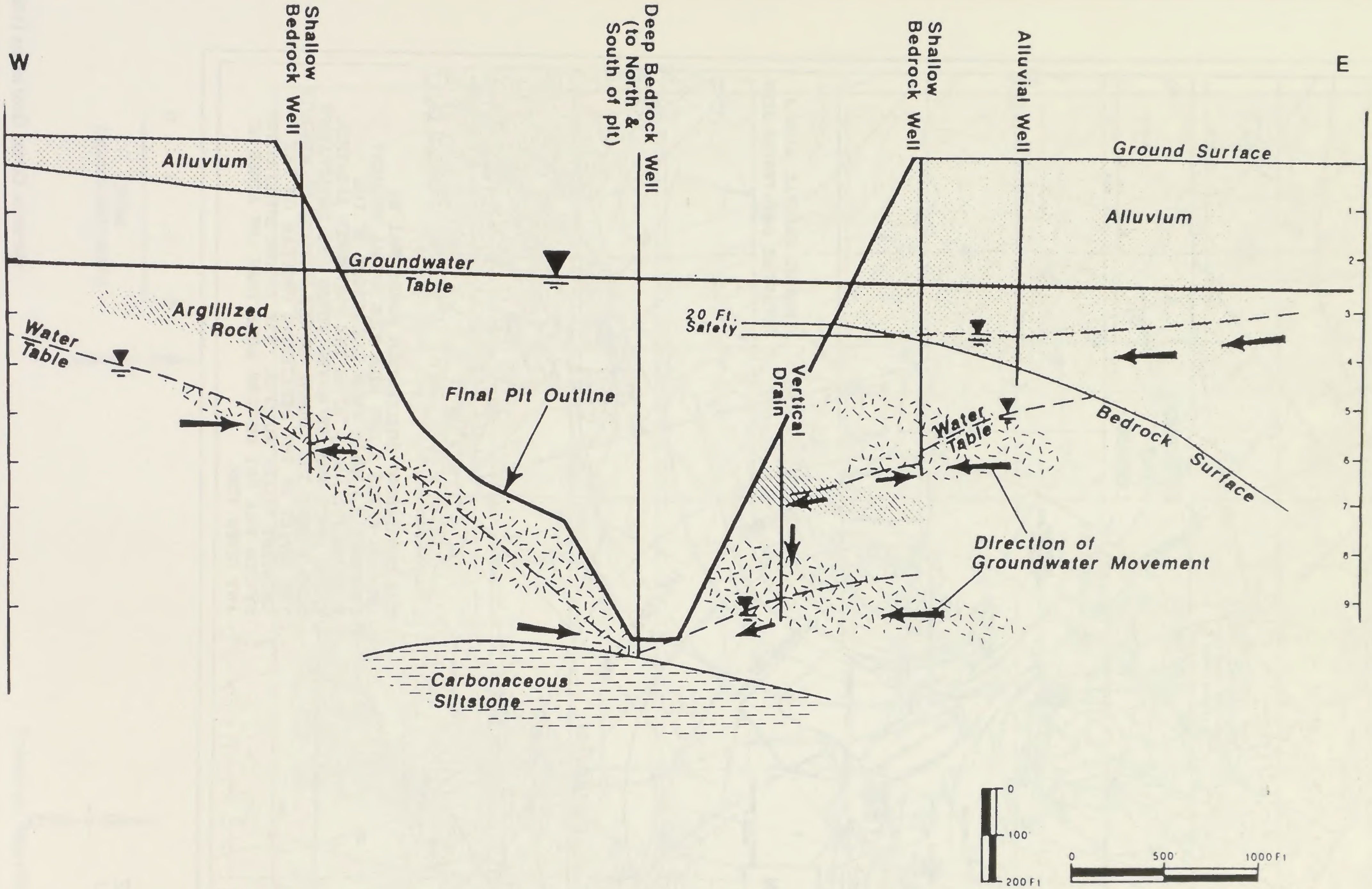
[b] Distribution based on current Cortez employee residence patterns.

TABLE 4.9-9

ESTIMATED ANNUAL TAXES

Tax	Amount ($)
County Property Tax	1,300,000
Nevada State Taxes	
- Net Proceeds Tax	2,500,000
- Sales Tax	250,000
- Business License Tax	30,000
State and Federal Payroll Taxes	1,100,000

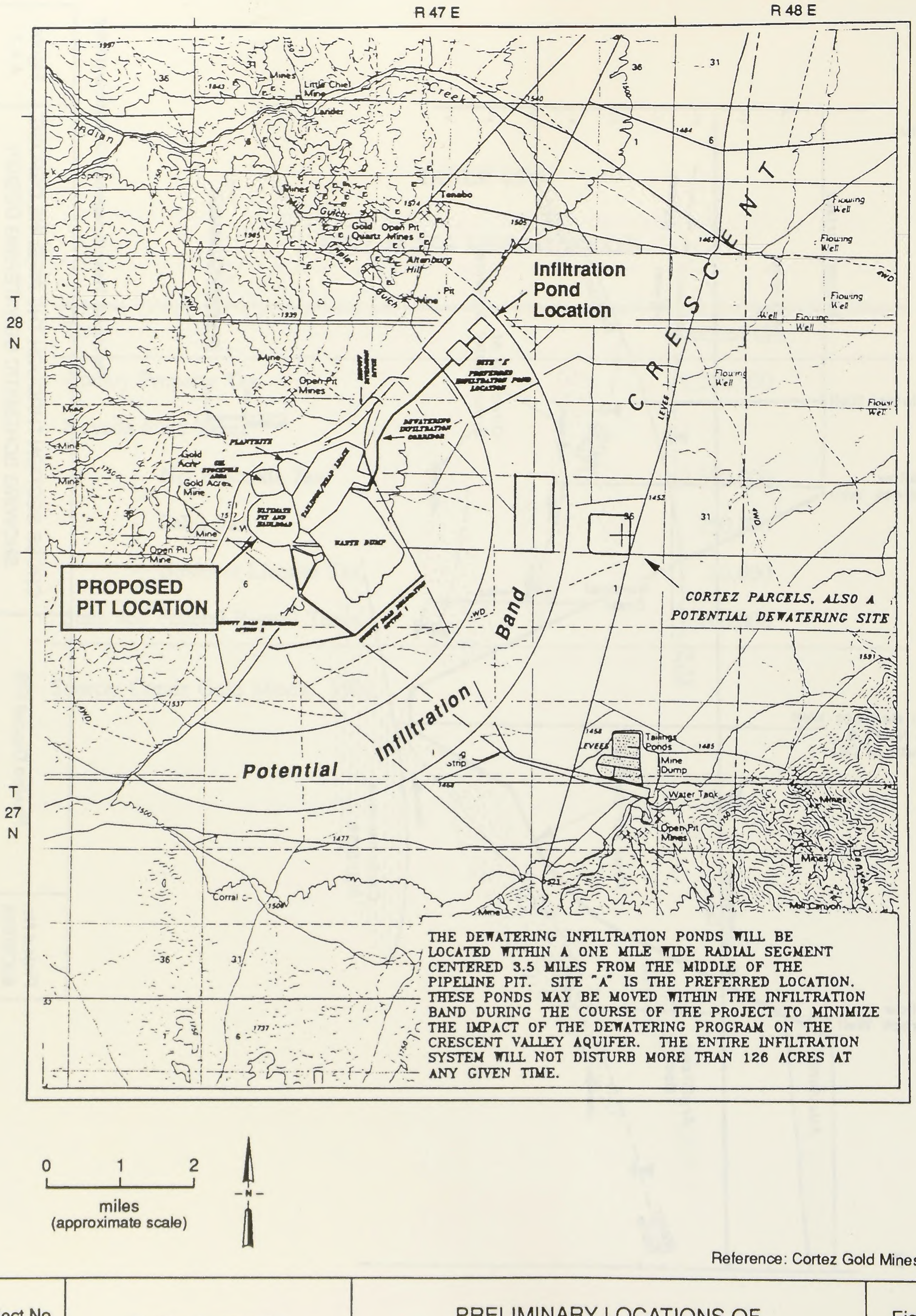
Source: Cortez Gold Mines. 1993.



Reference: Water Management Consultants (1992a)

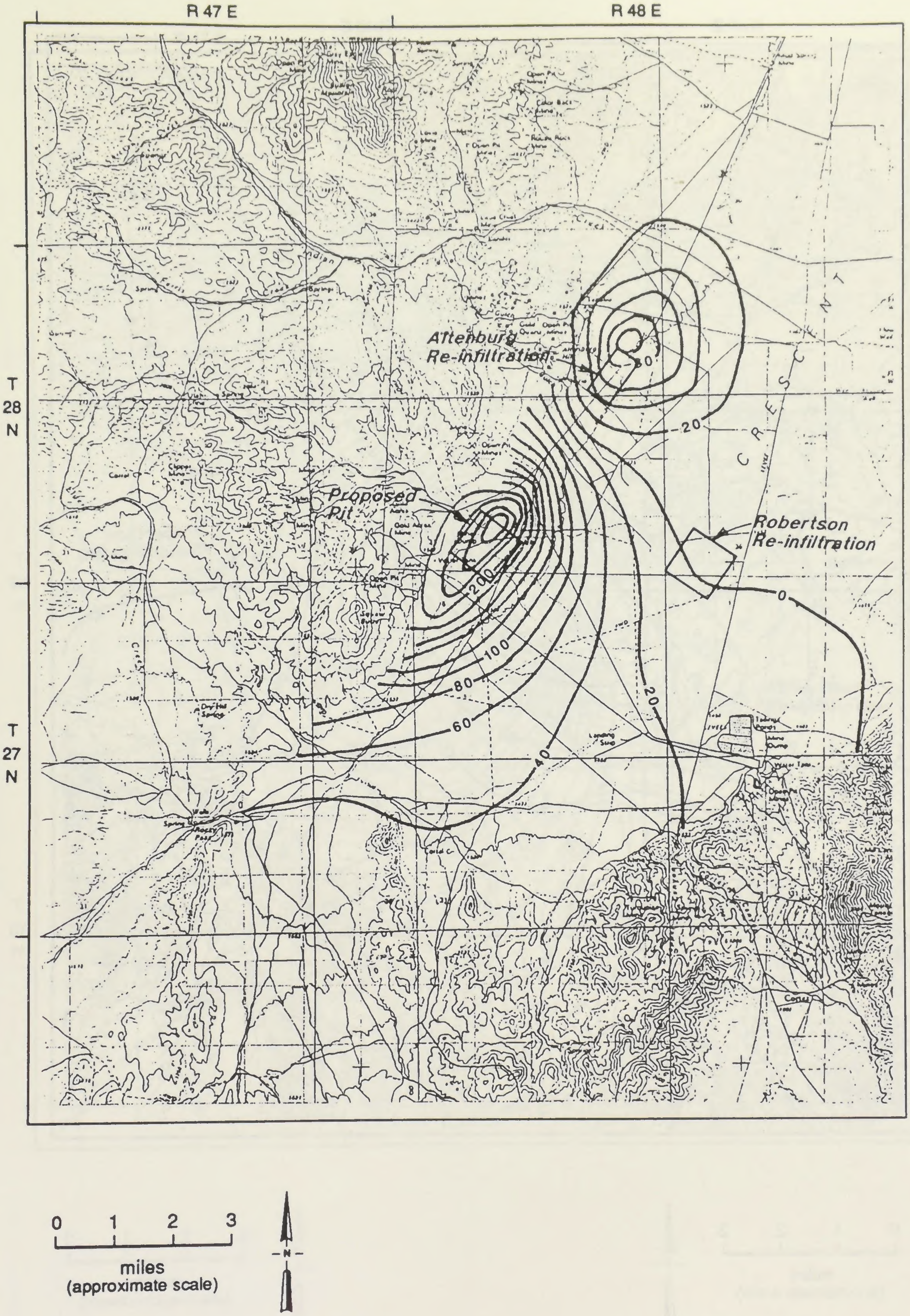
Project No. 92C0756A	Pipeline Deposit EIS	CROSS-SECTION THROUGH THE PIPELINE DEPOSIT SHOWING SCHEMATIC DEWATERING DESIGN	Figure 4.4-1

92C0756A-0010/032693



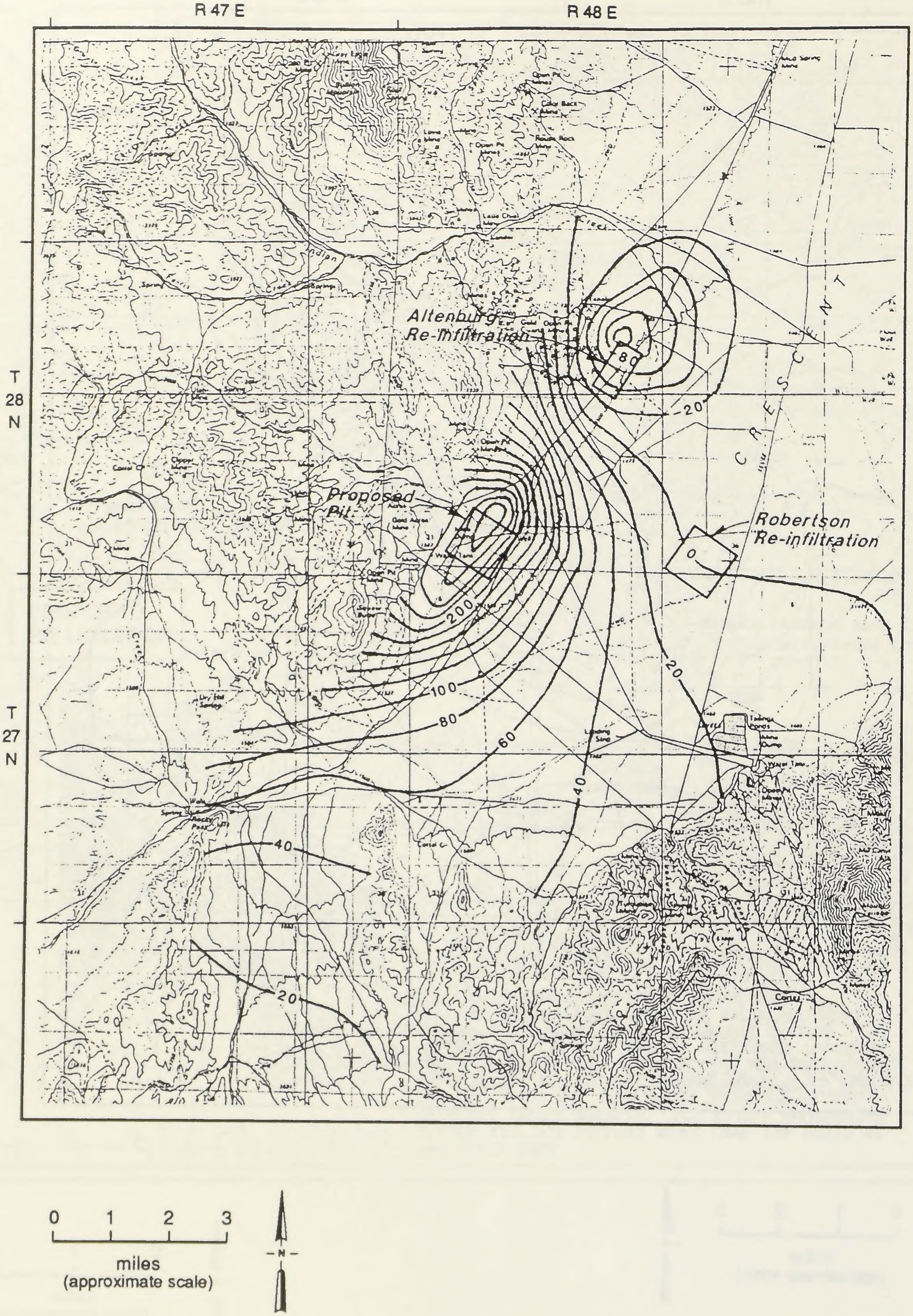
Reference: Cortez Gold Mines (1993)

Project No. 92C0756A	Pipeline Deposit EIS	PRELIMINARY LOCATIONS OF REINFILTRATION BASINS	Figure 4.4-2



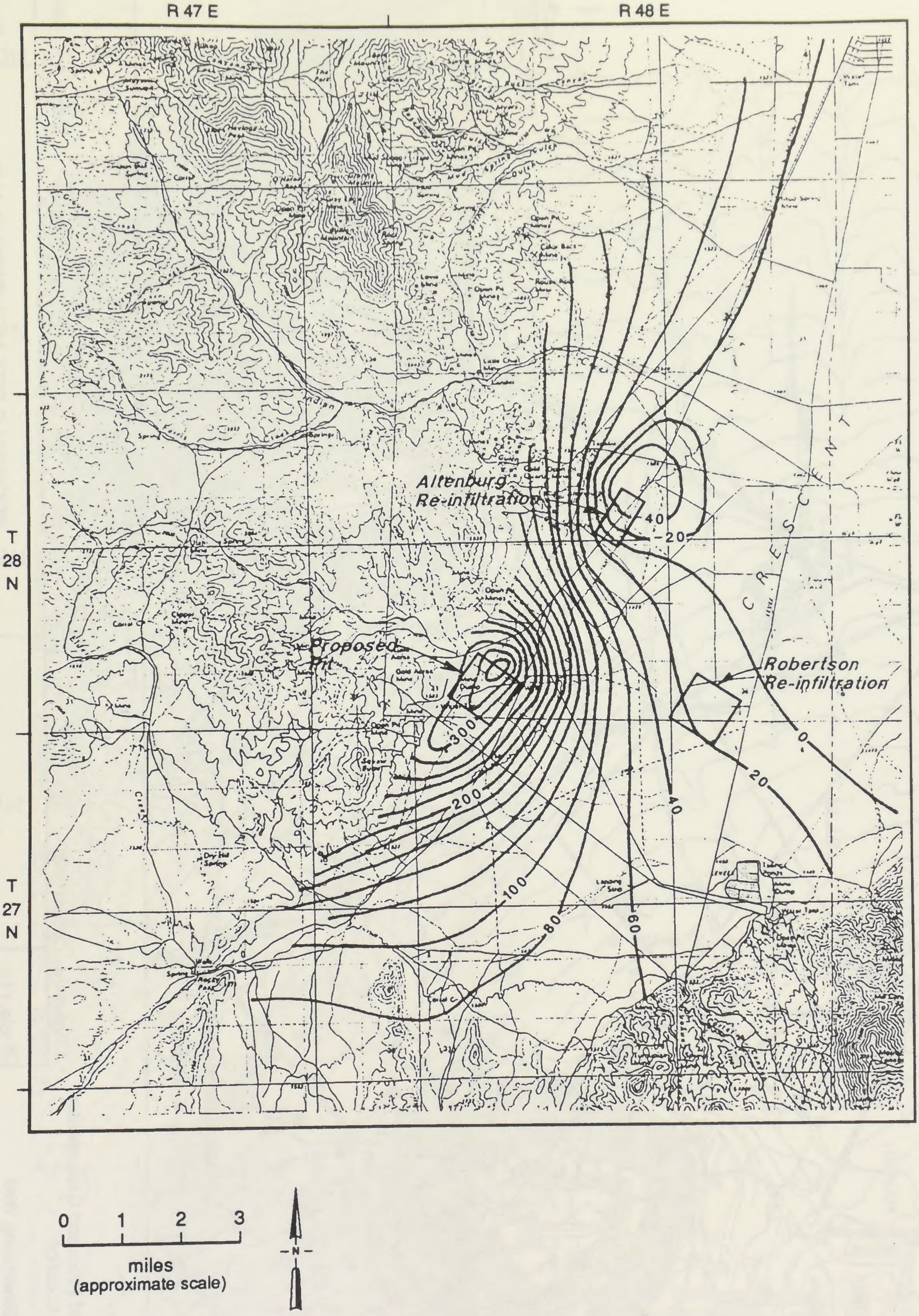
Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	ESTIMATED EXTENT OF DRAWDOWN USING 25,600 GPM PIT DEWATERING WITH REINFILTRATION	Figure 4.4-3



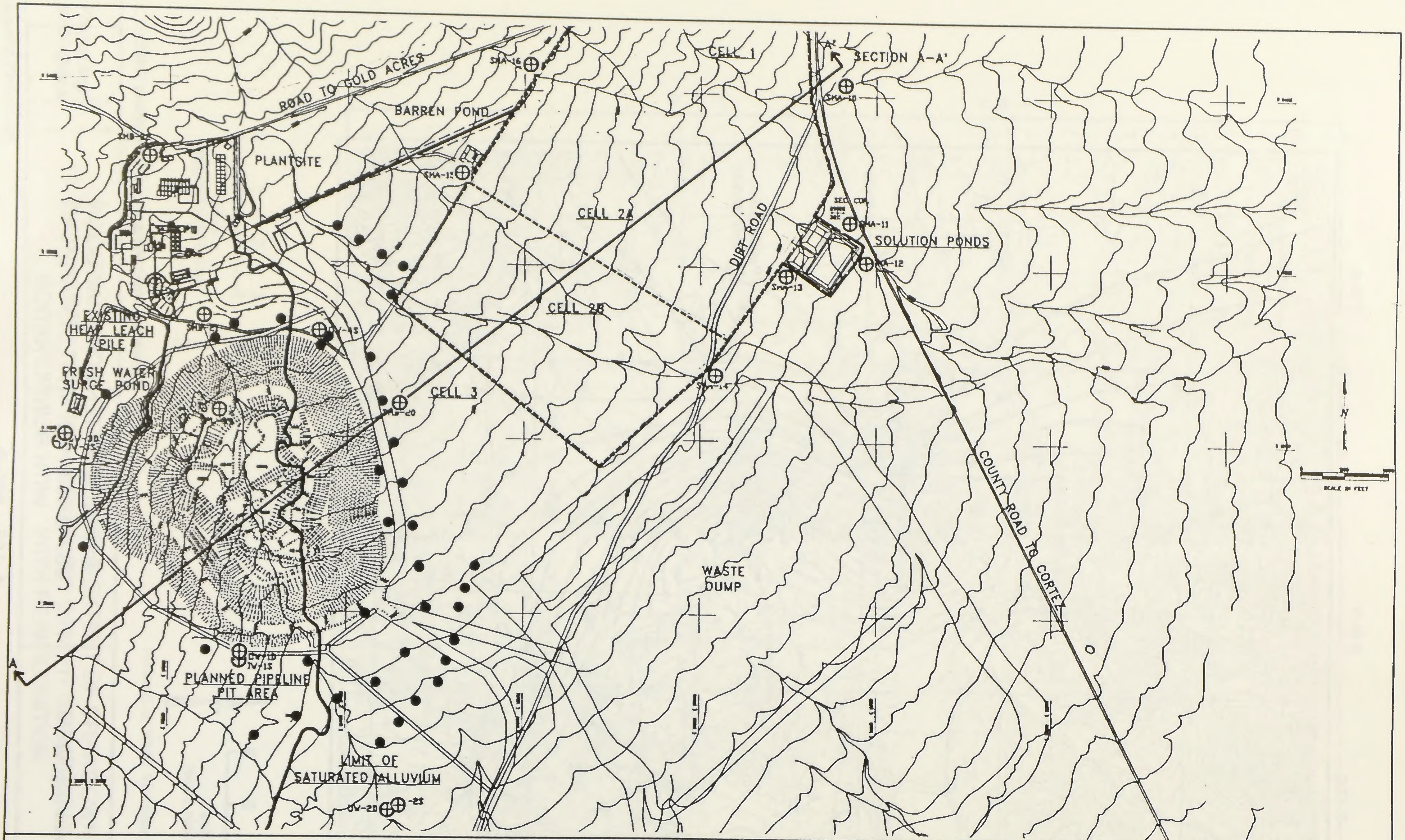
Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	ESTIMATED EXTENT OF DRAWDOWN USING 32,700 GPM PIT DEWATERING WITH REINFILTRATION	Figure 4.4-4



Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	ESTIMATED EXTENT OF DRAWDOWN USING 56,500 GPM PIT DEWATERING WITH REINFILTRATION	Figure 4.4-5



LEGEND

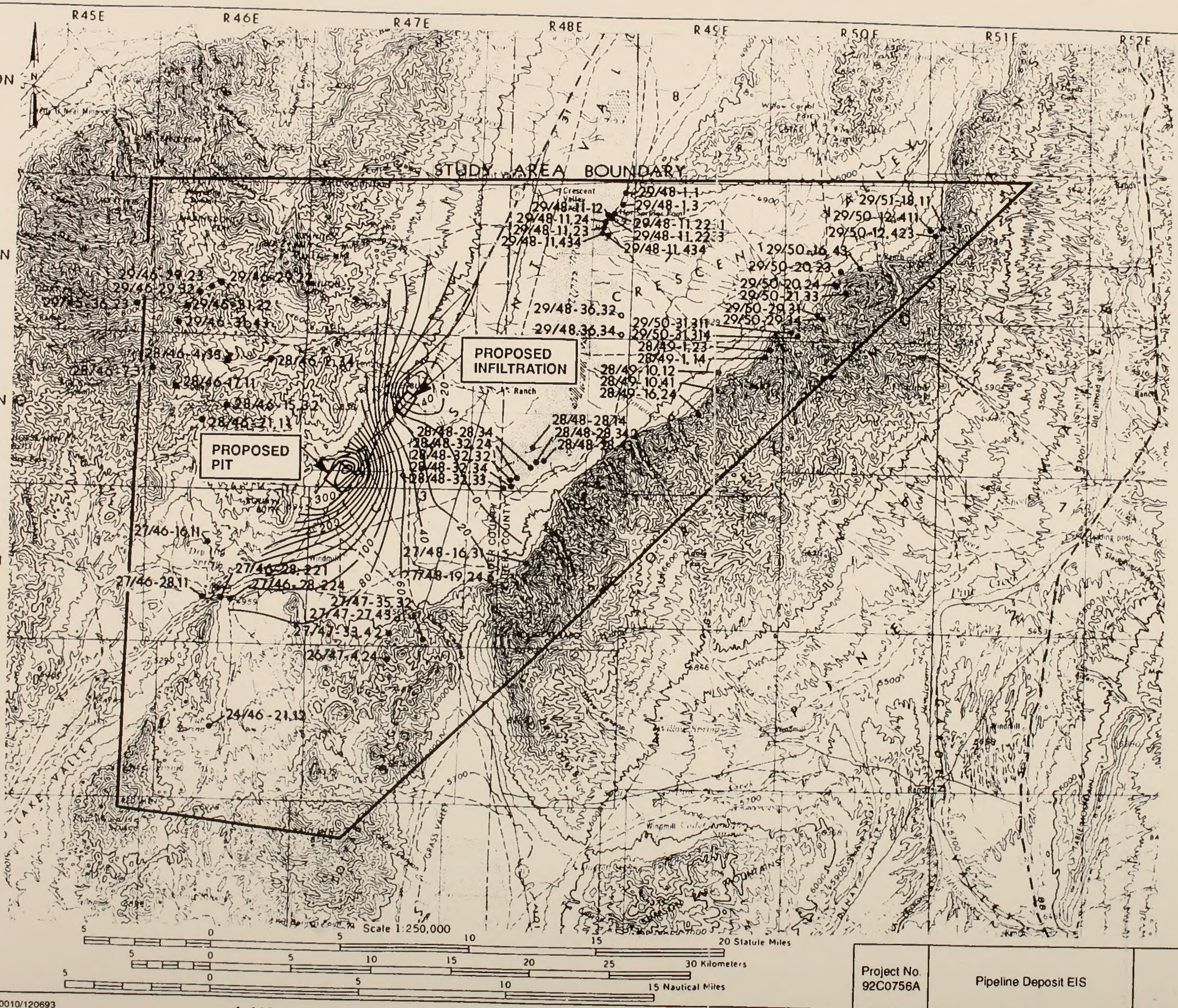
⊕ Existing and Proposed Groundwater Monitoring Location

● Proposed Dewatering Well Locations

Reference: Cortez (1993)

Project No. 92C0756A	Pipeline Deposit EIS	PROPOSED SITE MONITORING AND DEWATERING WELL LOCATIONS	Figure 4.4-6

92C0756A-0010/051793



LEGEND

● 27/48-16, 35 Seep or Spring location and identification

Drawdown contour lines

Reference: Base map from 1:250,000 scale USGS map of Winnemucca, Nevada #NK 11-11.

Note: This map shows springs that have potential to be affected by drawdown.

Project No. 92C0756A	Pipeline Deposit EIS	SEEP AND SPRING LOCATIONS	Figure 4.4-7

92C0756A-0010/120693

5.0 CUMULATIVE IMPACTS

Cumulative impacts are defined as the sum of all past, present, and reasonably foreseeable future impacts resulting primarily from mining and grazing operations. The purpose of the cumulative analysis in this EIS is to evaluate the significance of the contributions to cumulative impacts from the Proposed Action. The cumulative analysis was accomplished in a three-step process:

- Step 1 - Identify study areas for each resource evaluated.
- Step 2 - Define time frames, scenarios, and acreage estimates for cumulative impact analysis. Past and existing disturbances include mining operations with disturbed areas not reclaimed or unsatisfactorily reclaimed. Future scenarios address reasonably foreseeable mining operations identified in Notices of Intent, Plans of Operations, or best judgement based on recent mineral exploration history. Future grazing operations are based on assumptions and goals in Rangeland Program Summaries (RMP).
- Step 3 - Identify and quantify the location of possible project-specific impacts from the Proposed Action and judge the significance of these contributions to the overall impacts.

5.1 STEP 1 - CUMULATIVE IMPACT STUDY AREA

Individual study areas were identified in Section 3.0 for each resource area to include the region where direct, indirect, and cumulative impacts could occur. These study areas vary in size depending on the anticipated impact region for a given resource. For most of the physical and natural resources, e.g., air quality, water quality, geology, soils, cultural resources, vegetation, wildlife, land use, and livestock grazing, the study area is very similar. In general, these resources were evaluated for an area bounded by the Shoshone Range to the west, Cortez Range to the east, the town of Crescent Valley to the north and the north Toiyabe Range to the south. This general region is the area within which past, present and future development disturbances were evaluated for the cumulative impacts assessment of surface disturbance. This collective region is referred to in this section as the study area. This study area also gives the regional context from which to evaluate the incremental impacts of the proposed project.

For other resources, such as socioeconomics, visual resources and recreation, study areas described in Section 3.0 and used in this section for cumulative impact assessments represent a much larger region that includes consideration of communities and viewpoints that could be impacted.

For the purposes of developing the reasonably foreseeable future development scenario, the BLM assumed a cutoff date of January 1, 1993. This was necessary to finalize the cumulative impact analysis. Plans of Operations filed with either the BLM district office after that date (for the study area) are not considered in this analysis.

5.2 STEP 2 - EVALUATION OF PAST, PRESENT AND FUTURE DISTURBANCE

5.2.1 Historical and Existing Disturbances

The past disturbances have been associated primarily with livestock grazing and mining. The entire study area has been extensively utilized for past and ongoing livestock grazing. Native plant communities have been altered by this long-term grazing activity. In addition, relatively small acreages has been disturbed for water developments and fencing. Much of the disturbance has been colonized naturally by native and exotic vegetation.

The older mining disturbances were generally small acreages as mining was confined mostly to vein-type deposits. The exception is Gold Acres, which was one of the first large-scale gold mining operations that used leaching to retrieve the gold from low grade ore. The more recent mine activities in the 1980s and 1990s have been large scale mining operations for low grade deposits.

A summary of historic and more recent mining disturbances have been separated into old operations and newer operations. The old operations were generally those from the 1800s to the 1950s. The newer operations were from the 1950s to present but most of the acreage was disturbed in the late 1970s and through the 1980s. Estimated acreage for these disturbances is shown in Table 5.2-1. Estimates of disturbance of old operations are based on the assumptions and methodology described in Section 5.3.11 for cultural resource cumulative impacts. The acreage for newer operations was taken from PoO and NOIs filed with the BLM.

Cortez Mining District

The older operations in this historical silver mining district had disturbed 92 acres. An additional 50 acres have been disturbed by recent operations; 42 acres as seismic lines, 7 acres as roads and one acre as additional tailings.

Gold Acres

The older 1930s operations through 1950 had disturbed 450 acres consisting of roads, pits, tailings and the community of Gold Acres. Currently mining disturbance has disturbed a total of 881 acres, 431 acres in addition to the old disturbances. The community no longer exists due to mining activities on patent lands.

Lander

An older mining site with about 4 acres of disturbance.

Utah Mine and Utah Camp

An older mining site on the west edge of the study area. About 6 acres of disturbance when all the surrounding small sites are taken into consideration. The Utah Camp site is almost revegetated.

Tenabo

An older mining site and community with about 6 acres of disturbance. No new disturbances at the site.

Gold Quartz

Another older mining site with a small residential area. Past disturbances total of 6 acres with an additional 150 acres of disturbances from more recent mining activity.

Mill Canyon

The Mill Canyon disturbances of 17 acres occurred prior to 1950 and still exist today. One acre of new disturbance due to mineral exploration occurred in 1988 under permit.

Cortez Mine

A large operating gold mine that began in 1969 and has continued to add facilities and expand to the present day. The current disturbance is 858 acres of pits, dumps, roads, mill, leach pads and tailings pond. The newly permitted expansion will disturb an additional 428 acres for a total of 1286 acres.

Mud Spring Gulch

The area encompasses all the adits and small open pits in the Bullion Mountain - Mud Spring Gulch area. There is approximately 7 small mines and 7 small open pits.

Indian Creek

A mineral exploration project by Newmont Exploration Limited in the south Shoshone Range. There are 25.6 acres of disturbance in roads and pads.

Robertson - Triplet Gulch

The Robertson is a small open pit gold mine north of Gold Acres in the Shoshone Range. Disturbance is estimated at 100 acres. The Triplet Gulch is another small open pit gold mine operated by Coral Resources Inc. adjacent to the Robertson. The disturbance is estimated at 129 acres.

Grey Eagle

A small underground gold mine with a leach operation in the Shoshone Range. The disturbance is less than 5 acres.

Greystone

Another barite operation located on the west boundary of the study area in the Shoshone Range. The barite is still shipped from the stockpiles; otherwise the mine is inactive. The disturbance covers at least 500 acres.

Clipper

A barite operation located in the study area is the IMCO Service's Clipper Mine, located west of Gold Acres in the Shoshone Range, continues to supply barite from stockpiles which were mined during the last decade. The Clipper Mine covers 400 acres.

Hot Springs Sulfur Mine

An open pit mine near Hot Springs Point in Crescent Valley east of the town of Crescent Valley. The disturbance consists of roads, pits, dumps, and trenches. The mine is currently inactive but no reclamation has occurred to date.

Fox Mine

A turquoise mine located in the extreme northern portion of the Toiyabe Range. The surface disturbance is 4 acres.

Exploration Projects

The major existing mineral exploration drilling projects include Newmont's Indian Creek - 26 acres, Cominco American's Cottonwood/Brock canyons - 20 acres, and Santa Fe Pacific's Mill Canyon - 250 acres (Table 5.2-1). Miscellaneous exploration disturbances includes 90

NOIs in the Battle Mountain BLM District for 450 acres and 15 NOIs in the Elko BLM District for 75 acres. The disturbance consists of roadbuilding and drill pad construction.

5.2.2 Reasonably Foreseeable Future Development Scenarios for Mining

The Cortez Gold Mine properties are situated along well-defined mineral trends. The Battle Mountain/Eureka trends, as it is referred to in the mining literature, has a history of precious metals production, including major gold and silver mines. Given this background, coupled with an increase in mineral applications (both mining development and mineral exploration) in and around the Cortez-Gold Acres area, it could be assumed that surface disturbing activities associated with mineral exploration and mine development will continue at the same rate they have for the last 5 to 10 years. This scenario is very likely since it follows the norm with respect to the nature of mineralized formation structure such as in the Shoshone, Cortez and Toiyabe mountain ranges and intervening valleys.

For the purposes of analyzing cumulative impacts, the BLM has defined the "reasonably foreseeable future" as the project life (i.e., 12 years for the Pipeline Project Plan of Operations) plus an estimate of the time needed for successful reclamation; in this case that is assumed to be 3 years. This equates to a total of 15 years for the "reasonably foreseeable future" scenario.

For the purposes of developing the reasonably foreseeable future development scenario, the BLM assumed a cut-off date of January 1, 1993. This was necessary to finalize the cumulative impact analysis. Plans of Operations filed with either BLM district after that date (for the study area) are not considered in this analysis.

For the purpose of identifying cumulative environmental impacts as a result of mining activities in the study area, the BLM has hypothesized the following scenarios as the most likely to occur in the foreseeable future.

<u>**Exploration**</u>

Exploration disturbance will consist of construction of drill access roads and drill pads.

The Cortez Mountain Range, outside of Cortez's claim block, will average approximately 10 acres per year of surface disturbance due to continued mineral exploration; or 150 acres over the foreseeable future scenario.

The north Toiyabe Range, outside of Cortez's claim block, will experience limited exploration drilling. For the purposes of this analysis, the BLM will assume that 5 acres of surface disturbance in the northern part of the Toiyabe Range will occur per year, for a total of 75 acres for the foreseeable future scenario.

The Cortez Gold Mine expects to perform limited exploration over the life of the project. For the purposes of this analysis, the BLM will assume 2 acres total of exploration surface disturbance in the Cortez claim block, for a total of 30 acres for the foreseeable future scenario.

The Shoshone Range will likely experience the most exploration disturbance during this period. The BLM estimates that an average of 50 acres of exploration disturbance per year (for a total of 750 acres of exploration disturbance in the reasonably foreseeable future) will occur over the mountain range from that area known as the Cedars to the northern most extension of the range.

Mine Expansion

The Cortez 1990 Plan of Operations provides sufficient detail to explain the mine expansion anticipated by the BLM to occur in the Cortez/North Toiyabe Ranges in the reasonably foreseeable future. The direct and indirect impact from this mine expansion Plan of Operations amendment are addressed in the "Environmental Consequences" chapter.

Certain deposits that are of interest to Cortez are in the exploration or early development stage and the extent and type of mineralization has not been fully determined. Information needed to develop a distinct mine plan is unavailable. However, using the current data base, a preliminary estimate of the impact (with respect to size) can be made based on engineering and geological experience. The estimated acreages that would be disturbed by these reasonable foreseeable projects are summarized in Table 5.2-2. In addition, other reasonably foreseeable projects (not sponsored by the applicant) have been identified in the cumulative impact study area. These are also identified in Table 5.2-2 as the basis for the cumulative impact assessment.

Cortez Area.

West Pixie. Mining activities in the Cortez Canyon area, known as West Pixie, would consist of developing a new open pit and two new waste rock dump areas. The West Pixie Pit is located west of Cortez Canyon. The preliminary minable reserve of this deposit is 343,000 tons of ore, with a 5.3:1 (overburden:ore) stripping ratio.

The West Pixie waste rock dump areas would be located immediately north and southeast of the West Pixie Pit. Approximately 16,200 feet of new haul road would be required to transport ore from the West Pixie Pit to the Cortez milling and heap leach facilities. The ore haul route to the Cortez facilities is planned to utilize the Cortez Canyon county road, pending approval from Lander County. this could involve using tractor/trailer units for the ore haul. Approximately 6,800 feet of haul road would be constructed from the pit to the county road, and another 9,400 feet of haul road would be built across the Crescent Valley pediment for the final haul to the facilities. The entire new haul road would disturb 30 additional acres. Total estimated disturbed acreage including reclamation would be approximately 145 acres.

Cortez Pit Area. Mining operations in the Cortez Pit area would consist of pushing back existing pits and developing new areas. The proven reserves are not yet fully determined in this area. However, it is reasonably certain once development of the reserves was completed, the deposits would be minable, including those below the current water table. The ore mined in this area is generally oxidized and would be treated by either the mill or heap leaching facilities located at the Cortez mill site. The waste rock dump areas are located near the range front. Existing haul roads would be used whenever possible. Historical dewatering of the cortez Pit was at the rate of approximately 2,000 to 3,000 gallons per minute. Total estimated disturbed acreage including reclamation would be approximately 359 acres.

Mill Canyon Tailings. Mining activities in this area would consist of removing tailings from an historic mining operation northwest of Mill Canyon. The ore would be hauled to the

Cortez mill site for processing. Total estimated disturbed acreage including reclamation is approximately 33 acres.

<u>Gold Acres Area</u>.

<u>Golden Zone</u>. Mining activities around the Golden Zone would consist of development of a new open pit and waste rock dump area. Mill ore would be hauled to the Cortez mill on the existing Gold Acres haul road. Leach ore is planned for processing at the Gold Acres heap leach facility. Total estimated disturbed acreage including reclamation would be approximately 110 acres.

<u>North London Extension</u>. The North London Extension would include the development of a new open pit and waste rock dump area located north of the London extension pit. The reserve contains mixed carbonaceous/oxide material.

The waste rock dump areas are planned to the north and east of the pit area. Ore would be hauled either to the Gold acres heap leach facilities or to the Cortez mill facilities. Total estimated disturbed acreage including reclamation would be approximately 118 acres.

<u>Low-Grade Ore Stockpiles</u>. Low-grade ore stockpiles located over the existing dump areas and tailings located in the valley floor would be processed at the Gold Acres or Cortez new heap leaching facilities. Existing roads or routes through previously disturbed areas would be utilized wherever possible.

The Gold Acres area currently has heap leach ore stockpiled, and heap leach ore that can be economically mined. With the development of a heap leaching facility for the Proposed Action, the processing of heap leach ore at the Proposed Action facilities from Gold Acres looks very attractive. Additional disturbance would involve road construction and leach pad expansion. The amount of disturbance has not been estimated at this time.

<u>South Expansion</u>. Significant mining operations are foreseeable to the southeast of the proposed Pipeline Pit. These operations would include an open pit mine expansion, a tailing and a waste dump expansion, and a continuing mine dewatering program. Potential distur-

bance boundaries are shown on the map in Figure 5.2-1. A total disturbance of approximately 1,734 acres is expected (Table 5.2-2).

Mining of the South Pipeline Expansion would include either a single open pit mine with the footprint as given in Figure 5.2-1, disturbing approximately 233 acres, or a smaller open pit mine operated concurrently with an underground mining operation. Waste material removed during mining would be placed in both an expansion to the Proposed Action waste dump and a new waste dump located to the southeast of South Pipeline Pit, as shown in Figure 5.2-1. These dumps would disturb approximately 969 acres.

There are several possible processing scenarios for the South Pipeline Expansion ore. The South Pipeline ore could be hauled to the existing Cortez milling facility and processed there, or the ore could be processed in the new Pipeline mill, or possibly the ore could supplement production at both facilities. Finally, depending on economics, it is possible that a new milling facility could be built specifically for the South Pipeline ore.

Tailing facilities will have to be built wherever the ore is to be processed. Figure 5.2-1 shows the approximate size of a tailing facility and the most likely expansion area for the Pipeline mill tailing pond. The proposed South Pipeline tailing facility would disturb approximately 532 acres.

The BLM does not anticipate any other mine expansions in the Cortez/North Toiyabe or Shoshone Mountain Ranges during this period.

Mine Development

The BLM anticipates the development of two new mines in the Shoshone Range in the foreseeable future (Table 5.2-2). The development of these two projects will begin in early 1992 with various phases of discovery, construction, operation and concurrent reclamation occurring through the 15-year reasonably foreseeable future period.

Small Mine Scenario. Cortez has recently submitted a POO for a 320-acre development of the Crescent Pit just east of the Gold Acres facility and just south of the Pipeline Pit area.

The 320 acres of disturbance at the Crescent Pit would include 281.4 acres of new disturbance detailed below:

• Waste rock storage	113.7 acres
• Open pit (including perimeter berm	53.5 acres
• Public road relocation	17.2 acres
• Haul roads	7.9 acres
• Runoff diversion structure	13.4 acres
• Light-vehicle access roads	8.9 acres
• Gold Acres haul road expansion	40.6 acres
• Topsoil stockpile	14.5 acres
• Heap leach ore stockpiles	8.1 acres
• Utilities	3.6 acres

The remaining acreage required consists of already disturbed lands — i.e., Gold Acres haul road and County Road 225.

The Crescent Pit would be constructed prior to construction of the pit for the Proposed Action and would utilize the construction force and mine employees that would have been scheduled for the Proposed Action. Since no mill is involved with the Crescent Pit, the work force will be about 50 percent of those projected for the Proposed Action. The construction force is expected to peak at 175 employees, with the additional work force estimated to be about 75 employees.

- For analysis as a RFP, it is assumed that all acreage would be disturbed concurrently. The BLM assumes an average concurrent reclamation rate of 5 percent of the total disturbance per year.

- Construction and permanent workforce will be drawn from the existing Cortez workforce.

- It will use approximately 400 gpm (650 acre feet of water per year) from a well gallons per minute.

- Low grade ores would be heap leached at Gold Acres and mill grade ore would be processed at the Cortez CIL plant.

- It will likely see its full cycle (development, reclamation, and closure) occur within a 5-year reasonably foreseeable future scenario.

<u>Large Mine Scenario</u>. The second mine is anticipated to be a relatively large mine (approximately 4,000 acres). The large mine would begin construction in the period 1995-1998 and continue operations for 15 years.

- Disturbance will average 1,500 acres at any one time, with an average concurrent reclamation rate of 5 percent of the surface disturbance per year. Total disturbance over the life of the mine could include 4,000 acres.

- The construction force will be approximately 300 employees for the first 3 years, constructing ancillary facilities, performing initial stripping, etc.

- It will employ a permanent work force of 250 workers.

- It will be mining and processing sulfide ore deposits.

- A large, deep pit of approximately 800 to 1,000 feet deep will be excavated.

- The mine will use 1,600 acre-feet (1,000 gallons per minute) of water per year.

- Processing of sulphide ores will require a pre-treatment circuit using an autoclave. The use of this device may contribute to air quality degradation.

5.2.3 Reasonably Foreseeable Future Development Scenarios for Rangeland Management

Following are the reasonably foreseeable future scenarios for the three major types of rangeland consumers (grazers and browsers) in the Pipeline Deposit EIS cumulative analysis study area. These are livestock, wildlife and wild horses. Land Use Plan (LUP) objectives as identified in the Shoshone-Eureka and Elko Rangeland Program Summaries (RPS) are identified as short-term (5 years or less) and long-term (5 years or longer). Objectives related to the upland and riparian vegetation are also included in this projection.

Livestock

For purposes of analysis, the following assumptions will be made based on the RPS for grazing and current trends for reasonably foreseeable future grazing scenarios (Table 5.2-3). These assumptions are provided such that future management actions that may contribute to cumulative impacts may be analyzed.

- Project life is 15 years
- Long-term goals stated in the RPS are 20-year goals.
- BLM intends to implement proposed projects/improvements.
- Since the RPS was approved in 1987, 70 percent of the proposed management improvements will have been completed by project end.
- Future funding and staffing considerations as well as the number 22 priority rating of the Carico Lake Allotment will affect feasibility of completion of 70 percent of the proposed livestock management projects/improvements within the specified time frame.

Carico Lake Allotment. Existing actual use in the Carico Lake Allotment is 27,171 cattle and sheep AUMs. Of the 28 "I" category allotments, the Carico Lake has a priority rating of 22 for completion of an allotment management plan (AMP). The long-term goal is to increase licensed grazing use to 30,892 AUMs, a 13.7 percent increase. If 70 percent of this goal is completed by project end, then licensed grazing use would be increased 2,605 AUMs.

The following range improvements are identified in the RPS:

- 12 spring developments
- 4 water wells
- 4 water reservoirs
- 20 miles of water pipeline
- 86 miles of fence
- 8 cattleguards
- 4,250 acres of seeding

The long-term vegetation and ecological condition and trend objectives for the allotment include:

- Improve 99,038 acres to good condition and 3,158 acres to excellent condition.

- Stop the downward trend of 114,826 acres and manage for upward trend on 110,808 acres.

Utilization objectives for the allotment are:

- To not exceed 50 percent on key species by seed dissemination and 60 percent by the end of the grazing year

- Utilization of key browse species will not exceed 50 percent in terrestrial big game habitat

<u>Argenta Allotment</u>. Existing actual use in the Argenta Allotment is 12,107 AUMs for cattle, sheep and horses. In the long term, an AMP is proposed to be completed. Since only a small amount of the allotment on the valley floor is within the study area, specific objectives for the allotment are not considered applicable to the cumulative effect.

<u>South Buckhorn Allotment</u>. Existing actual use in the South Buckhorn Allotment is 20,654 AUMs for livestock. The permitees are Dominek Pieretti - 3,774 AUMs, Daniel Russell - 5,355 AUMs, Slagowski Ranches - 2,142 AUMs, Maynard Alves - 6,563 AUMs, Mary Bailey and Sons - 1,260 AUMs, Dewey Dann Estate - 965 AUMs, and Lander County Development Corp. - 595 AUMs.

The long-term goal is to sustain 20,175 AUMS, a slight decrease of 2 percent. Also in the long term, an AMP is proposed to be completed. Currently there is no grazing system. Season of use is from April 16 to November 30 each year.

The following range improvements are identified in the RPS for the allotment within the long-term:

- 10 spring developments
- 8 water reservoirs
- 4 water wells
- 15 miles of pipeline
- 61 miles of fences
- 10 cattleguards
- 4 water storage tanks

The long-term vegetation and ecological condition and trend objectives for the allotment include:

- Improve ecological status on 1,495 acres from mid to late seral and 279 acres from late to potential natural community. Maintain or enhance the current forage condition on the non-native range.

Utilization objectives for the allotment are:

- Maintain or enhance native vegetation with utilization levels not to exceed 50 percent on the key species

Wildlife Objectives

Carico Lake Allotment. Wildlife management objectives in the Carico Lake Allotment are specifically defined in the Shoshone and Callaghan Habitat Management Plans (HMP) and the RPS. The objectives are considered for the Proposed Action study area.

The existing big game use is 1,241 AUMs. The long-term objective is to provide forage for 1,750 AUMs of big game use. The expected level of big game AUMs at project end would be an additional 509 AUMs.

Within the Shoshone HMP Area, the objective is to improve 26,678 acres of big game habitat to good and 851 acres to excellent condition. Another objective is to stop downward trends on 30,932 acres and manage for upward trends on 29,849 acres.

The long-term objectives within the Callaghan HMP Area are to improve 1,980 acres to good and 63 acres to excellent condition and to stop downward trends on 2,296 acres and manage for upward trends on 2,215 acres.

An overall objective is to manage rangeland habitats to maintain or enhance sage grouse leks and nesting areas.

Argenta Allotment. In the Argenta Allotment, a riparian management plan specifies improve for 2.0 miles of riparian/aquatic habitat on Indian Creek. The utilization of riparian habitat to be improved will not exceed 30 percent on key species.

South Buckhorn Allotment. Both short-term and long-term wildlife management objectives for the South Buckhorn Allotment are defined in the Elko Resource Management Plan, completed in 1987. The existing use by big game on the South Buckhorn Allotment is 864 AUMs, the long-term objective is to increase big game use to 2,058 AUMs. A general long-term objective is to maintain or improve all mule deer and antelope habitat to at least good condition.

Other long-term objectives are to manage rangeland habitat to protect or enhance crucial sage grouse leks and nesting areas. To improve and maintain meadow and riparian areas for mule deer and sage grouse. Utilization levels will not exceed 50 percent on these areas.

Big Game Habitat

Existing and reasonable levels of big game use are shown in Table 5.2-4. Distribution of important big game ranges are shown for the study area in Figure 3.6-1. Acres by ranges are summarized in Table 5.2-5. Results of habitat monitoring studies (4 in winter and 1 in summer range) are summarized in Table 5.2-6. Table 5.2-6 also shows the limiting factors which have been identified in these areas.

Sage Grouse Habitat

Four leks have been identified within the study area located in the Shoshone Range.

Stream and Riparian Habitat

Results of ocular stream surveys completed in 1980 indicate Brock Canyon has poor habitat conditions and Cottonwood Canyon Creek has good habitat conditions although poor livestock grazing practices were evident.

Surveys conducted in the Cortez Range in 1991 indicate all stream and riparian habitat conditions were poor. Generally; riparian vegetation is lacking, streambanks are cut and eroding, sedimentation levels are high, and streams are wide and shallow. Poor livestock grazing practices resulting in overuse of the riparian zone are the primary cause of poor habitat conditions along the streams in the study area. Survey results are summarized in Table 5.2-7.

Wild Horses

Portions of two wild horse herd management areas extend into the study area, although there are no wild horse populations in areas projected for disturbance.

5.3 STEP 3 - EVALUATE CONTRIBUTION OF CORTEZ IMPACTS TO CUMULATIVE IMPACTS

For each resource discussed below the contribution of impacts from the Proposed Action to cumulative impacts from past, present, and reasonably foreseeable future projects is evaluated. Impact significance criteria used for individual resources in Section 4.0 are also used for cumulative analysis. For cumulative impact analysis the percentage or portion of cumulative impacts that would be contributed by the Proposed Action is the basis for judging the significance of incremented impacts resulting from the proposed action.

5.3.1 Air Quality

Combined emissions from sources at the proposed mill, sources at the existing Cortez mill, and other existing and proposed sources in the Crescent Valley air basin could potentially cause cumulative PM_{10} impacts.

Proposed Mill and Existing Mill

Cumulative impacts from sources at the proposed mill and the existing Cortez mill were modeled using the ISCST2 and COMPLEX 1 models. These models are useful for calculating the combined impacts, at a single receptor, from one or more sources. In addition to the use of the coarse grid described above, the dense 3 km by 3 km grid was placed around both the proposed mill and existing mill. Permitted sources at the existing Cortez mill are listed in Table 5.3-1. An emissions inventory of those sources is summarized in Table 5.3-2.

Table 5.3-3 summarizes the cumulative analysis results. The maximum total PM_{10} concentration (modeled concentration plus background) from cumulative impacts for a 24-hour averaging time is 143.6 $\mu g/m^3$, which is below the 24-hour AAQS for PM_{10}, resulting in no significant impact. The maximum total PM_{10} concentration from cumulative impacts for an annual average is 34.8 $\mu g/m^3$, which is below the annual PM_{10} AAQS, resulting in no significant impact. The background annual concentration used was the NDEP accepted value of 9.0 $\mu g/m^3$. These maximum concentrations occurred near the Cortez mill facility, with an insignificant concentration from the proposed mill complex.

Other Sources in the Crescent Valley Air Basin

Emissions of particulate matter less than 10 micrometers (PM_{10}) from the proposed mill facility combined with PM_{10} emissions from other process sources in the Crescent Valley Air Basin were evaluated to identify potential cumulative impacts. There is one other source of particulate emissions from ore processing in the Crescent Valley air basin, M-I Drilling

Fluids, that would contribute to cumulative impacts from the proposed mill. This source is located at the southwestern edge of the Crescent Valley. Information about sources in the Crescent Valley Air Basin (Hydrographic Basin 54) was obtained from an NDEP inventory of source in that basin.

The EPA SCREEN model was used to conservatively estimate ambient PM_{10} concentration increases from the primary crusher and single deck screen at M-I Drilling Fluids. Although emissions from the crusher and screen are measured as Total Suspended Particulates (TSP), it is conservatively assumed here that all TSP is in the form of PM_{10}. The analysis used hypothetical, worst-case meteorological conditions to estimate maximum 1-hour concentration increases. The resulting 1-hour modeled concentrations were multiplied by the scaling factors 0.4 and 0.1 to derive 24-hour and annual concentrations, respectively. Results of the ISCST2 and COMPLEX I modeling of sources at the proposed mill were used to estimate modeled PM_{10} concentrations increases from the Proposed Action.

A significance level area was defined for 24-hour and annual TSP impacts from M-I Drilling Fluids and the Proposed Action. Significance levels are defined as modeled values below which is assumed no detriment to air quality. Significance levels for PM_{10} for 24-hour and annual impacts are 5.0 $\mu g/m^3$ and 1.0 $\mu g/m^3$, respectively.

A significance level area is determined by outlining an area around the source beyond which modeled values fall below significance levels (5.0 $\mu g/m^3$ for a 24-hour average and 1.0 $\mu g/m^3$ for an annual average). Outside this area, no significant impact to air quality would occur. From the proposed mill, the 24-hour impact area extends roughly 5.5 km outward. The annual impact area extends approximately 10 km outward. From M-I Drilling Fluids, the 24-hour impact area extends 2.5 km from the source, and the annual impact area extends 3 km from the source. Therefore, the significance level areas from modeled values of PM_{10} (24-hour average and annual average) from the Proposed Action mill and from M-I Drilling Fluids do not overlap. No cumulative impacts would result from sources at the proposed mill and at M-I Drilling Fluids.

Other point sources have been identified as part of reasonably foreseeable developments. For example, additional CIL plants may be planned as part of Cortez's future operations and as part of the large mine scenario. These sources would add to ambient levels of pollutants such as TSP and SO_2. However, impacts from these cannot be quantified at this time, because no permit applications for them have been filed with the NDEP.

Fugitive Dust Emissions

The reasonably foreseeable future activities would involve surface disturbances that would result in fugitive dust emissions. These activities include development of an open pit mine to the southeast of the proposed Pipeline Project. A disturbance area of 1,734 acres is anticipated for this project. Emissions of PM_{10} from a surface disturbance of this area are estimated to be 749 tons. This is based on a 1.2-tons-TSP-per-acre-of-disturbance emission factor, with 36 percent of TSP assumed to be PM_{10} (EPA 1985).

Another foreseeable project involves processing of Gold Acres heap leach ore at the proposed Pipeline facility. This would result in surface disturbances during road construction and leach pad expansion. However, the amount of disturbance has not yet been estimated.

Surface disturbance activities occur at a great enough distance from each other, such that an additive, i.e., cumulative, impact from fugitive dust is not anticipated. Surface disturbance acreage at each area is less than or approximately equal to those at the Newmont Gold Company Gold Quarry site.

5.3.2 Geology, Minerals and Paleontology

Approximately 233 million tons of waste rock would be excavated and permanently placed in dumps. About 34.5 million tons of ore would be removed, processed, and placed in heap leaches and tailings ponds. An additional 896 million tons may be excavated and relocated during the mine developments discussed under Reasonably Foreseeable Future Projects. The Proposed Action represents about 23 percent of the waste rock and ore that could be relocated in the foreseeable future.

The short-term result of the proposed expansion of mining and minerals exploration activities would be that additional mineralization may be encountered that may warrant additional intensive investigation. The long-term impact would be that the proposed work may lead to the defining of additional ore reserves and, subsequently, future mining operations should market conditions provide an economic incentive. No significant cumulative impacts are anticipated.

No significant cumulative impacts to paleontological resources are anticipated from implementation of the Pipeline Project.

5.3.3 Soils Cumulative Impacts

Current and historic mining operations within the study area have resulted in disturbance to approximately 4,529 acres of soils. An additional 1,880 acres of disturbance would result from the Proposed Action. Of this acreage, 241 acres would remain disturbed as an open pit. Foreseeable future mining operations will result in an additional 5,550 acres of soil disturbance. With the exception of any open pits, this disturbance would also be required to be reclaimed. During reclamation activities, growth medium would be distributed in a random and unstratified manner. Erosion would result in the loss of additional soil materials over the time frame of the foreseeable future. The removal of 46,000 cubic yards of topsoil materials to the Cortez Mine Expansion reclamation will allow for the complete reclamation of 24 acres of dump slopes.

Total current, historic, proposed, and foreseeable future disturbance to soils from mining activities within the study area is 11,973 acres. Of this disturbance, 652 acres are historic disturbance and not subject to current reclamation regulations. Assuming that 17 percent of all disturbance consists of open pits, and assuming that all non-historic mining related disturbance other than these pits will be required to be reclaimed, 9,397 acres would be reclaimed. These disturbances would be short-term and insignificant providing reclamation was successful in stabilizing the disturbed sites. Approximately 2,576 acres (including open pits and historic mining disturbances) would remain as long term disturbances. The entire study area includes approximately 340,000 acres; the 2,576 acres of long term disturbance (including the Proposed Action long-term disturbance) represents 0.8 percent of the study area and is not considered significant.

Livestock grazing has had, and would continue to have, direct and indirect impacts on soils. Grazing impacts to soils are not quantified. The expected disturbance to soils due to range improvements is 4,462 acres (Table 5.2-3).

5.3.4 Water Resources

Groundwater

Cumulative impacts to groundwater and surface water resources within the study area are considered from a water quality and water quantity perspective. Proposed process facilities would be designed and constructed to be zero-discharge units in accordance with NDEP regulations. As such, the contribution to cumulative groundwater quality degradation is considered to be low. For reasonably foreseeable projects, similar facilities using similar chemicals would be constructed and operated. If the facilities were also designed and constructed as zero-discharge units, they should have a similarly low potential for degrading groundwater quality. The South Pipeline Expansion would also contribute to cumulative impacts to groundwater quality. Based on preliminary plans, the South Expansion Pipeline project would use ore-processing facilities constructed for the Proposed Action or the existing facilities located at the Cortez Mine. New ore-processing facilities for both the Proposed Action and the Cortez Mine expansion will be designed as zero-discharge units and, therefore, cumulative impacts to groundwater quality are considered to be low.

The South Pipeline Expansion would involve increasing the size of the mine pit for the Proposed Action and, therefore, increasing the dewatering rate. Based on conceptual plans, the rate of pumping needed to dewater the combined pit areas might increase from the estimated 30,000 gpm for the Proposed Action to 55,000 gpm for the combined amount with the South Pipeline Expansion. The impacts of increasing the dewatering pumping rate would result in a greater area of drawdown in the water table that would correspond to worst-case impacts (see Section 4.4.2) for the Proposed Action alone.

The contribution to cumulative impacts from the Proposed Action is significant. Mitigation would be the same as discussed in Section 4.4.6. The mitigation would include reconfiguration of reinfiltration ponds, addition of reinfiltration ponds, or a combination of both. The general area for relocation of reinfiltration ponds is shown in Figure 4.4-2.

Surface Water

No cumulative impacts to perennial streams are anticipated because no perennial drainages are located within the vicinity of the Proposed Action area. Potential erosion and sedimentation impacts to ephemeral drainages would increase somewhat if the South Pipeline Expansion project was implemented either simultaneously or sequentially to the Proposed Action before the area was reclaimed. Ephemeral drainages would need to be rerouted around a larger facility, making the courses longer and increasing the potential for erosion and sedimentation impacts. If the Proposed Action and the South Pipeline Expansion are implemented either simultaneously or sequentially, the resulting pit lake that would eventually form after mining ceases would be larger than the lake for the Proposed Action alone. Evaporative losses from the larger pit lake would also be greater. Greater evaporative losses may also occur if a greater number of reinfiltration basins are required to mitigate groundwater quantity impacts described above. No feasible mitigation for evaporative losses is presently available.

5.3.5 Cumulative Impacts to Vegetation

Existing mining-related disturbance to vegetation within the study area encompasses approximately 4,279 acres. Table 5.3-4 summarizes existing, proposed and other foreseeable future disturbance by community type within the study area. The site-specific estimates for existing and reasonably foreseeable disturbances are listed in Tables 5.2-1 and 5.2-2.

Impacts to vegetation due to livestock grazing are noted throughout the study area; however, these impacts are not quantified.

Approximately 0.3 percent of the shadscale/greasewood community type, 6.4 percent of the shadscale/bud sagebrush community, 1.7 percent of the sagebrush/grass community type, 2.5 percent of the pinyon-juniper/sagebrush community, and 2.2 percent of the mountain mahogany community would be disturbed by mining-related activities. The contribution to cumulative impacts to these communities is not significant (Table 5.3-5).

5.3.6 Wildlife Resources

The environmental consequences to most wildlife species resulting from direct disturbance as described in the Proposed Action are low to minimal, largely because the majority of direct disturbance would occur either adjacent to existing disturbance or in habitats not utilized by a wide variety of species. Mule deer seldom utilize the dry, open flats of the valley floor, while antelope numbers in the area are low. The nearest identified antelope use area is located east of the Cortez Mountains, though recently antelope seem to be expanding their range in southern Crescent Valley. Similarly, areas which would be directly disturbed are not generally utilized by game bird species, with the exception of mourning doves.

According to the Pipeline Plan of Operations, approximately 1,880 acres of predominantly shadscale and budsage habitat, located just east of the existing Gold Acres area, would be directly disturbed by the Proposed Action. These habitats would be lost to those resident species listed in Section 3.6. While this loss represents a potential loss of 412 mule deer AUMs and 515 antelope AUMs, the project area is seldom used by either of these species. The 1,880 acres of disturbance would impact habitat for lagomorphs, small rodents, and passerine birds. The acreage that would be directly affected by mining represents approximately 0.5 percent of the study area. As shown in Table 5.3-6, disturbance resulting from the Proposed Action represents 16 percent of the total existing, proposed, and reasonably foreseeable future disturbance within the study area.

In addition to these direct disturbances, a much larger area would be indirectly impacted by disturbance resulting from activities associated with mining projects within the study area. The zones of disturbance created by these activities are, for the purposes of this analysis, considered to include areas within 1/4 mile of active mining or exploration activities. Wildlife may avoid areas near active disturbance or may curtail use of such areas to varying degrees. If these zones of disturbance are included in this analysis, a total area of approximately 31,790 acres, or approximately 9.4 percent of the study area, falls within 1/4 mile of existing or proposed or reasonably foreseeable future mining activity, excluding the Notice level and reasonably foreseeable future exploration activities. The Proposed Action disturbance, direct and indirect, would affect approximately 3,075 acres, or 9.7 percent of this total disturbance.

Direct disturbance to habitats within the study area approved under Notices of Intent, and assumed to be primarily exploration-related disturbance, totals 525 acres. Exploration disturbance projected to occur in the reasonably foreseeable future within the study area would directly affect 975 acres. Zones of disturbance surrounding this exploration disturbance would include approximately 51,015 acres, or approximately 15 percent of the study area. The indirect disturbance resulting from exploration activities should be considered separately from disturbance resulting from actual mining operations, which usually include regular and in many cases continuous disturbance. Disturbance resulting from exploration activities is irregular and not continuous over the long term. The Proposed Action would not add significantly to the total area affected by exploration activities.

Dewatering activities may result in the reduction or elimination of some seeps and springs within the study area. Modeling suggests those seeps and springs located below the bedrock-alluvium contact have the highest probability of being affected, but some springs above this contact may be affected as well, depending upon local groundwater hydrology. The bedrock-alluvium contact generally follows the contact between alluvial fans and foothills, and includes approximately 53 percent of the study area. This area includes approximately 36 acres of jurisdictional wetlands. The largest of these are associated with the hot springs complex east of the community of Crescent Valley, at the northern end of the study area. The irrigated fields at Rocky Pass also lie below the bedrock-alluvium contact, and within the modeled drawdown zone. As noted in Section 3.6, riparian habitats are limited on the valley floors, but occur in association with many foothill seeps, springs, and creeks or watercourses. Any loss of the 36 acres of jurisdictional wetlands would be considered a significant impact because of the importance of these areas to wildlife species.

5.3.7 Recreation and Wilderness

Reasonably foreseeable actions include exploration and mining activities at the Gold Acres, Cortez, and Horse Canyon sites. There could be approximately 5,195 acres of new disturbance associated with these foreseeable actions. These disturbances would continue to decrease the amount of land available for dispersed recreation (such as hunting) within the resource area. Increased traffic in the Cortez Canyon would adversely affect recreationists using the highway to access the Cortez historic mining district or other dispersed recreational opportunities in the area.

Other reasonably foreseeable actions discussed in Section 5.3.9, Socioeconomics, would result in additional workers during construction and operation phases. Recreational opportunities are already limited in many of the communities where the new workers are likely to live. An increase in population would increase the demand of an already inadequate supply of developed recreation opportunities.

5.3.8 Visual Resources

Foreseeable actions include continued mining activities at the Cortez, Gold Acres and Horse Canyon sites. Exploration activities are expected to continue in the future on an annual basis. Potential mining activities in Cortez Canyon, known as West Pixie, would occur on BLM VRM Class III lands. This project would not be an expansion of existing operations, but would be a new activity on previously undisturbed land. This disturbance would attract attention from a travel route; however, the duration of view would be short. The South Expansion, located to the southeast of the Proposed Action pit, represents a potential major development. If that development occurred, it would result in large scale modifications to the natural landscape.

5.3.9 Socioeconomic Impacts

Cumulative socioeconomic impacts would result from all proposed or envisioned actions that have the potential to affect population, housing, public services and utilities, and the economy in the study area. As noted in Section 3.9.1, the study area for socioeconomic impacts encompasses a three-county area, focused on the communities of Elko, Carlin, Beowawe, Crescent Valley, and Battle Mountain.

Table 5.3-7 lists proposed and envisioned actions in the study area that could potentially result in socioeconomic changes in the study area. The locations of these projects and the affected communities are presented on Figure 5.9-1. As the table shows, the construction schedule of these projects overlap, creating therefore a possibility of short-term cumulative impacts. Some of these actions also involve creation of new permanent mining jobs; therefore, there is a potential for long-term cumulative impacts.

There is some uncertainty regarding the Mule Canyon Project, and the project is currently on hold. If the project goes forward, it is likely that the currently proposed schedule for the project would slip by about a year. Table 5.3-7 is based on this revised schedule for this project.

Other events in the study area could also have cumulative socioeconomic impacts. As noted in Section 3.9, Elko County School District is planning to construct one new school each year over the next 7 years. Therefore a work force for school construction is likely to be present in the study area. In addition, the gold mining companies are constantly conducting exploration in the study area, and a large number of exploration rigs with 3 to 5 persons per rig are present in the study area for 6 to 8 months each year. The work force related to exploration tends fluctuate from one part of the year to the other, and these exploration crews move in and out of the region depending on the season.

Mine closures would also potentially result in cumulative impacts. Battle Mountain Gold has proposed the closure of its plant, which would result in the layoff of 200 employees — i.e., a reduction in mining jobs. In addition, Echo Bay Minerals underground operations have been closed recently, resulting in a loss of mining jobs, and in about 8 years, the remaining mine operations would be closed, reducing mining jobs in the study area by about 750. And as already explained in Section 4.9, current mining operations at Cortez would be phased out by 1996, causing the elimination of 195 jobs. Therefore over the next 3 to 8 years there would be some fairly large losses of mining jobs in the study area, at the same time that new mining jobs are created. In estimating the potential cumulative impacts, losses of jobs in the study area other than the 195 jobs at Cortez are not taken into account.

Table 5.3-8 presents estimates of construction and operations jobs associated with the five major proposed/planned projects. Other projects such as the Dee Gold Expansion and Jerritte Canyon that are smaller in terms of their employment levels also would affect the study area. The combined employment associated with these smaller projects are also listed in this table.

Assumptions Used in Cumulative Socioeconomics Analysis

Certain assumptions were utilized to estimate the population changes that could occur in the study area due to these projects. Overall these assumptions result in conservative estimates of population increases. In the case of construction impacts, estimates are worse-case results because it has been assumed that only 10 percent of the construction workers would be hired out of the local labor pool. In the case of operations impacts also, results appear high relative to other independent estimates of population change triggered by an increase in mining. This is discussed further in the Operations Impact section, below. Assumptions utilized for this study are described below:

<u>Construction Work Force</u>.

- Only 10 percent of the construction crews would be local workers, and the remaining non-local hires.
- 80 percent of the non-local construction workers would either be single, or married but not accompanied by families.
- Married non-local construction workers accompanied by families would have a family size of 3.52 persons, with one school-aged child per family.

<u>Operations Employees</u>.

- About 25 percent of operations employees would be local, and the remaining non-local.
- Of the non-local employees, 75 percent would be married and accompanied by families.
- The household size of the married non-local employees would range from 4.05 to 5 persons, with 1.43 to 2.6 school-aged children per household.

Note that the first assumption above differs slightly from the one used to estimate the Pipeline Mine operation impacts. As noted in Section 4.9, 53 out of 265 mining employees (about 20 percent) for the Pipeline mine are likely to be non-local.

Residence Pattern of New Non-local Employees. The following percentages were used to estimate the numbers of non-local construction and operations workers who would reside in the study area communities. The percentages assigned to the affected communities vary with each project. In general, large communities would attract most of the new workers; however, commuting distances would tend to make some of the smaller communities nearer to the mine site also attractive to immigrants. Note that gravity models were not used to estimate these percentages.

	Percentage of New Workers (both married and single)			
Community	Pipeline Project[a]	South Pipeline	Mule Canyon	Meikle/Gold Quarry/Jerritte Canyon
Elko (incl. Spring Creek)	43	43	40	70
Carlin	17	17	20	30
Battle Mountain	8	8	40	--
Beowawe	2	2	--	--
Crescent Valley	30	30	--	--
	100	100	100	100

[a] Used for single construction workers only; for married construction workers it is assumed that 80 percent would live in Elko and 20 percent in Battle Mountain.

Cumulative Construction Impacts

Employment. In 1994, when the construction on all projects would occur, approximately 1,133 jobs would exist in the study area, with the Proposed Action responsible for about 16 percent of all new construction jobs (see Table 5.3-9). Construction of the South Pipeline project would most likely occur later and therefore would not result in cumulative construction impacts with the other projects in 1994. Under the worst-case scenario (i.e., all construction contracts are awarded to non-local contractors) 115 of these jobs (about 10 percent) would go to local workers. However, if at least one of the four large construction projects in 1994 was awarded to a local contractor, about one-third (over 300 jobs) would accrue to the local workers.

These direct jobs would trigger the creation of indirect jobs. Based on a local employment multiplier of 1.74, approximately 840 indirect jobs in the study area would be supported by these construction jobs.

Population. Under the worst-case scenario, the study area would see an influx of about 1,020 (90 percent of 1,133 new jobs) non-local workers and their dependents for 15 months to 2 years. Based on assumptions noted earlier, about 814 of these would be single workers, and about 204 married and accompanied by families. With a family size of 3.52 persons, about 500 dependents would accompany these non-local married construction workers. Therefore there would be a total increase of about 1,530 persons in the study area. The project would contribute about 17 percent of this total short-term increase in study area population.

Of these new persons, about 972 persons (63 percent) would move into Elko and Spring Creek. Carlin would see around 366 new residents (24 percent of the influx) and Battle Mountain would gain about 182 persons (12 percent of the influx). The Pipeline Mine would be responsible for about 17 percent of the increase in Elko's population and about 25 percent of the increase in the population of Battle Mountain.

There would be limited if any immigration of new persons into the study area in response to the indirect jobs. Most indirect jobs are relatively low paying and tend to be filled by local persons (already in the study area) or spouses/dependents of migrating direct job-holders.

Housing. The simultaneous construction of the proposed/planned projects would create a demand for a large number of housing units. Assuming one housing unit (hotel/motel room/ RV space/rental house) per non-local worker, approximately 1,020 units would be needed, with about 637 in Elko and Spring Creek. However, it is likely that given the shortage of housing in these communities, single workers would double up, thereby reducing the number of required units to about 600 study-area wide and 380 units in Elko and Spring Creek. Even with the reduced numbers, the study area housing would be significantly affected.

Schools. Assuming one school-aged child per married construction worker household, there would be about 200 new school-aged children in the study area for 15 months to 2 years.

With the exception of 25 children who would likely attend Battle Mountain schools, the remaining school-aged children would attend schools in Elko, Spring Creek, and Carlin.

<u>Social Conditions</u>. Influx of construction workers would place an increased burden on most city services in Elko and Carlin. As noted in Section 3.9.10, the study area communities do not have many social activities to offer to the residents. This lack would cause non-local workers to seek other forms of entertainment, primarily drinking and gambling, and crimes resulting from drinking and gambling would increase.

Operations Impacts

<u>Employment</u>. Together the five major and the three smaller mining projects would result in about 1,000 new mining jobs in the study area (see Table 5.3-10). The Pipeline Mine would add 70 new jobs (i.e., 7 percent of all new jobs). About a quarter of these new mining jobs would accrue to local workers. These direct jobs would trigger the creation of 740 indirect/induced jobs.

The proposed and envisioned projects would result in the continuation of mining employment in the region. In the light of recent and projected mine closures, it appears that these future projects would not result in large increase in mining jobs, but would offset some of the job losses associated with current and imminent mine closure. These projects would, however, result in a continuation of the current situation where the regional economy is driven primarily by one basic industry — metal mining. This continued dependence on one sector would possibly lay the grounds for a bust of the economy if gold prices change.

<u>Population</u>. Based on assumptions noted earlier, the projects collectively could cause an increase of about 2,626 to 3,200 new residents in the study area (see Table 5.3-10). The range results from the use of two alternate family sizes. Of these new residents, about 52 percent (1,367 to 1,650 persons) would likely move into Elko. About 22 percent (589 to 870 persons) would move into Carlin, and Battle Mountain would see an influx of 360 to 440 persons related to the new projects. Immigration of new persons in response to the indirect jobs is not expected because of reasons mentioned earlier under construction employment impacts, and the high unemployment rates in the study area.

Independent estimates of population change that would be associated with a change in mining employment were also obtained. Metal mining employment in Elko, Eureka, and Lander counties for 1985 through 1991 was examined. These data revealed that metal mining employment increased from 2,039 in 1985 to 6,126 in 1991. During the same period, population in the three counties grew from 28,170 to 43,190 persons. This yields a ratio of 1:3.68 — i.e., for every new job in metal mining, population in the three-county area increased by 3.7 persons. The ratio for the period 1985 through 1990 was 3.00. If an average of these two ratios (3.34) is applied to the new mining jobs created by all the projects, the three-county study area would experience an increase in population by about 3,340 persons. Note that a portion of this increase (about 500 persons based on a natural growth rate of 1 percent per annum) would be due to natural increase, and about 2,840 persons would likely migrate into the study area.

A comparison of this independent estimate (2,840 immigrants) with population increase estimated for this study (2,626 to 3,200 non-local persons) indicates that the study results are similar to this independent estimate. The study results do not include immigration due to the creation of indirect jobs, which is included in the independent estimate.

Note that this population growth would occur only if there is a net increase in mining jobs. In the event that there are mining job losses also in the region, as is anticipated, the growth would be smaller. Also note that if the increase in mining jobs is of the order reported in the study, population growth patterns experienced in the last 5 to 7 years will be continued.

Housing. Assuming one housing unit per non-local new employee, about 800 housing units would be needed in the study area to accommodate the new households. About 416 units would be needed in Elko and Spring Creek, about 140 units in Carlin, and about 110 units in Battle Mountain. The Proposed Action would be responsible for about 7 percent of this demand for housing, and as noted in Section 4.9, if needed half of the housing units for the new Proposed Action employees could be constructed on the approved subdivision in Carlin. Therefore although the project would add to the existing burden on housing resources in the study area, Cortez has available mitigation measures that would be applied if required.

In sum, collectively the projects would increase the burden on the limited housing resources in the study area, although the effects of each project individually may be mitigable to some extent.

<u>Schools</u>. The operations of the planned/proposed projects would result in the addition of about 857 to 1,560 school-aged children to the study area schools. Of these, 94 to 172 school-aged children would likely attend Battle Mountain schools and the balance (763 to 1,388 students) would attend schools in Elko, Spring Creek, and Carlin. A small number could attend the elementary school in Beowawe. Cumulatively, the projects would significantly affect the Elko County school district's resources, and could require the provision of as many as 48 to 50 new class rooms in the District's schools.

<u>Social Conditions</u>. The addition of the new persons would place a burden on the resources of the communities. As noted in Section 3.9.8, the current service ratio for the Elko Police Department is 1.7 officers per 1,000 residents and the department is striving to improve this ratio by adding new officers. This ratio would likely improve in the future; however, the addition of population due to the projects would reduce some of the gains made. Similarly, other services such as schools, water supply and local streets would be adversely affected, and this could result in a diminution of well-being of the local long-term residents. As discussed in Section 3.9.11, residents of the area have indicated that the rapid growth in the past 5 years has brought problems to the study area. Population growth has occurred in the communities where housing is lacking, jobs are hard to find, and prices are high. Some residents have related the problems to immigrants. This trend would be maintained by the new projects. However, the people of the study area appear pro-growth and willing to welcome newcomers.

5.3.10 Land Use/Livestock Grazing

Table 5.3-11 reflects the estimated cumulative impact to livestock forage as a result of existing, proposed, and foreseeable future mining activity in the study area. The data related to AUMs are based on range surveys conducted in the 1960s by the Battle Mountain District of the BLM. The estimate of foreseeable future actions pertaining to BLM and private lands is difficult to quantify both with respect to land ownership and grazing capacity. It is estimated that much of the future mining in the Cortez area will occur on patented mining claims, and that mining in other areas within the study area will take place on unpatented mining claims (BLM-administered lands). Grazing forage capacity for livestock in areas to be mined would be similar to those presently being impacted. The level of harassment and potential livestock mortality due to increased mining activity and vehicle traffic would be expected to increase in proportion to the increase in activity.

No range improvements would be lost, but in some areas where fences are breached, cattle guards would have to be installed to prevent drift of livestock. Also, the potential exists for competition at developed water sources where exploration activities require water for drilling purposes. Livestock could be subject to both harassment and actual loss of historically available water, particularly at the Filippini #2 water well (R-4269) where dewatering of the Proposed Action could adversely impact water production at the well.

Projected BLM rangeland seedings of 4,250 acres in the Carico Lake Grazing Allotment would result in an estimated increase of 184 AUMs in that portion of the allotment that is situated in the study area. The increase of 184 AUMs is based on a stocking rate of 6 acres per AUM on 842 acres. Consequently, the net cumulative loss of AUMs in the study area would be 45, or 2.7 percent of the estimated average licensed use within the study area.

The cumulative loss of AUMs related to mining activities in the study area would be 613. This loss of AUMs would be offset by seedings in portions of the study area that are in the Carico Lake Grazing Allotment.

5.3.11 Cultural Resources

A cumulative impacts analysis for cultural resources was conducted for the Expansion EIS and is detailed in that document. The same cultural resources cumulative impacts study area employed in the Expansion EIS is used for the Proposed Action.

For the entire study area, the contribution to cumulative impacts from the Proposed Action is less than 0.01 percent for non-significant prehistoric and historic resources and 0 percent for significant sites in both categories. Based on these results, the incremental addition of the Proposed Action to cultural resources cumulative impacts is not significant.

There is no incremental cumulative impact from the Proposed Action to traditional resources and values of importance to Native Americans.

TABLE 5.2-1

HISTORICAL AND EXISTING DISTURBANCE IN THE CUMULATIVE STUDY AREA

Sites	Old Acres	New Acres	Total Acres
Cortez District	92	50	142
Gold Acres	450	431	881
Lander	4	0	4
Utah Mine and Utah Camp	6	0	6
Tenabo	6	0	6
Gold Quartz	6	150	156
Mill Canyon	17	1	18
Cortez Mine	0	1,286	1,286
Mud Spring Gulch	21	0	21
Robertson	0	100	100
Triplet Gulch	0	129	129
Grey Eagle	0	5	5
Greystone	0	500	500
Clipper	0	400	400
Hot Springs	50	0	50
Fox	0	4	4
Indian Creek Exploration	0	26	26
Cottonwood/Brock Exploration	0	20	20
Mill Canyon Exploration	0	250	250
NOIs, (90) BLM, Battle Mountain	0	450	450
NOIs, (15) BLM, Elko	0	75	75
Totals	**652**	**3,877**	**4,529**

TABLE 5.2-2

SUMMARY OF REASONABLY FORESEEABLE FUTURE DISTURBANCES BY MINING (ACRES)

	Area	Waste Rock				
		Pit	Dump	Other	Roads	Total*
Cortez						
West Pixie		68	47	--	30	145
Cortez		196	143	--	20	359
Mill Canyon Tailings		23	0	--	10	33
Exploration		--	--	--	2	2
					Subtotal	**539**
Gold Acres						
No. London Extension		48	60	--	10	118
Golden Zones		40	60	--	10	110
Low-Grade Stockpiles		--	110	--	20	130
South Expansion		233	969	532	0	1,734
					Subtotal	**2,092**
Other Exploration						
Cortez Range					10/yr.	150
North Toiyabe Range					5/yr.	75
Shoshone Range					50/yr.	750
Mill Canyon						250
	Small Mine				**Subtotal**	**1,225** **200****
	Large Mine					**1,500****
Totals		**608**	**1,389**	**532**	**181**	**5,556**

* Total includes acreage affected to accomplish reclamation.

** Acres disturbed at any one time assuming concurrent reclamation.

TABLE 5.2-3

SUMMARY OF REASONABLY FORESEEABLE FUTURE DISTURBANCES BY RANGELAND MANAGEMENT (ACRES)

Range Improvements by Allotment	Seedings	Constructed Projects	Total
Carico Lake	4,250	118	4,368
Argenta	---	---	----
South Buckhorn	---	94	94
Totals	4,250	212	4,462

TABLE 5.2-4

EXISTING AND REASONABLE NUMBERS AND AUMs OF BIG GAME USE FOR THE SOUTH BUCKHORN ALLOTMENT

Species	Existing		Reasonable	
	Numbers	AUMs	Numbers	AUMs
Mule Deer	400	865	953	2,058
Pronghorn Antelope	25*	---	**	**

* Counted in the winter of 1991 at north end of Simpson Range.
** No data are available.

TABLE 5.2-5

SEASONAL BIG GAME HABITAT IN PORTIONS OF THE SOUTH BUCKHORN AND PINE CREEK ALLOTMENTS WITHIN THE STUDY AREA

Habitat Type	Acres
Crucial Antelope Summer	576
Antelope Yearlong	1,577
Deer Summer Range	903
Deer Winter Range	895

TABLE 5.2-6

LOCATION AND CONDITION OF WILDLIFE HABITAT AS INDICATED BY RANGE CONDITION SURVEYS IN THE CORTEZ MOUNTAINS, BLM ELKO RESOURCE AREA

Transect	Habitat Type	Habitat Condition[a]	Limiting Factors[b]
DW-1-T-03	Deer Winter	Poor	SAC,SFC,FP,DM
DW-1-T-04	Deer Summer	Good	SAC,SFC
DW-1-T-05	Deer Winter	Fair	SFC,SAC
DW-1-T-07	Deer Winter	Fair	SAC,SFC,FD
DW-1-T-08	Deer Winter	Good	SAC

[1] The habitat condition score and rating are based on a composite of several factors, including browse vigor, forage quality, cover, disturbance and interference, and water distribution.

[2] SAC = Shrub Age Class
SFC = Shrub Form Class
FD = Forage Density
FP = Forage Production
DM = Disturbance from Mining

TABLE 5.2-7

RESULTS OF STREAM SURVEYS CONDUCTED ON STREAMS IN THE CORTEZ RANGE BY THE BLM IN 1991

Creek Name	Percent of Optimum[a]	Riparian Condition Class[a]	Percent Sedimentation[b]	Width to Depth Ratio[c]
Cottonwood Creek	41.4	32.8	55.9	21.0
Brock Creek	25.4	25.0	43.6	29.0
Cottonwood Canyon Creek	39.8	34.4	20.2	29.0
Duff Creek	56.8	73.6	14.6	15.0

[a] Based on the following scale; 0-49% = Poor; 50-59% = Fair; 60-69% = Good; 70+% = Excellent.

[b] Streambottom sedimentation levels in excess of 54% are generally considered undesirable.

[c] The following scale can be used to evaluate the width to depth ratio; 26+ = Poor; 15-25 = Fair; 8-15 = Good; <7 = Excellent.

TABLE 5.3-1

PERMITTED AIR EMISSION SOURCES AT CORTEZ GOLD MINES

Cleaver Brooks Boiler

Lime Handling System

Bartlett-Snow Carbon Reactivation Kiln

Roasting Circuit

- Surge Bin
- Fluid Bed Roaster
- Calcine Fluid Bed Cooler
- Quench Tank
- Product Handling System

Ore Storage Silo

Dry Grinding System

Two Wabi Iron Works Furnaces

Hydrastoke Feeder and Jaw Crusher

Symons Shorthead and Cone Crusher

Vibrating Screen and Associated Conveyors

Surface Area Disturbances

TABLE 5.3-2

EMISSION INVENTORY OF PERMITTED SOURCES AT THE CORTEZ GOLD MINE FACILITY

Source Number	Source Type	Controls	Location	Hours of Operation per Year	Capacity[a]	TSP (lb/hr)	SO_2 (lb/hr)	TSP (ton/yr)	SO_2 (ton/yr)
1	Carbon Reactivation Kiln	Achieve Allowable	S23 T27N R47E	8760	0.08	0	0	0	0
2	Grinding Mill	Cyclone, Baghouse	S24 T27N R47E	8544	90	8.15	0	29.9	0
3	Fluid Bed Roaster	Cyclone, Esp, Scrubbers	S24 T27N R47E	8544	90	32.47	29.15	135.3	125
4	Lime Handling System	Enclosed Systems, 20%	S24 T27N R47E	8760	2.1	0	0	0	0
5	Boiler	None	S24 T27N R47E	8760	6.31	0	0	0	0
6	Ore Storage Silo	Fabric Filter, 7%	S24 T27N R47E	8544	90	0.22	0	0.9	0
7	Primary Crusher	Moisture, 20%	S19 T27N R48E	6570	200	3.99	0	13.1	0
8	Secondary Crusher	Moisture, 20%	S24 T27N R47E	6570	200	6.52	0	21.4	0
9	Vibrating Screen	Moisture,m 20%	S24 T27N R48E	6570	200	3.52	0	11.6	0
10	Furnace	Gas Scrubber	S19 T27N R48E	8760	0.09	0.48	0	2.1	0

Source: NDEP 1991; Woodward-Clyde Consultants

[a]Capacity = MMBTU/hr for boilers and other combustion sources

= Tons/hr for all others, except land disturbances

= Acres disturbed for land disturbance sources

TABLE 5.3-3

MAXIMUM MODELED PM_{10} CUMULATIVE CONCENTRATIONS FROM SOURCES AT THE PROPOSED MILL AND EXISTING MILL

Averaging Time	Modeled Cumulative Concentration ($\mu g/m^3$)	Ambient Background ($\mu g/m^3$)	Total Cumulative Concentration ($\mu g/m^3$)
24-hour	98.6	45.0[a]	143.6
Annual	25.8	9.0[b]	34.8

[a] This is the highest measured value at the Cortez monitoring station to date.

[b] Ambient PM_{10} levels have not yet been monitored at the proposed site for a full year. This is an NDEP-assumed value for annual background PM_{10} concentration.

TABLE 5.3-4

EXISTING AND FORESEEABLE FUTURE DISTURBANCE BY VEGETATION COMMUNITY TYPE

		Foreseeable Future		
Community Type	Existing Disturbance	Proposed Action	Other	Total
Shadscale/greasewood	104			104
Shadscale/bud sagebrush	1,755	1,894	1,864	5,499
Sagebrush/grass	1,519		1,656	3,175
Pinyon-juniper/sagebrush	370		267	637
Mountain mahogany	0		37	37
Unknown	531		1,702	2,233
TOTALS	4,279	1,894	5,526	11,685

TABLE 5.3-5

PERCENTAGE OF EXISTING AND FORSEEABLE FUTURE DISTURBANCE BY VEGETATION COMMUNITY TYPE

Community Type	Acres in Study Area	Percent of Study Area	Acres of Disturbance	Percent of Community Type
Shadscale/greasewood	41,000	12	104	0.3
Shadscale/bud sagebrush	86,100	25	5,513	6.4
Sagebrush/grass	185,600	54	3,175	1.7
Pinyon-juniper/sagebrush	25,600	8	637	2.5
Mountain mahogany	1,700	1	37	2.2
TOTALS	340,000	100	9,466	

TABLE 5.3-6

ACREAGES OF EXISTING, PROPOSED, AND FUTURE FORESEEABLE DISTURBANCE WITHIN THE CUMULATIVE STUDY AREA, BY HABITAT TYPE

Habitat Type	Acres in CSA	Existing, Proposed, and RFF* Disturbance	Proposed Action	Percent Contributed by Proposed Action
Shadscale/Black Greasewood	41,000	104	0	0
Shadscale/Bud Sagebrush	86,100	5,631	1,880	34
Sagebrush/Grass	185,600	3,175	0	0
Pinyon-Juniper Sagebrush	25,600	637	0	0
Mountain Mahogany	1,700	37	0	0
Unknown**	0	2,233	0	0
Total	340,000	11,817	1,880	16

* Reasonable Foreseeable Future

** Unknown represents the existing disturbance conducted under Notice of Intent (525 acres), two reasonably foreseeable future mine scenarios (1,700 acres, described below), and other exploration or unknown disturbance (8 acres).

TABLE 5.3-7

PROPOSED/PLANNED AND REASONABLY FORESEEABLE PROJECTS

Company	Project	Construction Schedule	Construction Jobs	Project Life	New Mining Jobs
U.S. Placer Dome	Pipeline	1994	185	1995-2008	265 (av)
U.S. Placer Dome	South Pipeline	1997-98	185	1997-2011	265 (av)
Santa Fe Gold	Mule Canyon	1993-95	375-500	1994-2010	225-350
Barrick	Meikle	1993-95	100-250	1993-2005	220
Newmont	Gold Quarry Expansion	1993-94	77-760	--	0
Dee Gold	Expansion	--	50-70	1994-2005	30
Dee Gold	Underground	--	20-30	--	0
Independence Mining	Jerritt Canyon Mine Expansion	1994-95	0	1994-2007	150-200
Independence Mining	California Mountain	1993-94	0	--	0
Independence Mining	New Tailings Impoundment	1994	70	--	0

TABLE 5.3-8

SHORT- AND LONG-TERM EMPLOYMENT ASSOCIATED WITH PROPOSED/PLANNED/REASONABLY FORESEEABLE PROJECTS

Year	Pipeline		South Pipeline		Mule Canyon		Meikle		Gold Quarry		Other Projects		Total	
	Construction[a]	Operations	Construction	Operations	Construction[a]	Operations	Construction[a]	Operations	Construction[a]	Operations	Construction	Operations	Construction	Operations
1993	--	9	--	--	--	--	100	20	356	--	--	--	456	29
1994	185	181	--	--	250	100	250	100	278	--	170	230	1133	611
1995	--	282	--	--	250	240	20	220	--	--	170	230	440	972
1996	--	269	--	--	--	290	--	220	--	--	170	230	170	1009
1997	--	274	185	265	--	290	--	220	--	--	--	230	185	1279
1998	--	272	--	265	--	290	--	220	--	--	--	230	--	1277
1999	--	266	--	265	--	290	--	220	--	--	--	230	--	1271
2000	--	261	--	265	--	290	--	220	--	--	--	230	--	1266

[a] Construction workforce will vary each quarter. The average construction workforce is reported here.

TABLE 5.3-9

CUMULATIVE CONSTRUCTION PHASE IMPACTS (1994): NON-LOCAL WORKERS

Community	Pipeline		South Pipeline[1]		Mule Canyon		Meikle		Gold Quarry		Others		Total		Dependents[2]	Total New Population
	Single	Married	Single	Married	Single	Married	Single	Married	Single	Married	Single	Married	Single	Married		
Elko	81	26	--	--	72	18	126	32	140	35	85	22	504	133	335	972
Carlin	17	--	--	--	36	9	54	13	60	15	37	9	204	46	116	366
Battle Mountain	22	7	--	--	72	18	--	--	--	--	--	--	94	25	63	182
Beowawe	5	--	--	--	--	--	--	--	--	--	--	--	5	--	--	5
Crescent Valley	7	--	--	--	--	--	--	--	--	--	--	--	7	--	--	7
	132	33			180	45	180	45	200	50	122	31	814	204	514	1532
Local Workers		20				25		25		28		17		115		
Project Total		185				250		250		278		170		1133		

[1] It is assumed that construction on South Pipeline project would not occur until 1997.
[2] Based on an average married-couple family size of 3.52 for non-local married construction workers.

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TABLE 5.3-10

CUMULATIVE OPERATIONS PHASE IMPACTS BASED ON AVERAGE WORKFORCE: NON-LOCAL WORKERS

Community	Pipeline		South Pipeline		Mule Canyon		Meikle		Gold Quarry[a]		Others[b]		Total		Dependents[c]	School-Aged Children[d]	Total Population
	Single	Married	Single	Married	Single	Married	Single	Married	Single	Married	Single	Married	Single	Married			
Elko	6	17	26	77	22	65	28	87	--	--	22	66	104	312	951	446	1367
Carlin	2	7	10	30	10	33	12	37	--	--	9	28	43	135	411	193	589
Battle Mountain	1	3	5	14	22	65	--	--	--	--	--	--	28	82	250	117	360
Beowawe	0	1	1	4	--	--	--	--	--	--	--	--	1	5	15	7	21
Crescent Valley	4	12	18	54	--	--	--	--	--	--	--	--	22	66	201	94	289
	13	40	60	179	54	163	41	124	--	--	31	94	198	600	1,828	857	2,626
Local Workers		17		26		73		55				80		201			
Project Total		70		265		290		220				205		999			

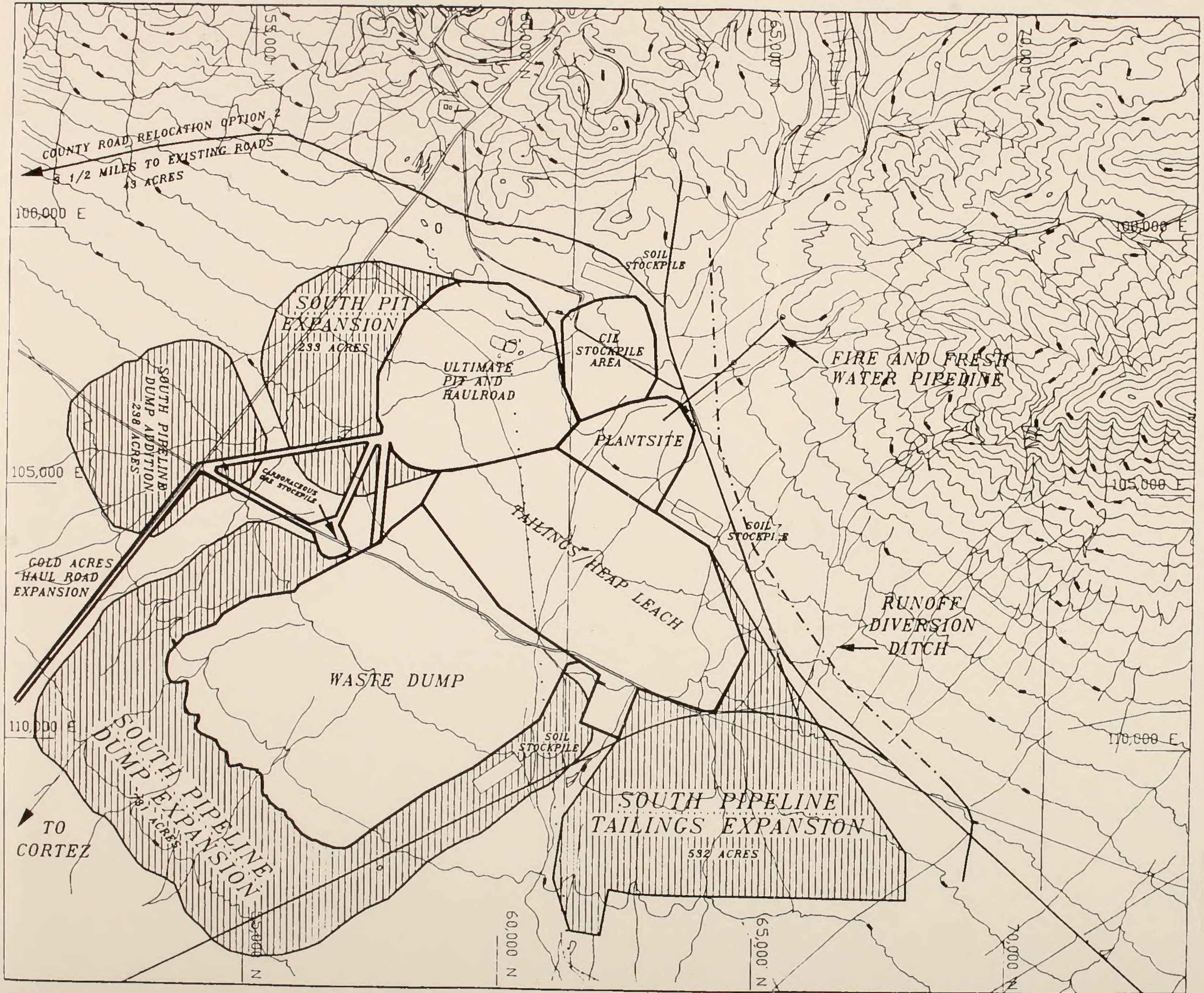
[a] No new permanent mining jobs.
[b] It is assumed that the 30 new mining jobs at Dee Gold would be filled by local hires. No non-local workers would be required; of the 200 new operation jobs at Jerritte Canyon, 50 would be filled by local hires.
[c] Based on average married-couple family size of 4.05 persons.
[d] Based on 1.43 school-aged children per nonlocal household.

TABLE 5.3-11

CUMULATIVE IMPACTS (INCLUDING FORESEEABLE FUTURE) TO LIVESTOCK GRAZING (ACRES AND AUMS)[a]

Category	Allotment	Area	Acres		AUMs	
			Public	Private	Public	Private
1. Existing Disturbance	Carico	Cortez	704	742	20	46
	Carico	Gold Acres	657	224	42	14
	study area-wide	Other[b]	1,848	104	158	9
Sub-total			3,209	1,070	220	69
2. Proposed Action	Carico	Gold Acres	1,768		98	
Sub-total			1,768		98	
3. Foreseeable Future	Carico	Cortez	783		28	
	Carico	Gold Acres	2,092		101	
	study area-wide	Other Exploration	951		73	
	study area-wide	Small Mine	200		11	
	study area-wide	Large Mine	1,500		82	
Sub-total			5,526		295	
TOTAL			10,503	1,078	613	69
4. Seedings[c]	Carico	Study area-wide	+842		+184	

[a] Number of AUMs is estimated, and is based on BLM Range Survey data for the Cortez Unit (BLM 1964-1967).
[b] Other than Cortez Gold Mine.
[c] Based on Foreseeable Future rangeland seedings within the study area portion of the Carico Lake Grazing Allotment. Stocking is based on 6 acres per AUM.

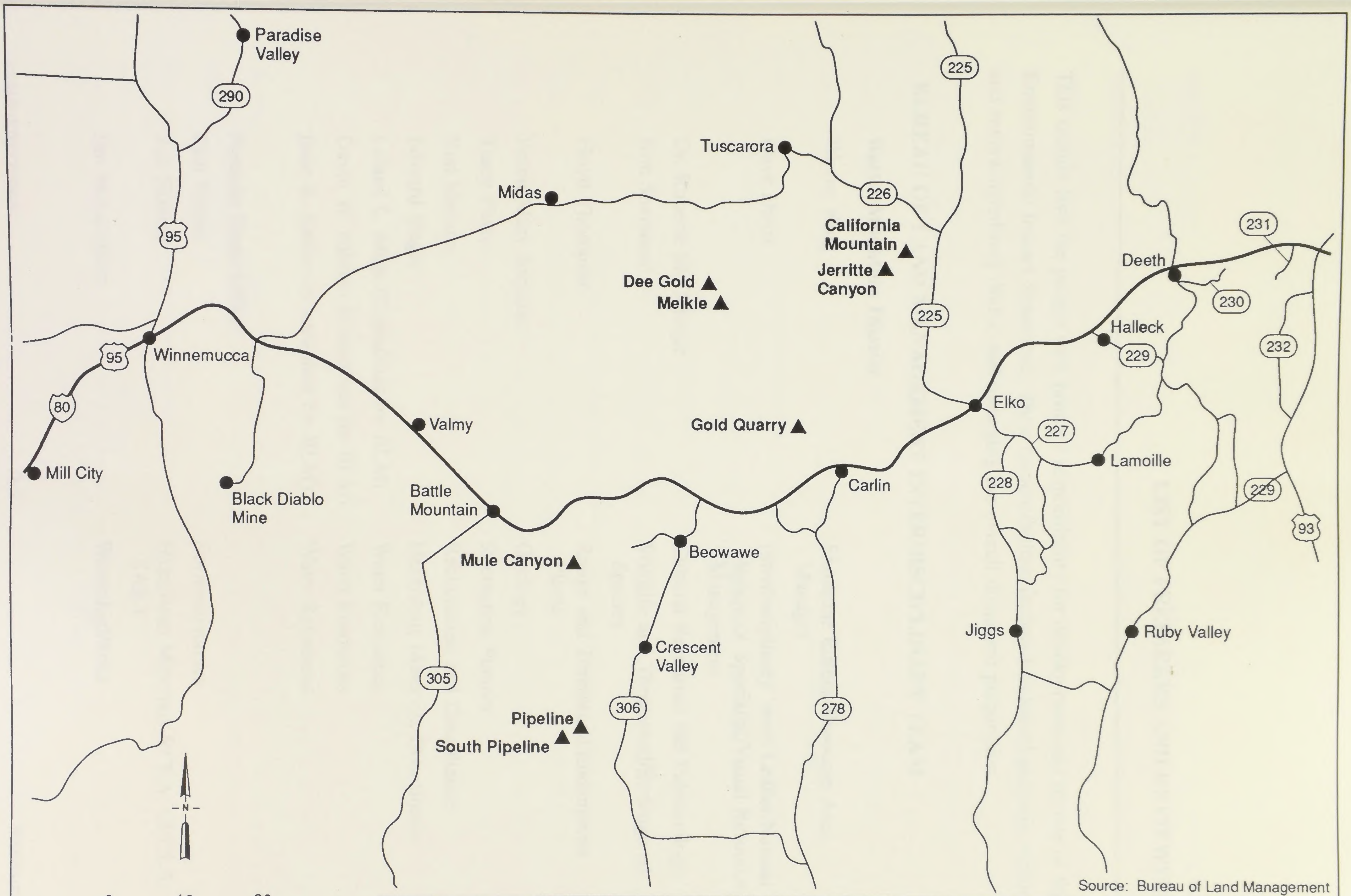


KEY

Potential south pipeline expansion areas

Source: Cortez Gold Mines

CONCEPTUAL SOUTH PIPELINE DEPOSIT SURFACE DISTURBANCE	Figure 5.2-1
Project No. 92C0756A	Pipeline Deposit EIS



Project No. 92C0756A	Pipeline Deposit EIS	REASONABLY FORESEEABLE PROJECTS IN THE STUDY AREA	Figure 5.9-1

92C0756A-0010/110493

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LELAND L. MINK

EDUCATION

1965 B.S. Math/Science Education, Idaho State University

1971 M.S. Hydrology, "Effect of Industrial and Domestic Effluents on the Water Quality of the Coeur d'Alene River Basin," University of Idaho

1973 Ph.D. Geology, "Evaluation of Settling Ponds as Treatment Devices For Mine Waste Water," University of Idaho

SHORT COURSES

1972-1973	Geothermal Resource Council Geothermal Exploration, Sacramento, California
1974	Montana State University Geothermal of Yellowstone Park, Bozeman, Montana
1977	Los Alamos Scientific Laboratory Reservoir Engineering, Los Alamos, New Mexico
1980	U.S. Government Effective Supervision Development, Portland, Oregon
1980	American Petroleum Institute Well Drilling Technology, Idaho Falls, Idaho (correspondence)
1981	U.S. Government Management Development, Phoenix, Arizona
1983	Geothermal Drilling, GRC, San Francisco, California
02/86	Practical Aspects of Groundwater Modeling, Boise, Idaho

ADVANCED COURSES

1987	OSHA Hazardous Waste Site Operations Safety Training, MKE, Boise, Idaho
1989	Project Management Training, MKE, Boise, Idaho

Twenty years experience in performing and managing hydrological evaluations and management of hazardous and radioactive waste projects. Currently specializes in groundwater and geothermal resource evaluations and development. Conducts exploration activities aimed at potential development of groundwater and geothermal resources. Involved in environmental studies relating to groundwater contamination and migration of hazardous waste.

Experience in managing and conducting water quality studies, groundwater hydrology investigations, surface water hydrology investigations, and geochemistry analyses at several hazardous waste and environmentally sensitive sites. These include hazardous waste spills, landfill operations, urban runoff, agricultural runoff, mining operations and energy development projects. Involved in scoping the investigations, conducting the field data collection including drilling and sampling, performing data and laboratory analysis, and writing formal reports. Experience includes analytical and numerical modeling techniques for both groundwater and surface water studies.

Active management experience on hazardous waste projects has provided an in-depth understanding of environmental and regulatory policy, particularly related to RCRA and CERCLA. Experienced in providing technical support and expert testimony at public and professional meetings, congressional hearings, and court cases.

EXPERIENCE

09/64	Teaching Assistant, Department of Geology, Idaho State University, Pocatello, Idaho
02/65	2nd Lieutenant, Artillery Officer, 4th Division Artillery, Fort Lewis, Washington
09/65	1st Lieutenant, Forward Observer, 1st Air Cavalry, Viet Nam
11/66	1st Lieutenant, Escort Officer, Visitor's Bureau, Fort Sill, Oklahoma
02/71	Captain, U.S. Army Reserve, Moscow, Idaho
02/67	Junior High Math Instructor, Jerome School District #261, Jerome, Idaho
09/67	Junior High Math/Science Instructor, Douglas County School District, Zephyr Cove, Nevada
05/68	Field Assistant, Idaho Bureau of Mines and Geology, Moscow, Idaho
09/68	Teaching Assistant, Department of Geology, University of Idaho, Moscow, Idaho
09/69	Research Assistant, College of Mines, University of Idaho, Moscow, Idaho

01/72 Hydrogeologist, Idaho Bureau of Mines and Geology, Moscow, Idaho
(Transferred in June, 1972 to Boise, Idaho, to set up a branch office at Boise State University)

Administered branch office of Idaho Bureau of Mines and Geology at Boise. Conducted and published investigations relating to Idaho geology and hydrology. Worked with and advised the general public and local industries on geological and hydrological matters. Assisted the Idaho legislature and elected officials dealing with Idaho minerals, water, and land status. Involved with other State agencies conducting short courses. Performed teaching and research one-quarter time with Boise State University in the areas of groundwater hydrology and environmental sciences.

02/72 Associate Professor, Department of Geology Boise State University Boise, Idaho

Instructed courses in groundwater geology, environmental geology, structural geology, fundamentals of geology, and advised 25 to 30 students. Principal investigator for research grants with the Corps of Engineers, ERDA (Energy Research and Development Agency), and NSF (National Science Foundation). Co-principal investigator for two grants with the University of Idaho and one with Idaho State University.

09/76 Research Geohydrologist, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada

Managed grants and contracts involving development of ground and surface water monitoring systems. Provided technical expertise in planning and assisting research programs aimed at developing and improving methodology for ground and surface water monitoring. Reviewed technical reports of private industry and other governmental agencies. Served as the Monitoring Systems Analysis representative on working groups for the development of ground and surfacewater monitoring technology.

04/77 Program Manager, U.S. Department of Energy, Resource Exploration & Assessment Branch, Division of Geothermal Energy, Washington, D.C.

Worked with the Energy Research and Development Administration in forming and managing the resource assessment and reservoir engineering program within the Division of Geothermal Energy. Interfaced with high level federal and administrative and congressional personnel dealing with budget and programmatic matters. Established long-term program plans and guidelines for geothermal development. Formed and monitored programs with national laboratories, universities, and state agencies. Established liaison with other federal programs and agencies, and with the private sector involved in geothermal exploration and development. Managed major international cooperative geothermal programs with Italy and Mexico.

06/78 Physical Scientist, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Served as the principal expert in hydrology for the Resource Definition Branch. Provided program management for geoscience, resource definition, and drilling programs. Responsible for the identification, location, and characterization of geothermal resources for the states west of the Mississippi. Responsible for planning and evaluating functions for the various program elements as well as being involved in interpreting, reporting, and distribution of the conclusions of these programs. Principal areas of activity involved exploration technology, geothermal resource characterization, and drilling these resources. Determined need and recommended new direction which helped accelerate commercial development of geothermal energy. Provided evaluation and technical direction of contractor cork developing new concepts or equipment.

06/79 Chief, Resource Definition Branch, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Managed the Resource Definition Branch of the Office of Geothermal Energy. Involved supervision of a staff of two professional people and daily contact with personnel from DOE-HQ, subcontractors, national laboratories, foreign and domestic scientists, and the general public. Served as Technical Program Manager in a decentralized operation mode to DOE-HQ for the following national geoscience programs: Reservoir Engineering; Exploration Technology and Development; State Resource Assessment; and Industry-Cost Share Drilling Program. Duties included scoping, developing, and monitoring the technical aspects of these national programs and interfacing with DOE-HQ on major programmatic decisions. Served as the principal expert in hydrogeology and reservoir engineering for the energy Technology Division.

09/80 Chief, Geothermal Energy Branch, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Managed the Geothermal Energy Branch which involved the direct supervision of four personnel. Responsible for the implementation, management, termination, and reporting of a variety of programs designed to stimulate the development of geothermal resources. Developed technology and the methods by which those resources were to be used as a viable energy source. Provided leadership and expert advice within the Department on a national and regional scale to other agencies and the general public for the total geothermal program. Emphasis was placed on those hydrothermal systems of the Western States and the Economical and environmentally acceptable approaches to developing those systems.

Coordinated the geothermal program managed through the Idaho Operations Office with other Branches such as Low-Head Hydro, Alcohol, Biomass, Municipal Waste, and Conservation. Served as a member of national committees or groups which formulated fundamental policies and determined national priorities for existing and required programs. Established new programs and evaluated existing research and development activities. Developed standards and guides for use in selecting, funding, and managing new activities.

Responsible for 13 major programs involving over 100 individual contracts with a combined annual budget in excess of 30 million dollars. These programs involved several major national projects such as exploration technology, geothermal drilling, reservoir engineering, DOD MX/RES Missile program, and Raft River 5mw. binary power plant.

12/81	Staff Hydrologist, Mining Group, Morrison-Knudsen Company, Inc., Boise, Idaho Mining Managed projects relating to hydrology, resource investigation, waste management, energy development, and environmental technology. Supervised projects involving geothermal resources, geohydrology, reservoir engineering,and mining hydrology, as well as environmental baseline studies, mine reclamation studies, alternative energy resource investigations, groundwater modeling, and acid mine drainage problems.
01/82	Instructor, Hydrogeology and Geothermal Geology, Boise State University, Boise, Idaho
11/83	Senior Design Project Engineer, Hydrology, Morrison-Knudsen Company, Inc., Boise, Idaho Senior Manager on projects relating to hydrology, resource investigation, waste management, energy development, and environmental technology. Major emphasis on projects involving geothermal development, geohydrology, reservoir engineering, and mining hydrology, as well as hazardous waste remedial investigation and feasibility studies. Also responsible for projects relating to mine reclamation studies, alternative energy resource investigations, groundwater modeling, acid mine drainage problems, and hydrologic impacts of nuclear waste terminal storage. Has been involved in several groundwater development projects with wells ranging from 1,000 to over 4,000 feet deep.
01/86	Staff Design Project Engineer/Manager, Morrison-Knudsen Engineers, Inc. (Formerly Morrison-Knudsen Company, Inc.) Boise, Idaho Manages projects relating to hydrology, resource investigation, waste management, energy development and environmental technology. Has supervised projects involving geothermal resources, geohydrology, reservoir engineering, and mining hydrology, as well as environmental baseline studies, mine reclamation studies, alternative energy resource investigations, ground water modeling, acid mine drainage problems, and hydrologic impacts of nuclear waste terminal storage.
01/88	Manager, Hydrology/Geosciences, Morrison-Knudsen Engineers, Inc.Boise, Idaho Currently is Manager of Hydrologic Services for MKE's Hazardous Waste and Environmental Division specializing in remedial investigations, site assessments, feasibility studies, and remedial action for hazardous waste sites. Project experience includes management of site investigation and assessment, feasibility studies, and regulatory analyses work for a confidential RCRA site in Idaho. Also managed cleanup activities at a Utah railroad maintenance and switchyard facility which included site inspection, remedial investigation, feasibility studies, and remedial action alternatives. Assessed geologic, hydrologic, and soil conditions to characterize the hydrological regime as a basis for remedial planning. Major projects include investigations and site assessments to study the impacts of mining activities on groundwater resources and surface water quality and quantity in Idaho, investigation of contamination of groundwater from various spill and disposal activities at numerous hazardous waste sites, and assessment of groundwater impacts from a proposed high-level radioactive waste isolation facility. Has also been involved in several water well development and geothermal exploration projects for wells ranging from 1,000 to over 10,000 feet deep. Managing a major geothermal drilling and power development project in Guatemala.
89-present	Director, Idaho Water Resources Research Institute, University of Idaho, Moscow, Idaho.

BIOGRAPHICAL SKETCH

David W. Allman

Education

1964	B.S., Geology; McMaster University, Ontario, Canada
1968	M.S., Geology; University of Illinois, Urbana, Illinois
1973	Ph.D., Geology; University of Idaho, Moscow, Idaho

Professional Experience

1987 - present	Retired
1981 - 1987	Sr. Scientist, Geosciences Section, Earth and Life Sciences Branch, EG&G Idaho, Inc., Idaho Falls, Idaho. Group Leader, Hydrology Work Group; hydrology of geothermal resources and radioactive waste management site; review reports for siting high-level radioactive waste disposal facilities.
1979 - 1980	Visiting Research Scientist, University of Idaho, Moscow, Idaho. Hydrogeology instructor.
1978 - 1979	Associate Scientist, Geosciences Section, Earth and Life Sciences Branch, EG&G Idaho, Inc., Idaho Falls, Idaho. Hydrogeologic evaluation of geothermal projects; assisted in design of weighing soil lysimeter.
1975 -1978	Supervisor Prof. II, South Florida Water Management District, West Palm Beach, Florida. Supervised field-oriented projects for ground water division; technical input for Dade, Co. sewage injection wells; studied seepage problems of a canal in South Dade County.

1973 - 1975 — Hydrologist, Southwest Florida Water Management District, Brooksville, Florida.
Evaluated geology, hydrology and geochemistry of major well fields; assisted in developing well field monitoring programs; assisted in development of regional water supply plan.

1972 - 1973 — Environmental Geologist, Illinois U. S. Environmental Protection Agency, Springfield, Illinois.
Reviewed engineering and hydrogeologic aspects of applications for sanitary landfill permits.

1967 - 1972 — Graduate Student, University of Idaho, Moscow, Idaho.
Designed, installed and assisted in data collection for piezometers, neutron soil moisture access tubes and parshall flumes in an irrigated alfalfa field study.

1965 - 1967 — Graduate Student, University of Illinois, Urbana, Illinois.
Assisted in base flow study of Illinois streams.

1962 - 1965 — Field Assistant, Geological Survey of Canada, Ottawa, Ontario.
Assisted in ground water survey of Old Wives Lake Drainage Basin, Saskatchewan and well inventory near Winnipeg, Manitoba.

BIOGRAPHICAL SKETCH

Name: Dale R. Ralston

Education:

1964 B.S. Civil Engineering, Oregon State University
1967 M.S. Hydrology, University of Arizona
1974 Ph.D. Civil Engineering, University of Idaho

Professional Experience:

1970-present, Department of Geology, College of Mines and Earth Resources, University of Idaho.
1970-76, Assistant Professor of Hydrogeology, Part-time
1976-1981, Associate Professor of Hydrogeology
1989, Acting Director, Idaho Water Resources Research Institute
1981-present, Tenured Full Professor of Hydrogeology
1976-present, Consulting Hydrologist, part-time consultant in hydrology for well development, environmental problems and expert witness for legal cases
1970-1976, Supervisory Geologist, Idaho Bureau of Mines and Geology, Moscow, Idaho.
1967-1970, Assistant Director, Idaho Department of Water Administration, Boise, Idaho.
1966, Hydraulic Engineer, U.S. Geological Survey, Portland, Oregon.
1964-1965, Civil Engineer, California Department of Water Resources, Sacramento, California.

Honors:

Outstanding Faculty Award for Teaching and Research, 1983.
Excellent student evaluations.
Host for Fullbright Scholar from Kenya, 1985
Appointed by Governor Evans for Task Force on Envirosafe Hazardous Waste Disposal Site, 1985
Appointed by Governor Evans and confirmed by State Senate to serve on State Hazardous Waste Management Planning Committee, 1986.
Appointed by Governor Andrus to serve on State Ground Water Quality Council, 1989-1993.

International Involvement:

Presented papers in meetings in Spain (2), Australia and Hungary.

Participated in the University of Idaho A.I.D. program in Pakistan.

Registration and Membership in Professional Organizations:

Registered Professional Engineer, No. 2004, Idaho
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U.S. Army Corps of Engineers
Regulatory Section
Sacramento, CA 95814-2922

Eureka County Commissioners
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Branch of Mineral Assessment
Bureau of Mines
DOI
Washington D.C., 20240 (2)

Bureau Of Reclamation
Denver Federal Center (D-150)

Chief, Division of Environmental Coordination
Fish & Wildlife Service
DOI
Washington D.C., 20240

Minerals Management Services
Offshore Environmental Assessment Division
Minerals Management Service
DOI
Washington D.C. 20240

National Park Service
Division of Environmental Compliance (762)
DOI
Washington D.C., 20240 (4)

DOI-US Geological Survey
Environmental Affairs Program
National Center (423)
Reston, VA 22092 (3)

Office of Deputy A/S of the USAF
Environment, Safety, Occupational Health
SAF/RQ Room 4C916, Pentagon
Washington D.C. 20330-0001

HQ-USAF/LEEV
Environmental Division
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Chief, Planning Division
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Eureka, NV 89316

Department of Interior-USGS
Environmental Affairs Program

Office of Deputy A/S of the USAF
Environment, Safety, Occupational Health

HQ-USAF/LEEV
Environmental Division
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Chief, Planning Division
South Pacific Ocean Division
Army Corps Of Engineers

Office of Environmental Compliance (EH-23)
Department Of Energy

Office of Federal Activities
U.S. Envionmental Protection Agency
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9.0 GLOSSARY

Acid Generating Potential - The amount of acid-producing constituents in a given material. For rock material, the total sulfur concentration is determined, assumed to be reactive sulfide, and reported in terms of calcium carbonate equivalent per mass of material.

Acre-Foot - Volume of water covering 1 acre one foot deep; equal to 325,900 gallons.

Annual Duty - The maximum permitted volume of water which may be pumped from a designated hydrographic basin.

Ball Mill Circuit - Fine grinding of ore to a desired size is completed by circulating the material in a closed circuit consisting of grinding and size classification operations. Steel balls are used as the grinding medium and the grinding mill discharge is sorted such that properly sized material leaves the circuit while oversize material is returned for further grinding.

Carbon Adsorption Circuit - A vessel or system of vessels containing activated carbon. As the gold-bearing solution passes through the system, the carbon adsorbs the dissolved gold; subsequently, the "loaded" carbon is removed from the circuit, stripped of gold, reactivated, and returned to the adsorption circuit.

Carbon-in-Leach - The process where activated carbon capable of adsorbing gold is introduced into the ore-leaching circuit as opposed to passing the leach solution through a separate carbon adsorption circuit.

Carbonaceous/Oxide Ore - Two general ore types occur in mineral deposits mined in the Cortez project area: (1) carbonaceous ore refers to mineralized material which requires a pre-treatment step (such as roasting) prior to successful recovery of gold values by conventional cyanide tank leaching methods; and (2) oxide ore refers to mineralized material which is mildly carbonaceous to oxidized in nature and for which effective recovery of gold values can be achieved by direct processing using conventional cyanide leaching methods.

Circulating Fluid Bed Roaster - A mineral processing equipment system which achieves a desired reaction by controlled circulation and heating of ore material in a suspended form. This process is used to pre-treat difficult ores which otherwise would not respond effectively to conventional cyanide tank leaching.

Class II Cultural Resources Report - A professionally conducted statistical sample survey designed to characterize the probable density, diversity, and distribution of cultural resources in a designated area.

Class III Cultural Resources Report - A professionally conducted continuous intensive survey of the entire area of potential effect.

Cyanidation - A mineral liberation process by which a cyanide compound is used to dissolve gold or silver values occurring in the ore.

Cyanide Leach Countercurrent Decantation (CCD) - In metallurgical plants which use cyanide to extract gold from the ore, this processing step can be employed to separate an enriched gold solution from the rock pulp.

Diversion Rate - The maximum permitted rate at which water may be pumped from a designated hydrographic basin.

Euroamerican - American of European descent or origin.

Fluxes - Substances which aid in controlling the melting or fusibility of a metal during refining or fire assaying.

Freeboard - For an impoundment, pond, or dam: the vertical distance between the maximum operating level and the embankment crest which is provided by design to account for wave action.

Free Cyanide - This term refers to the analytical method used to determine the simple cyanide concentration. Free cyanide is considered to represent available cyanide, e.g., that which has not combined with other substances to form simple or complex cyanide compounds.

GPM - A measure of water flow rate; gallons per minute.

Heap Leach Ore - Lower-grade ore of sufficient gold value to justify processing by heap leach methods: that is, ore is placed upon a constructed pad over which a cyanide solution is applied. Gold is leached from the ore as the cyanide solution percolates through the heap and is recovered as the solution is collected and processed.

Heap Leaching - The process whereby lower-grade ore is placed on a constructed pad over which a low concentration of cyanide solution is applied. Gold is leached from the ore as the cyanide solution percolates through the heap and is recovered along the periphery of the heap in collection ditches for further processing (see Carbon Adsorption Circuit) to recover the gold.

Leach Solution - A cyanide solution applied to the heap leach ore as a means of extracting the gold values. The solution is a "barren" solution when applied to the heap and a "pregnant" solution when collected from the heap.

Lift - A single vertical interval in the placement of fill material.

Mass Stability - The degree to which a rock or soil mass will remain permanently in place. Slope angle, rock or soil characteristics, type of foundation materials, seismic risk, and surface and groundwater conditions are factors affecting mass stability.

National Register of Historic Places - This country's basic inventory of historic resources which is maintained by the Secretary of the Interior.

Neutralizing Potential - The amount of alkaline or basic constituents in a given material. The capacity of this material to neutralize acidity is determined and reported in terms of the equivalent mass of calcium carbonate per mass of material.

Oxidized Ore - Mineralized rock which is comprised predominantly of oxidized or weathered rock types and is of sufficient economic value to justify mining and recovery costs.

Patented Mining Claim - A parcel of mineral land for which the Federal Government has conveyed title to the private sector.

Projectile Point - A sharpened stone or other material attached to the end of a dart, spear, or arrow shaft.

Reagent - A substance used to chemically react with another substance to create or maintain a desired product or process condition.

SAG Mill - Semiautogenous grinding mills accomplish ore size reduction by using large pieces of the "as-crushed" ore, along with a small charge of steel balls, as the grinding media.

Secondary Flake - A chipped stone that has no cortex (outer weathered surface from the stone the flake came from) or pressure flaking (flaking pattern that results from directly applying pressure to a stone to create a finely flaked edge).

Stamp Mill - An outdated method of mineral processing which employed a mechanical stamping device to reduce the size of the ore followed by liberation and recovery of the precious-metal values.

Unpatented Mining Claim - A parcel of mineral land for which the Federal Government maintains title.

Weak Acid Dissociable (WAD) Cyanide - This term refers to the analytical method used to determine the weakly bound complexes of the cyanide compound and is generally considered to include free cyanide and the less-stable metallo-cyanide complex compounds. Iron and cobalt cyanide complexes are more stable and typically do not report as WAD Cyanide.

APPENDIX A
PALEONTOLOGICAL ASSESSMENT

[illegible] - Mineralized rock which is comprised predominantly of [illegible] of sufficient economic value to justify mining and processing.

Patented Mining Claim - A parcel of mineral land for which the Federal Government has conveyed title to the private owner.

Projectile Point - A chipped stone or other material attached to the end of a dart, spear, or arrow shaft.

Reagent - A substance used to chemically react with another substance to create or maintain a desired product or process condition.

SAG Mill - Semi-autogenous grinding mills accomplish ore size reduction by using large pieces of the "as-crushed" ore, along with a small charge of steel balls, as the grinding media.

Secondary Flake - A chipped stone that has no cortex (outer weathered surface) from the stone the flake came from, or pressure flaking (flaking pattern that results from directly applying pressure to a stone to create a finely flaked edge).

Stamp Mill - An outdated method of mineral processing which employed a mechanical stamping device to reduce the size of the ore followed by flotation and recovery of the precious-metal values.

Unpatented Mining Claim - A parcel of mineral land for which the Federal Government retains title.

Weak Acid Dissociable (WAD) Cyanide - This term refers to the analytical method used to determine the weakly bound complexes of the cyanide compound and is generally considered to include free cyanide and the less stable metal-cyanide complex compounds. The more stable cyanide complexes are more stable and typically do not report as WAD cyanide.

PALEONTOLOGICAL ASSESSMENT OF THE CORTEZ DISTRICT WITHIN PORTIONS OF THE BATTLE MOUNTAIN AND ELKO BUREAU OF LAND MANAGEMENT DISTRICTS, NEVADA

Prepared for JBR CONSULTANTS GROUP
By: James R. Firby, Consulting Paleontologist April 23, 1991

INTRODUCTION:

All known fossil localities within the proposed area are evaluated for potential of paleontological resource. No fossil vertebrate localities were confirmed to be within the affected or cumulative areas from literature search, Bureau of Land Management paleontological inventories, or queries to other paleontologists. All known fossil localities are included in this report, and located on an overlay of the 1:100,000 Crescent Valley surface management map, 1979 edition. The potential for the occurrence of vertebrate fossils is real, but considered to be low. Sensitivity of known invertebrate sites is based on their assigned ratings in the BLM inventory series (Firby et al, 1983 and 1984, non published documents prepared for BLM districts of Nevada). In this rating scheme, the most sensitive rating would be S-1 and the least sensitive S-3; the majority of all localities within the Cortez district is S-3. No fossil localities are known from the Black Beauty area.

This report is divided into a description and location of each fossil locality, its sensitivity, and known faunal assemblage. The bibliographical part is annotated as to the significance of the reference. Locality numbers given on the overlay follow the BLM inventory numbers, with the additional numeric code of the

Smithsonian standard usage given for those localities within the Battle Mountain District. In this system, requested by the BLM during preparation of that report, all states, districts or counties are numbered; additionally the type of locality (vertebrate, invertebrate, or plant) is numbered corresponding to the numeric position of v, i, or p in the alphabet. This code is then followed by the site number. For example, Nevada is 26, the Battle Mountain District in Lander County is 63, invertebrate paleontological resources are 09, and the last four digits are the site number. Thus, site I-0103 on the overlay is 2663090103. The Battle Mountain BLM inventory is the only one prepared in this way, previous inventories have only district site numbers, for example the I-0103, above. Institution locality numbers is also given, when known.

REGISTER OF FOSSIL LOCALITIES FOR CUMULATIVE AREA

A. Elko District

1. I-84 NE 1/4 Of NW 1/4, section 9, T. 26 N., R. 48 E. This equals United States National Museum (USNM) locality D 92 - SD, Fourmile Canyon Formation, Silurian. Sensitivity level S-2. Fauna: graptolites. Apparently a large collection of graptolites from this locality is housed at USNM.

2. I-091 NW 1/4 Of SW 1/4, section 14, T. 27 N., R. 48 E. Devonian (?) Fourmile Canyon [formation not reported, Fourmile probably refers to location], invertebrate fauna: corals.

3. Not plotted locality south of boundary, in section 17 of T. 25

N., R. 49 E., there are several vertebrate [Devonian fish] localities in the Windmill limestone which have USNM numbers 155931 through 155938 which are rated S-2; included here as information item in regard to any possible occurrences within the cumulative area.

B. Battle Mountain District.

1. I-0101 (2663090101); equals United States Geological Survey (USGS) locality D-104, listed in Bridges' catalog of Cambrian and Ordovician localities, an unpublished document of the Survey and hereafter referred to as Bridges' Catalog in this report. Age: Ordovician, formation not noted. Major reference for this and other Ordovician graptolite localities is Ross and Berry, 1963 (see annotated bibliography). Locality is center section 31, T. 28 N., R. 47 E., UTM coordinates are 484,000 easting, 2,032,250 northing. rated as S-3. Fauna: graptolites.

2. I-0100 (26633090100); equals USGS D-103, Bridges' Catalog. Age: Ordovician, formation not noted. Locality lies in the NW 1/4 of the section 25, T. 29 N., R. 46 E., UTM coordinates are 474,300 easting, 2,008,750 northing. Rating S-3, fauna: graptolites.

3. I-0102 (2663090102); equals USGS locality D-93 (Altenburg Hill locality 1), Bridges' Catalog. Age: Ordovician, formation not noted. Locality is center section 17, T. 28 N., R. 47 E., southwest of Altenburg Hill at elevation 5,520'; UTM coordinates 489,000 easting, 2,019,080 northing. Rated S-3, fauna: graptolites.

4. I-0103 (2663090103); equals USGS 106 (Altenburg Hill 2),

Bridges' Catalog. Age: Ordovician, formation not noted. Locality is in NE 1/4 section 17, T. 28 N., R. 47 E., at elevation 5,640'; UTM coordinates 489,200 easting, 2,016,800 northing. Rated S-3, fauna: graptolites.

5. I-0104 (2663090104); equals USGS D-111, Bridges' Catalog. Age: Ordovician, formation not noted. Locality is in NW corner section 34, T. 29 N., R. 46 E., no UTM data. Rated S-3, fauna: graptolites.

6. I-0105 (2663090105); equals USGS D-112, (Cook Creek Divide locality), Bridges' Catalog. Age: Ordovician, formation not noted. Locality is in NE 1/4 section 14, T. 28 N., R. 45 E., South Fork of Cooks Creek divide, east of Mill Creek summit, no UTM data. Rated S-3, fauna: graptolites.

7. I-0106 (2663090106); equals USGS D-113, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in NE 1/4 of the SW 1/4, section 36, T. 29 N., R. 46 E., at elevation 5,860 feet, 1,500 feet north of bench mark 5584 at junction of Feris and Indian creeks. No UTM. Rated S-3, fauna: graptolites.

8. I-0107 (2663090107); equals USGS locality D-114, Feris Creek Junction locality, Bridges' Catalog. Age: Ordovician, formation not noted. Locality is east of center of section 2, T.28 N., R. 46 E., south of Feris Creek junction with Indian Creek, no UTM data. Rated S-3, fauna: graptolites.

9. I-0110 (2663090110); equals USGS locality D-117, Bridges' Catalog. Locality is 600' east of SW corner section 23, T. 29 N., R. 46 E., no UTM data. Age: Ordovician, formation not noted. Rated

S-3, fauna: graptolites.

10. I-0113 (2663090113); equals USGS D-122, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in the SE 1/4 of the NW 1/4, section 9, T. 29 N., R. 45 E., at elevation 7,600' on north side of Crippen Canyon, UTM coordinates 429,250 easting, 2,057,100 northing. Rated S-3, fauna: graptolites.

11. I-0115 (2663090115); equals USGS locality D-125, Bridges' Catalog. Age: Ordovician, no formation noted. Locality lies on spur just west of center of border between sections 28 and 27, T. 29 N., R. 46 E., at elevation 6,200', no UTM data. Rated S-3, fauna: graptolites.

12. I-0116 (2663090116); equals USGS locality D-127, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in the NE 1/4 of the NW 1/4, section 31, T. 28 N., R. 46 E., 800 feet south, 3,600 feet west of northeast corner of section 31; no UTM data. Rated S-3, fauna: graptolites.

13. I-0117 (2663090117); equals USGS locality D-128, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in the NW 1/4 of section 12, T. 28 N., R. 45 E., at elevation 8,200', north of head of south fork of Mill Creek; no UTM data. Rated S-3, fauna: graptolites.

14. I-0118 (2663090118); equals USGS locality D-118, Bridges' Catalog. Age: Ordovician, no formation noted. Locality data is not precise; about center of western 1/2 of section 23, T. 28 N., R. 46 E., at elevation 6080' on spur SW of bench mark 5740, SE of Utah Mine Camp; no UTM data. Rated S-3, fauna: graptolites.

15. I-0119 (2663090119); equals USGS locality D-123, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in SE 1/4 of section 22, T. 28 N., R. 46 E., at elevation 6,160' on NE spur of hill 6821, 3,500' WSW of BM 5740, SE of Utah Mine. No UTM data. Rated S-3, fauna: graptolites.

16. I-0120 (2663090120); equals USGS locality D-121, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in SE 1/4 of section 15, T. 28 N., R. 46 E., at elevation 6,480', +/- 1 1/2 miles E of Utah Mine Camp, on SE spur of hill 6838 (= hill 2084 of Crescent Valley 1:100,000 map used in this report [6838 ref. Mt. Lewis 1:62,500 1949 quad.]). No UTM data. Rated S-3, fauna: graptolites.

17. I-0122 (2663090122); equals USGS locality C-130, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in NE 1/4 of section 10, T. 28 N., R. 45 E., at elevation 7,320'; no UTM data. Rated S-3, fauna: graptolites.

18. I-0123 (2663090123); equals USGS locality D-131, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in NW 1/4 of section 6, T. 28 N., R. 46 E., at elevation 8,260', on ridge. No UTM data. Rated S-3, fauna: graptolites.

19. I-0125 (2663090125); equals USGS locality D-102, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in center (?) section 25, T. 28 N., R. 46 E., no UTM data. Rated S-3, fauna: graptolites.

20. I-0127 (2663090126); equals USGS locality D-96, Bridges Catalog. Age: Ordovician, no formation noted. Locality is in NW

1/4 of section 6, T. 28 N., R. 47 E., at elevation 5,600'; UTM coordinates 481,650 easting, 2,029,250 northing. Rated S-3, fauna: graptolites.

21. I-0128 (2663090128); equals USGS locality D-97, Bridges' Catalog. Age: Ordovician, no formation given. Locality is in the SE 1/4 of the SE 1/4 of section 6, T. 28 N., R. 47 E., at elevation 6,080' on round-topped hill. UTM coordinates 488,200 easting, 2,029,650 northing. Rated S-3, fauna: graptolites.

22. I-0129 (2663090129); equals USGS locality D-98, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in W 1/2 of section 25, T. 28 N., R. 48 E., at elevation 6,000', on spur NE of mouth of Mule Canyon, Cortez Range. UTM coordinates 543,500 easting, 2,008,450 northing. Rated S-3, fauna: graptolites.

23. I-0130 (2663090130); equals USGS locality D-107, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is in NW 1/4 of section 19, T. 28 N., R. 47 E., at elevation 5,740', west side of quartzite ridge due north of Gold Acres. UTM coordinates 481,300 easting, 2,018,750 northing. Rated S-3, fauna: graptolites.

24. I-0131 (2663090131); equals USGS locality D-110, Bridges' Catalog. Age: Ordovician, no formation noted. Locality is west of center of section 21, T. 29 N., R. 46 E., at elevation 6,500', no UTM data. Rated S-3, fauna: graptolites.

MISCELLANEOUS LOCALITIES ADJACENT TO CUMULATIVE AREA: Not plotted

25. I-0140 (2663090140); equals USNM [U.S. National Museum] locality 17212, and equivalent localities of University California,

Riverside, 4553; also USNM locality 10807. Most of these localities differ in stratigraphic position and only slightly in geographic position. Age: Devonian (Givetian); Denay Formation. Although this locality lies south of the cumulative area boundary and within the Elko District of the BLM, it is included here due to its importance in invertebrate brachiopod research of the Great Basin. Additionally, it lies just north of the Devonian Red Hill localities, noted for fossil fish (placoderms). Locality is in section 8, T. 25 N., R. 50 E., and is not plotted on overlay of this report.

26. USGS vertebrate locality SF-248, equals BLM Paleontological Inventory number (Elko District) V-19. Age: Cretaceous, Newark Canyon Formation; north east of cumulative area boundary in section 14, T. 30 N., R. 51 E. Mentioned (but not plotted) in this report because of its <u>very</u> high sensitivity, being one of the very few dinosaur localities in Nevada.

ANNOTATED BIBLIOGRAPHY

BIGLOW, C. C. 1986. Stratigraphy and sedimentation of the Cretaceous Newark Canyon Formation in the Cortez Mountains, north central Nevada. M.S. thesis, Eastern Washington University, 133 p., 13 pl.

<u>Notes</u>: Stratigraphy and biostratigraphic correlations; primarily sedimentological.

CHRISTIANSEN, D. J. 1980. Petrology and biostratigraphy of Middle, Lower Devonian strata, southern Cortez Mountains, Nevada. M.S. thesis, University of California.

Notes: Sedimentation, physical and biostratigraphic correlations based primarily on conodonts. Includes the McColley Canyon Formation (all members) and correlative units within the Cortez Mountains, and Wenban Peak. Discussion of anoxic marine environments.

CHURKIN, M. Jr. 1963. Graptolite beds in thrust plates of central Idaho and their correlation with sequences in Nevada. American Association of Petroleum Geologists, Bulletin, 47:1611-1623.

Notes: Bears directly on several of the graptolite localities mentioned in the present report [Ordovician].

CLARK, D. L. and R. L. ETHINGTON 1966. Conodonts and biostratigraphy of the Lower and Middle Devonian of Nevada and Utah. Journal of Paleontology, 40:(3)659-689.

Notes: Biostratigraphy applies to cumulative area.

CLARK, D. L. and R. L. ETHINGTON 1967. Conodonts and zonation of the Upper Devonian in the Great Basin. Geologicial Society America, Memoir 103, 1-94.

Notes: Biostratigraphy applies to cumulative area.

DUEKER, G. T. 1985. Devonian rocks of the Roberts Mountains allocthon in the Roberts Mountains, central Nevada. M.S. thesis, University of California.

Notes: Discusses biozones based on conodonts in units which correlate with units in the cumulative area.

EVANS, J. G. 1980. Geology of the Rodeo Creek NE and

Welches Canyon quadrangles, Eureka County, Nevada. United States Geological Survey Bulletin 1473.

Notes: Main area of this report lies north and east of the project area, however the type of lithology (western assemblage siliceous limestones and shales) is intermittently exposed in the cumulative area. Fauna reported is composed exclusively of graptolites, contemporaneous those from several localities within the cumulative area.

JOHNSON, D. B. 1972. Devonian stratigraphy of the southern Cortez Mountains, Nevada. M. S. thesis, University of Iowa.

Notes: Describes fauna (primarily brachiopods) and biostratigraphy in parts of the Cortez Mountains lying within Eureka County. Discusses depositional environments and paleoecology of brachiopods.

JOHNSON, J. G. 1966. Middle Devonian brachiopods from Roberts Mountains, central Nevada. Paleontology, 9(1):152-181.

Notes: Includes several taxa found within cumulative area boundaries, primarily brachiopods.

JOHNSON, J. G. 1971. Lower Givetian brachiopods from central Nevada. Journal Paleontology 45:301-326.

Notes: Key biostratigraphic paper for Devonian brachiopods. Specific to locality I-0104 (not plotted as outside cumulative area; see miscellaneous localities, above).

LANGENHEIM, R. L. Jr. and E. R. LARSON 1973. Correlation of Great Basin stratigraphic units. Nevada Bureau of Mines and Geology Bulletin 72:1-36, 3 correlation charts.

Notes: Although several units have been redefined since publication of this work, the basic correlations stand. Fossil content is recorded for applicable strata, and extensive bibliography (up to 1972) presented in this work make it a good biostratigraphic reference for all of Nevada.

MERRIAM, C. W. 1940. Devonian stratigraphy and paleontology of the Roberts Mountains region, Nevada. Geological Society of America Special Paper 25.

Notes: Basic biostratigraphic and taxonomic reference for Devonian strata of Roberts Mountains, Simpson Park Range, parts of Antelope Valley, and equivalent units within the cumulative area including Fourmile Canyon Formation and the Woodruff Formation.

MULLENS, T. E. 1980. Stratigraphy, petrology, and some fossil data of the Roberts Mountain Formation, north - central Nevada. United States Geological Survey Professional Paper 1063.

Notes: Includes discussions of correlative units and Early Devonian conodont bearing strata, as for example the Popovich Formation.

ROSS, R. J. and W. B. N. BERRY 1963. Ordovician graptolites of the Basin Ranges in California, Nevada, Utah, and Idaho. Unites States Geological Survey Bulletin 1134.

Notes: Primary reference for Ordovician localities within the boundaries of the cumulative area; virtually all

Ordovician localities noted within the present report are identified in this reference.

SLATTEN, M. H. 1978. The Windmill Limestone at Wenban Peak, southern Cortez Mountains, Nevada. M. S. thesis, University of California.

Notes: The Windmill Limestone or its correlatives are found within the cumulative boundary area. This paper discusses and describes taxa of Ostracoda and their stratigraphic position.

SMITH, J. F. and K. B. KETNER 1975. Stratigraphy of Paleozoic rocks in the Carlin - Pinon Range area, Nevada. United States Geological Survey Professional Paper 867 - A.

Notes: Conodonts collected by USGS personnel from the Late Devonian Woodruff Formation, which has equivalent units south and east of the cumulative area, are listed and their zonation noted. Conodont fauna reported in this paper is essentially similar to conodonts reported from the Roberts Mountain, McColley Canyon, and Denay Formations, which either extend or have correlative units which extend into the cumulative area.

STEWART, J. H., C. H. STEVENS and A. E. FRITSCHE 1977. Paleozoic paleogeography of the western United States; Pacific Coast paleogeography symposium. Pacific Section Society Economic Paleontologists and Mineralogists. 157-164.

Notes: Contains sections, stratigraphic correlations of units within cumulative area; mostly Ordovician graptolite correlations. Includes the Cortez Mountains and many of the graptolite localities (or at least their lithostratigraphic units) within the cumulative area.

SUYDAM, J. D. 1988. Sedimentology, provenance, and paleotectonic significance of the Cretaceous Newark Canyon Formation, Cortez Mountain, Nevada. M. S. thesis, Montana State University, 1-90.

Notes: Primarily physical stratigraphy and sedimentology, petrography of the Newark Canyon Formations. However, it is noted that the unit in question does, outside of the cumulative area boundary (see miscellaneous localities, above) contain fossil vertebrates.

AFFECTED AREAS

All affected areas within the cumulative area are listed below. None are recognized as having any known fossil localities, either vertebrate or invertebrate, recorded within them based on a survey of the literature, examination of BLM paleontological inventories, or my personal knowledge and that of other paleontologists who are familiar with the area.

GOLD ACRES

Section 36, T 28 N., R. 46 E.; section 1, T. 27 N., R. 46 E.; section 31, T. 28 N., R. 47 E.; sections 18 and 19, T. 27 N., R. 48 E. No known localities.

HORSE CANYON

Sections 3 and 10, T. 26 N., R. 48 E. No localities known from this affected area, but invertebrate locality I-84 of this report lies within the adjacent section 9.

CORTEZ

Literature and recorded locality lists were searched for sensitive paleontological resources within the CORTEZ affected area in a task additional to that of the above report. Results are here reported as an addendum to the attached previous report. This effort was concentrated in those sections or partial sections lying within the affected area, and herein noted as being sections 1, 2, 11, 12 of T. 26 N., R. 47 E.; sections 6, 7, of T 26 N., R. 48 E.; sections 25, 26, 35, 36, of T. 27 N., R. 47 E.; sections 18, 19, 30, of T. 27 N., R. 48 E. None of the previously reported localities occur within these coordinates. No new localities or literature refer to this affected area in the sense of either vertebrate or invertebrate paleontological resources. There are no known localities within the CORTEZ affected area.

James R. Firby, 6/8/92 — J. Firby

APPENDIX B
SOIL SURVEY

Literature and recorded locality lists were searched for sensitive paleontological resources within the CORTEZ affected area in a task additional to that of the above report. Results are here reported as an addendum to the attached previous report. This effort was concentrated in those sections or partial sections lying within the affected area, and herein noted as being sections 1, 2, 11, 12 of T. 25 N., R. 47 E.; sections 6, 7, of T 26 N., R. 48 E.; sections 25, 26, 35, 36, of T. 27 N., R. 47 E.; sections 18, 19, 30, of T. 27 N., R. 48 E. None of the previously reported localities occur within these coordinates. No new localities or literature refer to this affected area in the sense of either vertebrate or invertebrate paleontological resources. There are no known localities within the CORTEZ affected area.

James R. Firby, 6/8/92

APPENDIX B
STUDY AREA SOIL SURVEY RESULTS

The Argid soils are Aridisols, soils that formed under an aridic moisture regime. The Argids have either an argillic (clay) layer or a natric (sodium-affected) horizon. Argid soils within the project area include Xerollic Haplargids, Lithic Xerollic Haplargids, Duric Haplargids, Haplic Durargids, Haplic Nadurargids, and Duric Natrargids.

Xerollic Haplargids are characterized by 1) the percentage of organic carbon in the soil which ranges from 0.6 percent to approximately 0.14 percent depending on the ratio of sand and clay in the soil; 2) an average annual soil temperature of 22°C, with a seasonal (summer to winter) of at least 5°C at a depth of 50 cm; and 3) an arid climate bordering on xeric. A xeric climate has moist, cool winters and warm, dry summers.

Lithic Xerollic Haplargids include all of the characteristics of Xerollic Haplargids, and in addition have the presence of a boundary between the soil and the underlying material (a lithic contact) within 50 cm of the surface.

Duric Haplargids include a soil layer (horizon) that is more than 15 cm thick, which either includes at least 20 percent durinodes (weakly cemented to indurated nodules) in a non-brittle matrix, or is brittle when dry and firm when moist.

Durargids are Argids without a sodium-affected component, and that include a duripan (or hardpan) below the clay layer and within 100 cm of the surface. In Haplic Durargids, the duripan is not platy or massive, and is not indurated (very hard).

Nadurargids are Argids with a duripan component underlying a sodium-affected horizon (layer). Haplic Nadurargids are similar to Haplic Durargids, in that the duripan is not platy or massive, and is not indurated.

Duric Natrargids are Argids with a natric, or sodium affected, horizon. The Duric Natrargids are not saturated with water in any horizon within one meter of the surface, do not have a lithic contact within 50 cm of the soil surface, and have a sodium adsorption ratio (SAR) of >13 or have 15 percent or more saturation with sodium throughout the major part of the natric horizon.

Orthids are Aridisols without a buried clay layer or sodium-affected component. Camborthids are Orthids with a cambic horizon. A cambic horizon is an altered horizon that does not have the dark color, organic-matter content, and structure that are definitive of other epipedons. The texture is very fine, the soil has structure or absence of rock structure, and the base of the horizon is at least 10 inches below the soil surface. Cambic horizons are not indurated or cemented, and do not have a brittle consistency when moist. Typic Camborthids have median Camborthid characteristics.

Duric Camborthids are Camborthids with a layer of durinodes, or weakly cemented to indurated silica nodules.

Order II Soil Survey Map Units

Soils within map unit 1a are Xerollic Haplargids. The surface texture to a depth of three inches is gravelly clay loam; texture below three inches is clay. To a depth of six inches, the pH of the soil is mildly alkaline (7.4 to 7.6); below six inches, the pH is moderately alkaline (pH 8.0 to 8.4). Suitability for topsoil is considered to be poor because of the clay texture. This soil is derived from sedimentary rock.

Soils within map unit 2a are Lithic Xerollic Haplargids. This unit is a soil association consisting of similar soils with 65 percent and 35 percent components. The major component has a surface texture of very gravelly loam to a depth of three inches. Soil texture from three to seven inches is clay loam, and from seven to fourteen inches is silt loam. The pH of the soil is strongly alkaline throughout (pH 8.6 to 9.2). This soil is derived from limestone.

The smaller portion of map unit 2a (35 percent) also has a surface texture of very gravelly loam to a three inch depth. Texture from three to six inches is clay loam, and from six to ten inches is light clay loam. The pH to a depth of three inches is moderately alkaline (pH 8.4); below this depth, the soil is strongly alkaline (pH 8.6 to 8.8). Suitability for use as topsoil is limited due to the shallow depth to bedrock. The parent material of this soil is tuffaceous.

Map unit 3a soils are Duric Haplargids. Map unit 3a consists of very deep, strongly to very strongly alkaline loams. Texture in the first three inches is very gravelly loam. Gravel content throughout this soil ranges from 15 to 60 percent. Topsoil suitability of this soil is fair, due to the clay loam texture and presence of carbonates. This soil is derived from limestone.

Map unit 5a is a Haplic Durargid. The top three inches have a sandy loam texture. From three to 14 inches, the texture is silty clay loam, and from 14 to 20 inches, the texture is very gravelly silt loam. A cemented duripan is encountered at a depth of 20 inch to 43 inches; below this depth is an indurated duripan. This soil is strongly alkaline (pH 8.8) to a depth of 14 inches; below this depth, the soil is very strongly alkaline (pH 9.2). Suitability of this soil for use as topsoil is poor due to the very strong alkaline nature of the subsoil materials. This soil is derived from limestone.

Soil unit 6a, a Haplic Nadurargid, is mapped north and east of unit 5a in the Gold Acres area. Unit 6a consists of a soil association with two similar components. The major soil component in this unit comprises 80 percent of the unit. The surface texture of this soil to a depth of six inches is a silt loam; the first three inches is a gravelly silt loam and the lower three inches is a heavy silt loam. Below this to a depth of 19 inches, the texture is clay. A strongly cemented duripan is encountered at a depth of 19 to 26 inches. From 26 to 32 inches, an indurated duripan is found. Suitability for use as topsoil for this soil is poor due to the clay texture and shallow depth to the duripan. This soil is derived from limestone.

The remaining 20 percent of this unit has a surface texture to a depth of 4 inches of a gravelly fine sandy loam. Below this, to a depth of 9 inches, the texture is sandy loam, and from 9 to 20 inches the texture of the soil is clay. The soil is very strongly alkaline throughout (pH 9.4 to 20 inches depth, pH 9.6 from 20 to 60 inches depth). A strongly cemented duripan is present below 36 inches. Suitability of this soil for use as topsoil is poor due to the very strong alkaline nature throughout the soil. This soil is derived from limestone.

Map unit A is a Duric Camborthid. The texture of this soil is silty clay loam to a depth of 7 inches; gravelly clay from 7 to 8 inches; clay from 8 to 15 inches; sandy loam from 15 to 24 inches; and gravelly sandy loam from 24 to 60 inches. The soil ranges from moderately (pH 8.4) to very strongly (pH 9.6) alkaline. Suitability of this soil for use as topsoil is poor due to the clay content. This soil is derived from alluvium.

Map unit Bk is a Duric Natrargid. The texture of this soil is silt loam to a depth of 8 inches; sandy loam from 8 to 18 inches; gravelly silt loam from 18 to 40 inches; and gravelly sandy loam from 40 to 60 inches. The first four inches of the soil is moderately alkaline (pH 8.2); from 4 to 8 inches the soil is strongly alkaline (pH 8.5); and below this depth the soil is very strongly alkaline (pH 9.7 to 10.0). Suitability for use as topsoil for this soil is poor due to the presence of small stones and excess salt and sodium. This soil is derived from loess (wind-deposited, fine-grained material) over mixed alluvium.

Map unit Cr is a Duric Camborthid. The texture of this soil is sandy loam to a depth of 2 inches, sandy clay loam from 2 to 6 inches; gravelly sandy clay loam from 6 to 10 inches; gravelly silt loam from 10 to 30 inches; and gravelly sandy loam from 30 to 60 inches. The soil is very strongly alkaline (pH 9.3 to 10.1) throughout. This soil is considered a prime farmland when irrigated; however, it is not currently under irrigation. This soil is rated as poor for suitability for topsoil because of a layer thickness less than 20 inches and the high pH. The soil is derived from silty mixed alluvium influenced by volcanic ash.

Map unit Rb is a Lithic Xerollic Haplargid. The texture of the soil is cobbly gravelly clay loam to a depth of 2 inches; cobbly clay loam from 2 to 10 inches; cobbly clay from 10 to 18 inches; gravelly hardpan from 18 to 30 inches; and gravelly sand from 30 to 60 inches. This soil ranges from moderately (pH 7.9) to very strongly (pH 9.9) alkaline. The topsoil suitability is rated poor due to the presence of small stones and clay content. This soil is derived from chert and shale.

Map unit Rf is a Duric Haplargid. The texture of the soil is gravelly sandy loam to a depth of 2 inches; very fine sandy loam froma depth of 2 to 18 inches; gravelly fine sandy loam from a depth of 18 to 30 inches; and gravelly sandy loam from 30 to 60 inches. This soil ranges from moderately (pH 8.2) to very strongly (pH 10.0) alkaline. The soil is rated as poor for suitability for topsoil because of the presence of small stones. This soil is derived from gravelly mixed alluvium.

Map unit Wr is a Typic Camborthid. The texture of the soil is sandy loam to a depth of 6 inches; gravelly sandy clay from a depth of 6 to 12 inches; and gravelly sandyloam from a depth of 12 to 60 inches. This soil is strongly to very strongly alkaline (pH 8.8 to 9.4). The soil is rated as poor for suitability for topsoil because of the presence of small stones. This soil is derived from mixed alluvium strongly influenced by loess.

Map unit Ju is a Lithic Xerollic Haplargid. The soil has a very gravelly loam surface texture to a depth of 8 inches. Texture of the soil below 8 inches is very cobbly clay, very gravelly clay loam, and very cobbly clay loam to a depth of 19 inches. The pH of the Jung soil ranges from mildly to moderately alkaline (pH 7.4 to 8.2). This soil is rated as poor for suitability for topsoil due to depth to rock (19 inches), presence of small stones, and excessive clay. The Jung soil is derived from volcanic rock.

<u>Order III Map Units</u>
Map unit 290 includes Creemon silt loam. The Creemon soil characteristics are discussed above under map unit Cr.

Map unit 2060 includes Oxcorel (40 percent), Beoska (30 percent) and Whirlo (15 percent) soil series. Inclusions make up the remaining 15 percent of this soil association. The Beoska soil is described above under map unit Bk, and the Whirlo soil is described under map unit Wr.

The Oxcorel soil has a very fine sandy loam texture to a depth of 5 inches, a clay or clay loam texture to a depth of 34 inches, and a very gravelly sandy loam and very gravelly loam texture to 60 inches. The pH of the Oxcorel soil ranges from moderately (pH 8.4) to strongly (pH 8.8) alkaline. This soil is rated as poor for topsoil suitability because of the presence of small stones and clay content.

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 1 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
1 - Soils on Lake Plains					
Ocala silt loam, occ. flooded	alluvium	silt loam	slow	slight	slight
2 - Soils on Alluvial Flats					
Batan silt loam	alluvium	silt loam	mod. slow	slight	slight
Batan-Wendane-Valmy association	alluvium	silt loam	mod. slow to mod. rapid	slight	moderate
Batan-Bubus-Ocala association	alluvium	silt loam	slow to moderate	slight	slight
Batan-Ocala-Ocala, rarely flooded association	alluvium	silty clay loam	slow to mod. slow	slight	slight
Bubus very fine sandy loam	alluvium	very fine sandy loam	moderate	slight	slight
Kelk-Ocala association	alluvium	very fine sandy loam	slow to moderate	slight	slight
3 - Soils on the Basin Floor					
Tulase-Bubus-McConnel association	alluvium	silt loam	moderate to very rapid	slight	slight
4 - Soils on Mountain Valley Fans					
Zoesta-Handy association	alluvium	cobbly loam	very slow to mod. rapid	slight	slight
5 - Soils on the Fan Piedmonts					
Beoska-Tenabo silt loams, sloping	alluvium	silt loam	mod. slow to mod. rapid	moderate	slight

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Berning-Alley association	alluvium	extremely cobbly loam	slow to mod. slow	moderate	slight
Chiara-Orovada association	alluvium	very fine sandy loam	moderate	slight	slight
Golconda-Dun Glen association	alluvium	gravelly very fine sandy loam	slow to moderate	slight	slight
Orovada-Wieland-Chiara association	alluvium	fine sandy loam	slow to moderate	slight	slight
Tenabo-Ricert association	alluvium	silt loam	mod. slow to mod. rapid	slight	slight
Whirlo gravelly loam, 2-8% slopes	alluvium	gravelly loam	mod. rapid	slight	slight
Redflame-Kingingham association	alluvium	very gravelly loam	slow to mod. rapid	slight	slight
Wieland-Allor association	alluvium	loam	slow to mod. slow	moderate	slight
Wieland-Oxcorel-Allor association	alluvium	loam	very slow to mod. rapid	moderate	slight
Wieland-Grassval-Puett association	alluvium & residuum	gravelly loam	slow to mod. rapid	moderate	slight
Oxcorel-Beoska-Whirlo association	alluvium	very fine sandy loam	very slow to mod. rapid	slight	slight
Oxcorel-Orovada association	alluvium	gravelly loam	very slow to mod. rapid	slight	slight
Oxcorel-Oxcorel, mod. steep-Pineval association	alluvium	gravelly loam	very slow to mod. rapid	moderate	slight

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 3 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Oxcorel-Rednik-Veta association	alluvium	gravelly silt loam	very slow to mod. rapid	moderate	slight
Grassval-Grina-Unsel Variant association	alluvium, residuum & colluvium	very gravelly loam	mod. slow	moderate	slight
Buffaran-Wieland association	alluvium	cobbly loam	slow	moderate	slight
Allor-Wieland association	alluvium	gravelly loam	slow to mod. slow	moderate	slight
Genaw-Wieland-Grina association	residuum & alluvium	gravelly loam	slow to moderate	moderate	slight
6 - Soils on Foothills					
Humdun-Havingdon-Bucan association	residuum & colluvium	silt loam	slow to moderate	severe	slight
Trunk-Burrita-Rock outcrop association	residuum & colluvium	cobbly loam	very slow to slow	severe	slight
Trunk-Dewar-Stingdorn association	residuum, colluvium & alluvium	very cobbly loam	very slow to mod. slow	severe	moderate
Boulflat-Havingdon-Dewar association	residuum, colluvium & alluvium	gravelly loam	slow to mod. slow	severe	slight
Bojo-Stingdorn association	residuum	fine sandy loam	mod. slow	slight	slight
Atlow, steep-Atlow-Stingdorn association	residuum	very gravelly loam	mod. slow	moderate	slight
Atlow-Colbar-Rock outcrop association	residuum & colluvium	very gravelly loam	mod. slow	moderate	slight
Stingdorn very cobbly loam, 4-30% slopes	residuum	very cobbly loam	mod. slow	slight	slight
Stingdorn-Stingdorn, steep-Colbar association	residuum & colluvium	cobbly loam	mod. slow	moderate	slight

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 4 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Perwick-Puett-Tulase association	residuum & alluvium	very gravelly loam	moderate to mod. rapid	severe	moderate
Colbar-Midraw association	residuum & colluvium	cobbly loam	slow to mod. slow	slight	slight
Robson-Old Camp-Rock outcrop association	residuum	extremely cobbly loam	slow to mod. slow	moderate	slight
Zoesta-Wieland-Akerue association	alluvium & residuum	gravelly loam	very slow to slow	moderate	slight
McVegas-Old Camp-Kingingham association	residuum & alluvium	very cobbly loam	mod. slow to slow	moderate	slight
Jung-Norfork-Buffaran association	residuum & alluvium	gravelly loam	slow	severe	slight
Jung-Stingdorn-Atlow association	residuum	very gravelly loam	slow to mod. slow	moderate	slight
Genaw-Perlor-Puett association	residuum	very fine sandy loam	moderate to mod. rapid	moderate	slight
7 - Soils on Mountains					
Millerlux-Reluctan-Cleavage association	residuum & colluvium	gravelly loam	very slow to mod. slow	severe	slight
Hapgood-Packer-Layview association	residuum & colluvium	very gravelly loam	mod. slow to moderate	moderate	slight
Hapgood-Tusel-Winada association	colluvium & residuum	very gravelly loam	mod. slow to moderate	severe	slight
Hapgood-Sumine-Cleavage association	residuum & colluvium	very gravelly loam	mod. slow to moderate	moderate	slight
Quarz-Linrose-Slaven association	residuum & colluvium	very gravelly loam	slow to moderate	moderate	slight
Slaven-Linrose-Cleavage association	residuum & colluvium	very gravelly loam	slow to moderate	severe	slight

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 5 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Slaven-Wiskan-Graley Variant association	residuum & colluvium	very gravelly loam	slow to mod. slow	severe	slight
Slaven-Glean-Cleavage association	residuum & colluvium	very gravelly loam	slow to mod. rapid	severe	slight
Wiskan-Locane association	residuum	gravelly silt loam	slow to mod. slow	moderate	moderate
Rock outcrop-Loncan Variant-Glean association	residuum & colluvium	gravelly silt loam	mod. to mod. rapid	severe	slight
Sumine-Reluctan-Cleavage association	colluvium & residuum	very gravelly loam	mod. slow	moderate	slight
Sumine-Hapgood-Cleavage association	residuum & colluvium	very cobbly loam	mod. slow to moderate	severe	slight
Sumine-Itca-Softscrabble association	residuum & colluvium	very gravelly loam	slow to moderate	severe	slight
Sumine-Winada Variant-Pernty association	residuum & colluvium	very gravely loam	mod. slow to moderate	moderate	slight
Floer-Slaven-Roca association	residuum	gravelly silt loam	very slow to slow	moderate	slight
Punchbowl-Belate-Reluctan association	residuum & colluvium	gravelly loam	mod. slow	severe	slight
Punchbowl-Clanalpine-Sumine association	residuum & colluvium	cobbly loam	slow to mod. slow	severe	slight
Old Camp-Colbar-Rock outcrop association	residuum & colluvium	very cobbly loam	mod. slow	slight	slight
Old Camp-Laped association	residuum & colluvium	very cobbly loam	mod. slow	slight	slight
Ninemile-Zoesta-Itca association	residuum & alluvium	extremely cobbly loam	very slow to slow	moderate	slight
Itca-Clanalpine-Sumine association	residuum & colluvium	extremely cobbly fine sandy loam	slow to moderate	severe	slight
Robson-Wiskan association	residuum	very gravelly loam	slow to mod. slow	severe	slight
Zoesta-Loncan-Welch association	alluvium & residuum	cobbly loam	very slow to moderate	slight	slight

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 6 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Belate-Sumine-Softscrabble association	colluvium & residuum	gravelly loam	slow to moderate	severe	slight
Reluctan-Roca-Colbar association	colluvium & residuum	very cobbly loam	very slow to mod. slow	moderate	slight
Izod-Rock outcrop association	residuum	extremely cobbly loam	moderate	slight	slight
Jung-Itca-Roca association	residuum & colluvium	very cobbly loam	very slow to slow	moderate	slight
Jung, steep-Robson-Jung association	residuum	very gravelly loam	slow	severe	slight
8 - Soils on Inset Fans					
Whirlo very fine sandy loam, 2-4% slopes, occ. flooded	alluvium	very fine sandy loam	mod. rapid	slight	slight
Whirlo-Creemon association	alluvium	gravelly loam	moderate to mod. rapid	slight	slight
Rasille-Kelk association	alluvium	silt loam	slow to moderate	slight	slight
Kelk silt loam, saline, 0-4% slopes	alluvium	silt loam	slow	slight	slight
Settlemeyer fine sandy loam, drained, 0-4% slopes	alluvium	fine sandy loam	mod. slow	slight	slight
Settlemeyer, drained--Settlemeyer loams	alluvium	loam	mod. slow	slight	slight
Welch loam, drained, 2-8% slopes	alluvium	loam	mod. slow	slight	slight
9 - Mined Areas					
Disturbed soils.					

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TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 7 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
10 - Soils on Fan Skirts					
Broyles very fine sandy loam, 0-2% slopes	alluvium	very fine sandy loam	mod. rapid	slight	slight
Broyles-Creemon association	alluvium	silt loam	moderate to mod. rapid	slight	slight
Creemon silt loam, 0-2% slopes	alluvium	silt loam	moderate to mod. rapid	slight	slight
Creemon-Cren association	alluvium	silt loam	moderate to mod. rapid	slight	slight
Creemon-Hessing association	alluvium	silt loam	moderate to very rapid	slight	slight
Orovada fine sandy loam, 2-4% slopes	alluvium	fine sandy loam	moderate	slight	slight
Whirlo-Broyles association	alluvium	gravelly very fine sandy loam	mod. rapid	slight	slight
Zineb gravelly loam, 2-8% slopes	alluvium	gravelly loam	mod. rapid	slight	slight
11 - Soils on Piedmont Slopes					
Relley-Broyles association	alluvium	silt loam	moderate to mod. rapid	slight	slight
Ricert-Oxcorel-Whirlo association	alluvium	gravelly fine sandy loam	very slow to mod. rapid	slight	slight
Ricert-Whirlo-Pineval association	alluvium	gravelly silt loam	mod. slow to mod. rapid	slight	slight

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 8 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Oxcorel-Golconda-Whirlo association	alluvium	gravelly very fine sandy loam	very slow to mod. rapid	slight	slight
Grassval-Zineb-Izod association	alluvium & residuum	very gravelly sandy loam	mod. slow to mod. rapid	severe	slight
Dun Glen-Whirlo association	alluvium	very fine sandy loam	moderate to mod. rapid	slight	slight
13 - Plateaus					
Old Camp-Rock outcrop-Colbar association, steep	residuum & colluvium	extremely cobbly loam	mod. slow	moderate	slight
14 - Soils on Hills					
Laped-Colbar association	residuum & colluvium	very cobbly loam	mod. slow	moderate	slight
Puett-Genaw-Orovada association	residuum & alluvium	very gravelly loam	moderate to mod. rapid	moderate	slight
Colbar, steep-Burrita-Colbar association	residuum & colluvium	very cobbly loam	slow to mod. slow	moderate	slight
Grina-Grina, eroded-Caniwe association	residuum & alluvium	gravelly loam	mod. slow	moderate	slight
Zoesta Variant-Jung-McVegas association	residuum & colluvium	gravelly loam	very slow to slow	severe	slight
Old Camp-Kram Variant-Rock outcrop association	residuum	gravelly loam	mod. slow to moderate	moderate	slight
Old Camp-Osoll-Colbar association	residuum	gravelly loam	mod. slow to mod. rapid	severe	slight

TABLE B-1

SOIL SURVEY OF NORTH LANDER COUNTY AREA, NEVADA

(Page 9 of 9)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Genaw-Orovada-Puett association	residuum & alluvium	fine sandy loam	moderate to mod. rapid	severe	slight
15 - Soils on Flood Plains					
Needle Peak silt loam, occ. flooded	alluvium	silt loam	mod. slow	slight	slight
Paranat silty clay loam	alluvium	silty clay loam	mod. slow	slight	slight

TABLE B-2

SOIL SURVEY OF EUREKA COUNTY AREA, NEVADA

(Page 1 of 3)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
2 - Soils on Alluvial Flats					
Batan-Ocala association	alluvium	silty clay loam	slow to mod. slow	slight	slight
3 - Soils on the Basin Floor					
Tulase-Bubus-McConnel association	alluvium	silt loam	moderate to very rapid	slight	slight
5 - Soils on the Fan Piedmonts					
Cherry Spring-Tomera association	alluvium	loam	slow to mod. slow	slight	slight
Tomera loam, 4-8% slopes	alluvium	loam	slow	slight	slight
Tenabo-Ricert association	alluvium	gravelly very fine sandy loam	mod. slow to rapid	slight	slight
7 - Soils on Mountains (crests and side slopes)					
Granzan Variant-Granzan-Highams Variant association	residuum & colluvium	very gravelly loam	moderate	severe	severe
Ramires-Singletree association	residuum & colluvium	gravelly clay loam	slow to mod. slow	severe	slight
Bregar-Jivas-Duff association	residuum & colluvium	very gravelly loam	mod. slow to moderate	severe	slight
Chen-Ramires association, mod. steep	residuum	cobbly loam	very slow to slow	severe	slight
Chen-Singletree-Jivas association	residuum & colluvium	very cobbly loam	very slow to moderate	moderate	slight
Chen-Pie Creek-Ramires association	residuum	very cobbly loam	very slow to slow	moderate	slight
Decram-Decram Variant-Duff association	residuum & colluvium	very gravelly loam	mod. slow to moderate	severe	slight

TABLE B-2

SOIL SURVEY OF EUREKA COUNTY AREA, NEVADA

(Page 2 of 3)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Ebic-Ziram-Jivas association, mod. steep	residuum & colluvium	very stony clay loam & very cobbly clay loam	very slow to moderate	moderate	slight
Ebic-Ziram-Jivas association, steep	residuum & colluvium	very stony clay loam & very cobbly clay loam	very slow to moderate	moderate	slight
Hopeka-Solak-Ados association	residuum, alluvium & colluvium	very gravelly loam	moderate	moderate	slight
Quarz-Bregar-Duff association	residuum & colluvium	very gravelly loam	slow to moderate	severe	slight
Solak-Highams-Hymas association	residuum	very gravelly loam	moderate	severe	slight
Soughe Variant-Pie Creek-Singletree association	residuum & colluvium	gravelly loam	very slow to mod. slow	severe	slight
8 - Soils on Inset Fans					
Tulase silt loam, 2-8% slopes	alluvium	silt loam	moderate	slight	slight
Tulase silt loam, 0-2% slopes	alluvium	silt loam	moderate	slight	slight
Perwick-Puett-Tulase association	residuum & alluvium	gravelly loam	moderate to mod. rapid	moderate	slight
Enko loam, 0-2% slopes	alluvium	loam	slow	slight	slight
9 - Mined Land					
Disturbed soils.					
10 - Soils on Fan Skirts					
Broyles-Ricert association	alluvium	very fine sandy loam	mod. slow to mod. rapid	slight	slight

TABLE B-2

SOIL SURVEY OF EUREKA COUNTY AREA, NEVADA

(Page 3 of 3)

Association or Series	Parent Material	Dominant Texture	Permeability	Erosion Hazard	
				Water	Wind
Whirlo-Creemon association	alluvium	gravelly loam	moderate to mod. rapid	slight	slight
Creemon-Relley association	alluvium	silt loam	moderate	slight	slight
Enko-Davey-McConnel association	alluvium	loam	slow to rapid	slight	slight
Zineb gravelly loam, 2-8% slopes	alluvium	gravelly loam	mod. rapid to rapid	slight	slight
12 - Soils on Alluvial Fans					
Whirlo gravelly loam, 2-8% slopes	alluvium	gravelly loam	mod. rapid	slight	slight
14 - Soils on Hills					
Soughe-Fortank-Kodra Variant association	residuum	gravelly loam	slow to mod. slow	moderate	slight
16 - Soils on Flood Plains					
Needle Peak silt loam, occ. flooded	alluvium	silt loam	mod. slow	slight	slight
Paranat silt loam, drained, occ. flooded	alluvium	silt loam	mod. slow	slight	slight

This appendix provides a detailed summary of presently available information pertaining to the hydrogeology and surface water hydrology of Crescent Valley, including the immediate vicinity of the proposed Pipeline facilities. This summary presents technical information not presented in the EIS Section 3.4, including:

- A description of the groundwater model used to estimate potential impacts to water resources
- Details of the hydrogeology and aquifer properties

C.1 DEFINITION OF STUDY AREA

The description of the limits of the water resources study area presented in detail in Section 3.4 is based on the results of an extensive groundwater modeling study performed by WMC (1992b, 1993). Preliminary results showed that potential impacts to water resources would be limited to an area smaller than the entire modeling domain (e.g., Crescent Valley) and therefore the study area was established to generally include the potentially affected area only. For purposes of completeness, some of the following description of the conditions of water resources extends beyond the study area defined in Section 3.4.

The purpose of the modeling study was to:

- Simulate the natural groundwater system in the valley and improve understanding of the flow system within the Crescent Valley
- Study the regional effects of groundwater pumping during pit dewatering over the estimated 12-year life of the mine
- Outline the impact of re-infiltrating the water pumped from the dewatering system

The modeling was performed using hydrogeologic data collected by WMC and others. The USGS code MODFLOW was used for the study. MODFLOW is a three-dimensional layered finite-difference groundwater-flow model that simulates a groundwater flow system incorporating effects of nearby mountains, rivers, streams, wells, and evapotranspiration. The groundwater modelling domain is shown in Figure C-1. Additional details on the groundwater modelling are presented in WMC (1992b, 1993).

C.2 GROUNDWATER RESOURCES

C.2.1 Hydrogeology of Crescent Valley

The hydrogeology of Crescent Valley, and, to a much smaller degree, the Cortez Mountains and Shoshone Range surrounding Crescent Valley, has been studied by the U.S. Geological Survey and reported in Water-Supply Paper 1581 (Zones 1961). Three hydrogeologic reports, prepared by WMC in 1992 and 1993 for the applicant, provide additional information on water resources in Crescent Valley and, more specifically, in the Pipeline deposit. Much of the following section is derived from WMC (1992a,b; 1993), and WCC (1992). For additional information, see WMC (1992a,b; 1993).

Groundwater in the Cortez Mountains and Shoshone Range surrounding Crescent Valley occurs mainly in joints and fractures within the metamorphic and sedimentary bedrock. Most precipitation falling on the mountains travels downslope in ephemeral streams toward the valley floor. Recharge from this runoff enters the regional groundwater system as it crosses the alluvial deposits of the valley uplands at the base of the mountains. Groundwater moves through these alluvial deposits (fanglomerates) towards the alluvium beneath the valley floor where large quantities of groundwater are stored. The valley floor is a relatively flat area of playas, small dunes, and some terraces. Geophysical data from gravity and seismic surveys conducted by the USGS and others show that the alluvium may be as much as 9,300 feet thick in some portions of Crescent Valley (WMC 1992b). In other intermountain basins in central Nevada, alluvium is likely to exceed several hundred feet, and may be up to several thousand feet in thickness (Zones 1961).

C.2.1.1 Principal Aquifer Units

Groundwater flow in the Crescent Valley Hydrographic basin occurs in several bedrock and alluvial aquifer units including:

Bedrock:	Carbonate rocks
	Siliceous rocks
	Tertiary volcanics
Alluvium:	Older alluvium
	Younger alluvium

Only the carbonate and alluvial with minor amounts of siliceous aquifer units are present in the upper 1,000 feet in the vicinity of the pipeline deposit. Figure 3.4-3 is a schematic geologic cross section through the deposit which shows these formations. The following sections describe the occurrence, extent, and hydraulic characteristics of these aquifer units.

Carbonate Rocks. A regional carbonate aquifer system extends westward from the Wasatch Front in Utah, to the northwest of Elko in northern Nevada, and to Tonopah in southern Nevada. To the southwest, the carbonate system extends as far as Las Vegas and the Death Valley region of California. The local extent and continuity of the carbonate system in the Crescent Valley area is uncertain. Seismic data infer that carbonate rocks occur at depths greater than 10,000 to 14,000 feet beneath the deepest part of Crescent Valley.

Carbonate rocks are exposed in the Gold Acres window and in the Cortez Mountains near Cortez Mine, where the upper plate rocks of the Roberts Mountain Thrust have apparently been removed by erosion. Around Pipeline, the carbonate rocks of the Roberts Mountain formation, Wenban Limestone, and Pilot Shale occur at ground surface or at a shallow depth beneath the alluvium. Based on exploration drilling for the project, the Roberts Mountain formation is known to reach a thickness of 2,000 feet or more. The Roberts Mountain formation was encountered at a depth of 3,000 feet in a drill hole near the Lander town site on Indian Creek. Carbonate rocks were also reported in a drill hole located just north of Altenburg Hill (3 to 4 miles north-northeast of Pipeline) at a depth of 250 feet. West of the town of Beowawe in Whirlwind Valley on the northern edge of the Malpais Mountains, drilling for geothermal resources indicated that no carbonate rocks were present to a depth of 9,500 feet. This is consistent with previous geologic work near Palisade, which indicated that the depth to the carbonate system in that area is greater than 7,500 feet.

Apart from the Pipeline deposit, there is little information on groundwater elevations within the carbonate system in Crescent Valley. The groundwater elevation within the Roberts Mountain formation around the Pipeline orebody is about 4,795 feet, and is similar in all of the wells and drill holes which have been measured. Figure 3.4-4 shows that the elevation of the water table around the Pipeline deposit is consistent with groundwater elevations elsewhere in the basin within the alluvium.

Groundwater flow in the carbonate rocks, particularly on a small scale, is strongly controlled by the geologic structure. Well pumping and production tests conducted by WMC (1992b) on well BW1 at the Pipeline showed that the major water producing zones in the Roberts Mountain formation are associated with open faults and fracture systems. These preferential flow paths may be offset and discontinuous due to the complex structural history of the Shoshone Range and Crescent Valley.

Transmissivity values of over 100,000 ft^2/day are possible in fractured carbonate rocks. Pumping test data from BW1 and other test holes in the Pipeline deposit indicate that the local transmissivity of the Roberts Mountain formation ranges from about 150 to 110,000 ft^2/day in the vicinity of the orebody. Values of hydraulic conductivity for the carbonates may therefore range from about 0.15 ft/day to 110 ft/day, assuming an aquifer thickness of 1,000 feet. Groundwater flow appears to occur under confined conditions, and storativity values calculated from pumping test data range from about 0.001 to 0.006.

Siliceous Rocks. Siliceous rocks overlie the carbonate rocks throughout much of the Crescent Valley Hydrographic basin, except in areas where the siliceous rocks have been eroded and carbonate rocks are exposed at ground surface or are covered by alluvial and Tertiary sediments. Siliceous units that occur at lower elevations, below the regional water table in Crescent Valley, are predominantly the Valmy and Vinini formations. The Slaven Chert also occurs at isolated locations, and possibly also, at greater depths, the Harmony formation.

Exposures of the Valmy formation and the Slaven Chert occur extensively throughout the Shoshone Range. Drill hole data and geologic mapping suggest that the total thickness of siliceous rocks could be up to 3,000 feet in the Indian Creek area, and at least 6,400 feet in the area of geothermal test drilling west of Beowawe.

In the southern part of the Cortez Mountains, surface exposures of the Vinini and Valmy formations also exist. It is not known whether siliceous rocks are present below the valley floor in the window between Pipeline and the Cortez Mine. The overall geometry and continuity of the siliceous rocks below the valley floor is difficult to determine due to the complexity and extent of the Roberts Mountain thrust contact and the subsequent erosion of siliceous upper plate rocks. Faulting, thrusting, and folding have repeated entire sections of siliceous rocks. Local thicknesses are therefore highly variable.

Several wells have been completed in siliceous rocks in the Cortez Mountains and in the Shoshone Range. The available data suggest that groundwater elevations in the siliceous rocks are elevated on the slopes of the ranges. This is typical within the basin and range province. The rocks receive significant recharge from snow melt and precipitation. Consistent with the carbonate rocks discussed above, groundwater flow in the siliceous rocks is controlled by the presence and alignment of faults and open fracture systems. In unfractured rocks, hydraulic conductivities are low, ranging from $5x10^{-6}$ ft/day to $1x10^{-1}$ ft/day. Locally, permeabilities will be much higher where the rock is broken and fractured. A water supply well for Horse Canyon Mine, located approximately 1.5 miles east of Mount Tenabo, was tested for a period of 3 hours at a rate of 130 gpm with an observed drawdown of 66 feet.

Tertiary Volcanics. Tertiary volcanic rocks occur in outcrops in the northern Shoshone Range along the Malpais. Aeromagnetic geophysical data suggest that these flows may be layered and could possibly continue to the southeast beneath the valley floor towards the southern part of the Cortez Mountains. The data indicate that the volcanic flows could attain a width of up to 7 to 10 miles and that they dip to the southeast, where they are covered by an increasing amount of valley fill material. The thickness of the Tertiary basaltic andesite flows ranges from several hundred feet near Mud Spring Gulch to over 3,100 feet in the geothermal drill holes west of Beowawe. The thickness of the volcanic layers beneath the floor of Crescent Valley in unknown.

No hydrologic data exist for the Tertiary volcanics in Crescent Valley. Hydrologic work in Boulder Valley to the north of the Humboldt River indicates that the Tertiary volcanics can have hydraulic conductivity values ranging from about 0.01 ft/day to 10 ft/day. The upper range is likely to be associated with areas where the rocks are fractured; the lower value may be typical of areas where the fractures have become infilled.

Older Alluvium. The alluvial material that fills Crescent Valley is comprised of older alluvium, Tertiary sediments, and probably Tertiary and recent volcanic layers, including flows and air fall deposits. Figure C-2 shows that the overall shape of the basin is asymmetric, and that the deepest part of the valley is located 6 to 7 miles east-northeast of the Pipeline deposit near the Eureka-Lander county line. Here the valley fill material has a probable thickness of about 9,000 feet. Cross sections based on geophysical data (Figure C-3) show that the buried fault scarps give the bedrock surface a much steeper slope beneath the eastern side of the valley than beneath the western side. This is also reflected by the current topography and by the present configuration of the younger alluvial fans.

An area where the bedrock elevation is lower has been recognized to the south-southeast of the proposed pit. This has been described as a southeast-trending paleochannel (WMC 1993). The line of the channel can be inferred from the bedrock elevation contours on Figure C-2. The alluvium is considerably thicker within this channel, and it appears that coarser, less-cemented alluvium is present at deeper levels. Potentially, the overall transmissivity (the rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient) in the area of the channel is much greater than that in the surrounding alluvium. Test Well AW-1 was sited within the area of the paleochannel.

Figure C-2 also suggests that presence of a second possible channel in the area to the northeast of the proposed pit. Thicker alluvium in this area was encountered in drill holes PL-55, PL-41, and PG91-10 (WMC 1993). The recognition of areas where the bedrock surface is lower will be critical for optimizing the dewatering design. Further test drilling will therefore be carried out in the area to the northeast of the pit during Phase III.

Most wells in the valley are completed in coarse alluvial fan material within the upper 500 feet of the valley floor. Many of these wells are completed through both older and younger alluvium, usually into the first significant sand or gravel layers. Several flowing wells are shown on USGS topographic maps located along the eastern portion of the valley floor north of the existing Cortez mine. Finer-grained sediments overlying older alluvium may act as confining layers for groundwater flowing from the Cortez Mountains toward the axis of the valley. Wells completed in the older alluvium in these areas are reported to have hydraulic heads as much as 4 feet above ground level (WMC 1993).

Values of hydraulic conductivity for the older alluvium appear to range from about 0.1 ft/day to 10 ft/day. Storativity can be as high as 0.25. It is thought that many of the fine-grained, lower permeability zones in the center of the basin will have even higher values of storativity, possibly up to 0.30 to 0.40. Seismic data suggest that the older basin fill sediments are highly stratified. Sand and gravel layers interbedded with finer grained sediments will result in greater horizontal hydraulic conductivities than vertical conductivities.

Younger Alluvium. The younger alluvium that forms the alluvial fans consists of medium- to coarse-grained, poorly sorted materials, including cobbles and boulders. The larger, more extensive fans on the western side of the valley can reach thicknesses of up to 700 to 800 feet. Those on the eastern side may typically be only 400 to 500 feet thick. Streambed sediments are often deposited within the fans and these may show a wide range of material, ranging from boulders and cobbles to silt and clay. Younger alluvium also occurs as thinner deposits of sand, silt, and clay beyond the toe of many of the fans towards the center of the valley.

Hydraulic conductivities of the younger alluvium are dependent on the grain size, degree of sorting, and amount of cementation. Conductivities are relatively high near the bedrock-alluvium contact. In the Pipeline deposit, well AW1 was completed within alluvial fan material. Values of transmissivity calculated from pump test data ranged from about 9,000 ft^2/day to 12,000 ft^2/day. The data collected from the pumping test at AW1 suggest that groundwater flow occurs under locally confined and semi-confined conditions. Enhanced flow clearly occurs in certain layers, mainly towards the base of the alluvium. Values for storativity were calculated to range from about 0.0007 to 0.006 using data collected from the test on AW1.

Since the storage coefficient of the alluvial material is typically at least a factor of 10 or more higher than that of the bedrock, most of the water held in storage in the basin is present within the alluvial deposits. This is typical of most hydrographic basins in the state. Although the transmissivity of the bedrock can be locally high, pumping from the bedrock may induce downward leakage from the alluvium with bedrock fractures serving as local conduits for flow.

In the 1950s, the USGS conducted aquifer tests in four irrigation wells in the central part of the valley. Transmissivities ranged from about 900 ft^2/day to 8,000 ft^2/day. The highest transmissivity was measured in a well located at the toe of the alluvial fan deposited by Indian Creek. A well on the valley floor below the toe of an indistinct alluvial fan opposite the Malpais had the lowest transmissivity value.

Groundwater flow in the younger alluvium is generally from the margins of the basin towards the valley floor. At the toes of the alluvial fans, because of the contrast in hydraulic conductivity between the alluvial fan material and the underlying finer grained sediments, groundwater discharge may take place in the form of springs and seeps. These springs generally occur along the toes of the alluvial fans on the eastern side of the valley.

Playa deposits also occur within the younger alluvium. Typically, the playa deposits may act as a confining layer for groundwater flow in the underlying sediments, and vertical leakage may occur as groundwater levels are lowered. Although the hydraulic conductivity may be variable, the playa sediments typically have a high storage coefficient. Groundwater movement within the deposits can be fairly complex, with solution and secondary precipitation of evaporite material being common.

C.2.1.2 Groundwater Elevations

An inventory of all wells located in Crescent Valley and groundwater elevations are summarized in Table C-1 and are shown on Figure 3.4-4. All available historic data were compiled by WMC (1992b). Since many of the well elevations have not been surveyed, the groundwater elevations are typically only accurate to within 10 feet, which may have resulted in minor inconsistencies. Most wells are completed in alluvium, with those completed into bedrock designated as such.

Groundwater elevations are highest around the margins of the basin, and are typically around 4,850 to 4,950 feet in the upper parts of the alluvial fans. The highest groundwater elevation in the study area was measured near Rocky Pass at about 5,025 feet. Water moves from these areas towards the axis of the valley. The elevation of the water table within the alluvium beneath the axis of the basin ranges from about 4,760 feet east of the Pipeline deposit to about 4,730 feet near Crescent Valley Township and about 4,700 feet at the northern end of the basin at Beowawe. Since there is currently only minimal stress on the groundwater system, groundwater levels within the alluvium are generally continuous with those in the underlying Roberts Mountain formation.

Figure 3.4-5 shows estimated groundwater elevation contours in the vicinity of the Pipeline deposit. The depth to groundwater at Rocky Pass was measured at about 10 feet, corresponding to a groundwater elevation of about 5,025 feet, which is about 30 feet higher than the water elevation in the Pipeline deposit area. Groundwater elevations measured in exploratory boreholes at the Pipeline deposit range from 4,791 feet to 4,799 feet. The hydraulic gradient across the Pipeline deposit is easterly at about 0.001.

C.2.1.3 Groundwater Recharge

Groundwater recharge to Crescent Valley occurs primarily from snowmelt and runoff along the mountains and piedmont slopes around the margins of the basin. Seepage from streams which cross the alluvium of the piedmont slopes is the main mechanism for recharge. Most streambeds are composed of sand and gravel material.

At higher elevations, seepage from streams percolates into the bedrock and into the thin veneer of alluvium that overlies the bedrock. Since groundwater movement in the bedrock is probably restricted in most areas by the geologic structure, much of the recharge moves downslope in the alluvium as shallow underflow and then either percolates directly into the alluvial fans or appears as springs. Water that recharges the bedrock often emerges as localized springs.

Following periods of high precipitation, when flow rates in the streams are greatest, surface flow extends further onto the piedmont slopes and the alluvial fans. Only during times of exceptionally high flow does the surface flow reach the lower slopes of the fans and the valley floor. Runoff and streamflow is likely to be higher in the Cortez Mountains where the alluvial fans are steeper. Surface flow therefore reaches the valley floor more frequently on the eastern side of the basin.

Additional recharge to groundwater in Crescent Valley occurs from minor surface flow and groundwater underflow from Carico Lake Valley through Rocky Pass. The average surface inflow to the basin from Rocky Pass has been estimated to be about $5x10^7$ to $1x10^8$ gallons or 150 to 300 acre-ft per year. About $3x10^7$ gallons per year is thought to recharge groundwater in the younger alluvial sediments. The remaining surface water flow is thought to be lost in evapotranspiration. During periods of higher than average flow, some groundwater recharge to shallow alluvial sediments from the Humboldt River may occur.

Maxey and Eakin (1951) derived an empirical method to estimate the amount of recharge to groundwater utilizing Hardman's zones of assumed equal precipitation. The Maxey-Eakin method assumes that recharge becomes negligible in zones below 5,000 feet elevation where the annual average precipitation is less than 8 inches. Observations and monitoring in other basins have tended to support this. Recharge rates for the entire basin are summarized in Table C-2. The total recharge rate to the basin from precipitation has been calculated to be $8x10^9$ gallons/yr (24,500 acre-ft/yr) (WMC 1992b).

C.2.1.4 <u>Groundwater Discharge</u>

Groundwater discharge occurs in the valley through evapotranspiration, spring discharge, groundwater discharge to the Humboldt River during periods of low flow, and groundwater pumpage. Evapotranspiration by phreatophytes generally occurs up to a depth of 15 to 20 feet, but could be as great as 30 to 40 feet (WMC 1992b). The rate of evapotranspiration is a function of the depth to the water table, the type and density of the vegetation, soil type, water quality, and climatic factors such as wind velocity, temperature, and humidity. Although no direct measurements have been made in Crescent Valley, data collected by the USGS (unpublished) from Boulder Valley to the north, and from other similar basins in northeast Nevada, indicate that the average annual rate may be on the order of 1 foot per year.

Evapotranspiration is an important factor in establishing the water balance of a basin, but is generally applied only where the water table is sufficiently close to the surface, i.e., the center of the basin. Evapotranspiration which occurs in the upland and higher elevations is accounted for indirectly in the methods used to estimate recharge to basin storage (Maxey-Eakin; above). The potentially affected area for evapotranspiration in Crescent Valley is approximately 240 to 260 square miles, mostly in the playa areas along the central part of the valley floor. Using a rate of 1 foot per year, the potential annual average evapotranspiration is estimated to be about $9x10^8$ gallons per year or 2,800 acre-feet per year.

Groundwater discharge also takes place in the form of springs and seeps. Two of the spring systems in the valley are thermal springs; the remainder are cold springs. The largest spring system in the valley is located near the southern extremity of the Dry Hills at Hot Springs Point. This thermal system consists of five springs with an estimated total cumulative discharge of approximately 100 gpm. Water temperatures are between 79°F and 138°F. A water quality sample was collected from one of the discharge points on September 9, 1992, and the results are discussed in Section C.2.1.5. The Chillis Hot Springs occur near the alluvium-bedrock contact near Rocky Pass, east of the Filippini Ranch. The discharge rate has been measured at about 10 gpm and the temperature was recorded to be 102°F. A water quality sample was collected on March 26, 1992.

Figure 3.4-4 shows the main springs and seeps in the valley. Many of these occur at higher elevations around the margins of the valley, often in response to localized groundwater movement. It is estimated that the total combined discharge rate does not exceed 150 to 200 gpm, or 80 to 105 M gallons per year. Numerous springs also occur on the valley floor near the toe of the alluvial fans, probably due to the local contrast in hydraulic conductivity between the coarser alluvial fan materials and the finer-grained valley fill deposits. Combined flow from these springs has been estimated to be less than 50 gpm throughout the valley. A group of 8 to 10 shallow wells and springs occur around the Dean Ranch, close to the lower edge of the piedmont slope below Indian Creek. These are located 5 to 7 miles east-northeast of the Pipeline deposit.

Groundwater discharges to the Humboldt River between Rose Ranch and Beowawe (Figure 3.4-4). Data collected by a comparison of stream gaging measures during October 1992 indicate that this may be up to 2,700 gpm, although estimating flow volumes in the river is complicated due to local irrigation diversions (WMC 1992b). It is likely that a minor amount of groundwater also leaves the basin as underflow through the gap at Beowawe. Although no records are available for the depth to bedrock in this area, it is thought that the discharge rate is unlikely to exceed $1x10^8$ gallons (300 acre-feet) annually (WMC 1992b).

Groundwater discharge also takes place through well pumpage for domestic, industrial, municipal, and agricultural purposes (Figure 3.4-4). Records on groundwater pumpage for Crescent Valley are incomplete, but it is estimated that the total average groundwater pumpage from the valley does not exceed 10,000 gpm, or 5,300 M gallons (16,000 acre-ft) annually. Most of these wells derive water from the basin fill sediments. The maximum permitted groundwater diversion rate for the valley is discussed in Section 3.4. Table C-4 is the NDWR Hydrographic Basin Abstract for Crescent Valley.

C.2.1.5 Hydrochemistry

To characterize the present groundwater chemistry in the Crescent Valley, and specifically the Pipeline deposit, WMC (1992b, 1993) collected a total of 53 samples from the following sources:

- 19 alluvial and bedrock well samples from the Crescent Valley region
- 24 samples from exploration drill holes in the Pipeline deposit
- 10 bedrock and alluvial wells before, during, and after aquifer testing in the Pipeline deposit

The analytical suite included all parameters listed in the Nevada Division of Environmental Protection (NDEP) Standard Profile, plus a 36-element ICP standard suite of metals. The well samples were filtered and preserved in accordance with NDEP requirements. The samples from the exploration drillholes were not filtered. A summary of wells sampled and the analytical results for all 53 samples are presented on Table C-3.

Bedrock Aquifer. The bedrock aquifer water quality is a sodium calcium bicarbonate dominant water of generally good quality, based on the samples collected to date. The total dissolved solids (TDS) range from 434 to 872 milligrams per liter (mg/L) and generally exceed the EPA Secondary Drinking Water Standard of 500 mg/L. The available data suggest that the groundwater sampled from the Roberts Mountain formation at Pipeline appears to reflect a large component of recent recharge. It is also broadly similar in composition to other young carbonate waters north of the Humboldt River, though possibly with a slight sulfate and sodium enrichment and with marginally higher chlorides.

Figures C-4 and C-5 show TDS and chloride values for groundwater samples collected from bedrock and alluvial wells throughout Crescent Valley. The map figures C-4 and C-5 also shows TDS and chloride concentrations in surface water for comparison. Most of the values clustered around the pipeline deposit represent bedrock aquifer samples (WMC 1993). TDS is relatively high in the bedrock water samples and exceed 500 mg/L near the pipeline deposit. Chloride concentrations are relatively lower than in the alluvium, less than 50 mg/L, which is less than the EPA Secondary Drinking Water Standard of 250 mg/L. Fluoride levels around the pit area average 2.7 mg/L which exceeds the EPA Secondary Drinking Water Standard of 2 mg/L. In the Pipeline deposit, the mean of all other parameters tested are less than EPA Drinking Water Standards. Two samples collected from bedrock bore hole PL-49 at 680 feet of depth and 960 feet of depth showed weak acid dissociable (WAD) cyanide at concentrations of 0.021 mg/L and 0.023 mg/L, respectively. The presence of WAD cyanide in these samples suggest that groundwater recharge may have come into contact with material from old mine workings. Arsenic was not detected in these same samples; however, it was detected at 0.018 µg/L in a sample from bedrock hole PL45 at 800 feet of depth. Neither the WAD cyanide nor the arsenic concentrations exceed EPA drinking water standards.

Regional Alluvial Aquifer. The regional alluvial groundwater quality around the proposed pit area is slightly different in character from the bedrock groundwater. The TDS of the regional samples ranged from 236 to 582 mg/L (Figure C-4). Many of the alluvial samples also had a slightly lower sulfate concentration and a slightly higher chloride content than bedrock samples (Figure C-5). Sulfate content averaged 153 mg/L, while the regional alluvial samples averaged 85 mg/L. The difference in chloride content may be somewhat misleading since the samples from the Crescent Valley township well were high in chloride.

Arsenic exceeded the EPA primary drinking water standard of 0.05 mg/L in a sample from alluvial observation well OW-8 located in the proposed pit area at a concentration of 0.202

mg/L. The average concentration of samples collected in alluvial wells in the valley is below the primary drinking water standard for mercury of 0.002 mg/L. Iron and manganese levels exceed the secondary standards of 0.3 and 0.05 mg/L, respectively, with average values of 0.302 mg/L for iron and 0.066 mg/L for manganese. Again, the mean of all other parameters is within the limits for drinking water. TDS values within the alluvium to the east of the proposed pit are between 412 and 582 mg/L.

WMC (1992b, 1993) calculated ratios for major constituents ions in groundwater samples to evaluate potential trends in groundwater quality and source. The ratio of bicarbonate to chloride is higher at the margins of the basin and in the bedrock at the pit, relative to the alluvial wells near the valley center. This may reflect a relatively longer residence time for groundwater at the valley center. Sulfate-to-chloride ratios indicate the same trend. Bicarbonate-to-chloride ratios at the margins are generally greater than 4.5, while ratios in the valley center are between 0.9 and 2.7. Sulfate-to-chloride ratios at the margins are between 1.1 and 2.6; at the valley center the ratios range from 0.4 to 0.9. No clear trend is evident from the calcium/sodium ratio.

TABLE C-1. SUMMARY OF WELLS IN CRESCENT VALLEY, NEVADA

Location	Year Drilled	Elevation (ft)	SWL (ft)	Depth (ft)	Lithology	Name of well
27.46.20	1961	4770	4757	44	alluvium	Filippini
27.46.20.2	1961	5082	5077	36	alluvium	Filippini
27.46.28.12	1969	5030	5025	35	alluvium	Filippini
27.46.29.22	1970	5030	4997	811	alluvium	Filippini
27.47.10.14	1990	4803	4768	45	alluvium	CGM (SHB TB-5)
27.47.11.44	1990	4783	4767	36	alluvium	CGM
27.47.12.24	1950	4775	4760	45	alluvium	CGM Well #62
27.47.12.24	1988	4775	?	45	alluvium	CGM Well #65
27.47.12.34	1990	4777	4755	45	alluvium	CGM Well #60
27.47.12.34	1950	4777		105	alluvium	CGM Well #59
27.47.12.34	1990	4777	4756	45	alluvium	CGM Well #64
27.47.12.43	1950	4777	4755	45	alluvium	CGM Well #63
27.47.12.43	1950	4777	4755	45	alluvium	CGM Well #61
27.47.12.44	1988	4779	4761	42	alluvium	CGM
27.47.12.44	1990	4779	4790	30	alluvium	CGM
27.47.12.44	1989	4779	?	45	alluvium	CGM
27.47.13.22	1990	4789	4756	50	alluvium	CGM (SHB TB-13)
27.47.13.33	1950	4785	4767	45	alluvium	CGM Well #57
27.47.13.33	1990	4785	4725?	69	alluvium	CGM (SHB TB-2)
27.47.14.23	1990	4789	4757	60	alluvium	CGM (SHB TB-4)
27.47.14.42	1950	4787	4766	45	alluvium	CGM Well #58
27.47.19.33	1950	4872	4767	130	alluvium	Filippini
27.47.23.23	1990	4803	4772	40.3	alluvium	CGM (SHB TB-1)
27.47.24.14	1968	4798	4695	400	alluvium	CGM
27.47.24.14	1968		depth: 114ft	365	alluvium	Commonwealth Const. Co.
27.47.35	1965	5498		1902	BR	
27.47.8.3		4847		45	alluvium	
27.48.34.21	1982	7415	7300	370	BR chert	CGM 130
27.48.6.13	1989	4765	4752	29	alluvium	CGM (SHB TB-9)
27.48.6.13	1989	4765	4753	28	alluvium	CGM (SHB TB-10)
27.48.6.14	1989	4764	4752	28	alluvium	CGM (SHB TB-?)
27.48.6.14	1989	4764	4753	28	alluvium	CGM (SHB TB-11)
27.48.6.33	1989	4770	4757	40	alluvium	CGM (SHB TB-7)

TABLE C-1. SUMMARY OF WELLS IN CRESCENT VALLEY, NEVADA (Continued)

27.48.6.33	1989	4770	4758	36	alluvium	CGM (SHB TB-8)
27.48.7.11	1989	4770		45	alluvium	CGM Well #66
27.48.7.33	1989	4790	4765	45	alluvium	CGM (SHB TB-15
27.48.8.31	1989	4833	4790	65.7	alluvium	CGM (SHB TB-6)
28.46.32.41	1989		depth: 57ft	245	BR chert	IMCO
28.46.7.33	1976			400	BR chert	Alta Gold Co.
28.47.10.13	1958	5060	4780	340	alluvium	Eakin & Komp
28.47.11.31	1984	4930	4740	212	alluvium	Mea Nichols
28.47.13.14	1984	4832	4757	150	alluvium	Happy Days Ranch
28.47.13.21	1958	4830	4773	109	alluvium	Lorentzen
28.47.13.21	1959	4830	4755	200	alluvium	Lorentzen
28.47.13.31	1957	4830	4782	100	alluvium	McCloud
28.47.13.31	1959	4830	4782	200	alluvium	McCloud
28.47.13.41	1960	4795	4727	200	alluvium	Alexander
28.47.21.11	1957	4798	4728	100	alluvium	Maulchin
28.47.24.31	1957	4779?	4724?	95	alluvium	Maulchin
28.47.24.4	1961	4765	4742	100	alluvium	Alexander
28.47.25.22	1957	4755	4734	150	alluvium	Maulchin
28.47.25.3	1962	4770	4756	150	alluvium	Underwood
28.47.25.31	1958	4770	4750	150	alluvium	Roberts
28.47.27.22	1957	4810	4759	132	alluvium	Wright
28.47.27.32	1957	4835	4786	128	alluvium	Wright
28.47.33.22	1950	4885	4791	250	alluvium	Gold Acres
28.47.35.11	1958	4795	4762	228	alluvium	McCoy
28.47.35.31	1956	4795	4740	200	alluvium	McCoy
28.47.36.11	1958	4775	4757	150	alluvium	Roberts
28.47.36.31	1958	4775	4762	150	alluvium	Roberts
28.47.8.42	1980	5405	5123	412	BR chrt+qzt	Aaron Mining
28.47.9.4	1960		dry?	373	BR LS	Komp & Eakin
28.48.14.1		4740				
28.48.14.32	1957	4736	4741	132	alluvium	Filippini
28.48.14.424		4760	4745	180		Filippini
28.48.15.3		4735	4735	89		Filippini
28.48.15.31	1956	4736	4738	89	alluvium	Filippini
28.48.16.1		4750		108		Filippini
28.48.17.21	1949	4755	4743	174	alluvium	Filippini

TABLE C-1. SUMMARY OF WELLS IN CRESCENT VALLEY, NEVADA (Continued)

28.48.17.4	1968	4750	4727	310	alluvium	1/2 Circle Cattle Co
28.48.17.4	1954	4798	4743	200		Buchanau
28.48.17.42	1958	4750		597	alluvium	Filippini
28.48.17.43	1969			740	alluvium	1/2 Circle Cattle Co
28.48.19.41	1958	4755	?	200	alluvium	Filippini
28.48.27.4		4739	4743	144		Filippini
28.48.27.42	1958	4742		220	alluvium	Filippini
28.48.31.43	1989	4755	4744	34.7	alluvium	CGM (SHB TB-12)
28.48.6.13	1949	4855	4844	108	alluvium	Filippini
28.48.8.32	1949	4770	4755	190	alluvium	Filippini
28.48.8.4	1960	4750	4720	98	alluvium	Filippini
28.48.8.4		4780		151		Filippini
28.48.8.44	1984		depth: 25ft	158	alluvium	Happy Days Ranch
28.48.8.44	1949	4748	4752	151	alluvium	Filippini
28.49.7.11	1956	4794	4752	75	alluvium	Filippini
28.49.7.14	1975	4825	4761	600	alluvium	1/2 Cicle Cattle Co
28.49.9.14	1975	5040		1077	alluvium	Chevron
28.748.14.41	1949	4743	4728	180	alluvium	Filippini
29.47.24.22	1970	4945	4745	522	alluvium	IMCC
29.48.1.13	1975	4759		2337	BR	Chevron
29.48.1.24	1976			248	BR	Chevron
29.48.1.33	1976	4758	237?	246	BR	Chevron
29.48.14.21	1985	4730	4665	270	alluvium	Andrews
29.48.15	1963	4725	4721	185	alluvium	Nevelco
29.48.17.2	1954	4810	4740	212		Buchanau
29.48.17.21	1953	4805	4735	212	alluvium	Buchanau
29.48.17.324	1982	4798	4742	200		Buchanau
29.48.17.34	1953	4805	4751	200	alluvium	Buchanau
29.48.29.33	1953	4810	4755	275	alluvium	Buchanau
29.48.3.143	1991	4740	1991	53		Dean Ranch
29.48.30.22	1956	4835	4769	300	alluvium	Beowawe Farms
29.48.34.33	1952	4729	4726	296	alluvium	Filippini
29.48.5.21	1985	4820	4720	270	alluvium	Ward
29.48.6.11	1984	4980	4730	350	alluvium	Aslett
29.48.7.24	1984	4880	4752	204	alluvium	Stinnet
29.49.11.313	1952	4827	4814	298		Filippini

TABLE C-1. SUMMARY OF WELLS IN CRESCENT VALLEY, NEVADA (Continued)

29.49.23.42	1956	4970	4915	228	alluvium	Dewey Dann
29.49.29.23	1968	4785	4752			Nutler
29.49.34.42	1978	4925		500	alluvium	Dann
29.49.36.1	1961	5350	5278	600	BR	Filippini
29.49.36.23	1961	5380	5308	600	BR	Filippini
29.49.5.11	1976	5000		245	BR	Chevron
29.49.5.21	1985	5040	4970	250	alluvium	Hopper
29.49.6.41	1976	4900	4835?	185	alluvium	Chevron
29.49.7.14	1976	4775		250	alluvium	Chevron
29.50.10.22	1957	5085	4838	300	alluvium	Primeaux
30.46.12.33	1986		depth: 65ft	396	BR	Magabar Minerals - Dresser
30.46.13.31	1986	5620	5585	200	BR	Megabar Minerals - Dresser
30.46.6.22	1968		depth: 158ft	240	BR chrt	Milchem
30.47.21	1961	6320?		21	alluvium	Red Hill Co
30.47.22	1961	5800?	5784?	40	BR LS	Red Hill Co
30.48.15.21	198	4755	4715	200	alluvium	Harper
30.48.15.33	1977	4760	?	110	alluvium	Holley
30.48.15.33	1954	4760	4701	200	alluvium	Arnold
30.48.21.32	1990	4747	?	164	alluvium	Black
30.48.21.33	1988	4800	4735	165	alluvium	Kurtz
30.48.27.33	1952	4745	4730	352	alluvium	Buchanau
30.48.28.22	1977	4755	4732	360	alluvium	Gulf Coast Premix
30.48.33.33	1952	4790	4733	300	alluvium	Buchanau
30.48.33.33	1985	4790	4729	300	Alluvium	Town of Crescent Valley
30.48.9.21	1984	4875	4735	185	alluvium	Garate
30.50.15.13	1985	6300	6280	100	alluvium	Harpes
31.47.4.24	1988	6290	6125	300	BR	Goldfields
31.48.1.43	1979	4730		300	alluvium	Hunt Mining
31.48.17.21	1975	4835		6000	BR	Magma Energy Inc
31.49.25.31	1989	4785	4621	246	alluvium	Hill
31.49.5	1970		depth: 133ft	?		Martin Milano
31.49.5	1962	4700	4692	69	?	Martin Milano
31.49.5.41	1986	4700	4689	120	alluvium	Union Pacific Systems
31.49.6	1966	4715	4697	262	BR	Ed Friesen

TABLE C-1. SUMMARY OF WELLS IN CRESCENT VALLEY, NEVADA (Concluded)

31.49.6.1	1959	4710	4684	50	alluvium	Sansinina
31.49.8.2	1959	4710	4697	49	alluvium	Sansinina
31.49.8.42	1959	4710	4694	525	alluvium	Sansinina
31.50.16.13	1959	4760	4742	260	alluvium	Rose & Colburn

Reference: WMC (1992b).

TABLE C-2

ESTIMATED RECHARGE RATES FOR CRESCENT VALLEY

Precipitation Zone (in.)	Altitude Zone (ft)	Area of Zone (acres)	Precipitation (acre-ft/yr) (rounded)	Percent Recharge (after Eakin)	Approximate Recharge (acre-ft/yr)
Recharge as specified by the Maxey-Eakin method for entire basin					
>20	>8,000	3,738	6,500	25	1,600
15-20	7-8,000	31,924	47,000	15	7,000
12-15	6-7,000	96,025	108,000	7	7,600
8-12	<6,000	349,370	277,000	3	8,300
Total (rounded)		481,000	438,000		24,500

Reference: WMC (1992b).

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II

DATE	TYPE	DESCRIPTION
08/90	GW	Cortez Mine Well (not Profile 1)
11/89	GW	Crescent Valley town well (not Profile 1)
11/91-1/92	GW	Gold Acres well - unfiltered
11/91-1/92	GW	PG91-2 Exploration hole - unfiltered
11/91-1/92	GW	PL91-8 Exploration hole - unfiltered
11/91-1/92	GW	PL91-11 Exploration hole - unfiltered
11/91-1/92	GW	PL91-12 Exploration hole - unfiltered
11/91-1/92	GW	PG91-5 Exploration hole - unfiltered
11/91-1/92	GW	PG91-6 Exploration hole - unfiltered
11/91-1/92	GW	PG91-7 Exploration hole - unfiltered
11/91-1/92	GW	PL91-14 Exploration hole - unfiltered
11/91-1/92	GW	PL91-15 Exploration hole - unfiltered
11/91-1/92	GW	PL91-16 Exploration hole - unfiltered
11/91-1/92	GW	PR91-13 Exploration hole - unfiltered
11/91-1/92	GW	PR91-14 Exploration hole - unfiltered
11/91-1/92	GW	PL91-18 Exploration hole - unfiltered
11/91-1/92	GW	PL91-19 Exploration hole - unfiltered
11/91-1/92	GW	PL91-20 Exploration hole - unfiltered
11/91-1/92	GW	PG91-22 Exploration hole - unfiltered
11/91-1/92	GW	PG91-9 Exploration hole - unfiltered
03/04/92	GW	PL-40 Exploration hole from 820'
03/08/92	GW	PL-42 Exploration hole from 620'
03/09/92	GW	PL-42 Exploration hole from 860'
03/17/92	GW	PL-45 Exploration hole from 540'
03/18/92	GW	PL-45 Exploration hole from 800'
03/22/92	GW	PL-49 Exploration hole from 680'
03/23/92	GW	PL-49 Exploration hole from 960'
03/26/92	SW	Filippini Ranch Stream
03/26/92	SW	Filippini Hot Springs
03/27/92	SW	Indian Creek
04/01/92	GW	Gold Acres well
04/01/92	SW	Mill Creek
06/15/92	SW	Cortez pit water
06/15/92	SW	Cortez pit water
06/15/92	SW	Cortez pit water
07/30/92	GW	SA92-1 Exploration hole north of Cortez mill
08/06/92	Cuttings	G-2 at 410-420' (sieve analyses)
08/06/92	Cuttings	G-2 at 360-370' (sieve analyses)
08/28/92	Cuttings	RI-3 50-60' (meteoric water mobility tests, including sieves)
08/28/92	Cuttings	RI-2 70-80' (meteoric water mobility tests, including sieves)
9/08/92	GW	Dean Ranch Domestic Well
9/09/92	SW	Hot Springs Resort Spring
9/09/92	GW	BLM Windmill
9/22/92	GW	Crescent Valley town well
9/23/92	GW	Cottonwood field well (east side of valley)
9/24/92	SW	Fire Creek
9/30/92	GW	OW-1D Bedrock monitor well

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

10/01/92	GW	PL-67 Reinfiltration pit area drill hole
10/04/92	GW	OW-3D Bedrock monitor well
10/05/92	GW	USGS well (between Pipeline & Tenabo)
10/16/92	GW	PL-67 (1 hour prior to pump test)
10/18/92	GW	PL-49 Bailed from open hole
10/19/92	GW	BW-1 After 3 days of pumping
10/20/92	GW	TB-5 Monitor well in mid valley
10/30/92	GW	OW-2S Alluvial monitor well
11/02/92	GW	OW-8 Alluvial observation well
11/05/92	GW	AW-1 After 2 days of pumping
11/05/92	GW	PL-49 After completion of monitor well from 400'
11/05/92	GW	BW-1 After 3 weeks of pumping

Reference: WMC (1992b).

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

Sample Name Date Analysis	EPA Drinking Water Standards	MW-22 6/2/92	MW-23 6/2/92	East end Cortez Pit 6/15/92	Middle Cortez Pit 6/15/92	West End Cortez Pit 6/15/92	TB-5 10/20/92	PL-49 10/18/92
Alkalinity (Bicarb)		171	250	225	228	225	199	277
Alkalinity (Total)		171	250	225	228	225	198	277
Chloride	250	67.9	54.1	24.8	27.9	26.9	67.9	25.3
Cyanide (WAD)		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	2.4	1.16	0.598	1.78	1.76	1.76	0.806	2.94
Nitrate Nitrogen	10	3.6	0.7	<1.0	<1.0	<1.0	<1	1.7
pH (units)	6.5-8.5	7.99	7.79	8.02	8.07	8.13	7.59	7.55
Sulfate	250	82.8	123	86.5	85.6	81.9	103	157
TDS	500	483	582	434	438	425	510	553
Aluminum								
Antimony								
Arsenic	0.05	0.02	0.017	0.038	0.037	0.04	0.011	0.007
Barium		0.068	0.085	0.061	0.06	0.06	0.039	0.051
Boron								
Cadmium	0.01	<0.007	<0.007	<0.007	<0.007	<0.007	<0.005	<0.005
Calcium		57.6	70.8	44.2	43.1	43.1	72.1	57.8
Chromium	0.05	<0.01	<0.01	<0.010	<0.010	<0.010	0.012	<0.01
Cobalt								
Copper	1	<0.007	0.013	<0.007	<0.007	<0.007	<0.005	<0.005
Gold								
Iron	0.3	0.526	2.64	0.145	0.257	<0.050	<0.05	<0.05
Lead	0.05	<0.005	0.014	<0.005	0.006	0.007	<0.005	<0.005
Lithium								
Magnesium		11.4	18.2	18	17.7	17.7	14.4	25.3
Manganese	0.05	0.023	0.108	0.005	<0.003	<0.003	<0.005	0.135
Mercury	0.002	0.00061	0.00089	<0.0005	<0.0005	0.00138	<0.0005	<0.0005
Molybdenum								
Nickel								
Palladium								
Platinum								
Potassium		8.06	13.5	11.3	11.4	11.1	11.6	15.7
Selenium	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005
Silicon								
Silver	0.05	<0.01	<0.01				<0.01	<0.01
Sodium		72.2	94.3	72.8	72.4	71.4	95.2	104
Strontium								
Sulfur								
Tellurium								
Tin								
Thallium								
Titanium								
Tungsten								
Vanadium								
Zinc	5	0.016	0.076	<0.005	<0.005	0.006	<0.005	0.01
Temperature (deg C)							16.2	22.6
Conductivity							788	938
Ion Balance (%)		1.10	1.16	1.15	1.12	1.14	1.26	1.16

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

Sample Name Date Analysis	PL-49 at 680' 03/23/92	PL-49 at 960' 03/23/92	Mill Creek 04/01/92	Filippini Ranch 03/26/92	Filippini Hot Spr. 03/26/92	Indian Creek 03/27/92	Cortez Mine Well 8/90	Crescent Valley 11/06/89
Alkalinity (Bicarb)	237	237			158	148		
Alkalinity (Total)	237	237	202	359	163	148		146
Chloride	41.3	30.6	9.7	512	89.8	33.7	34	67
Cyanide (WAD)	0.021	0.023	<0.005	<0.005	<0.005	0.013		
Fluoride	2.91	2.88	0.319	0.741	5.17	0.527	1.61	0.2
Nitrate Nitrogen	10.1	4.8	1.1	<0.1	<0.1	<0.1	6.3	6.3
pH (units)	8.08	8.23	8.28	7.55	8.52	8.02	7.97	7.69
Sulfate	293	197	92.8	1440	106	106	97	110
TDS	872	692	380	3433	3486	394	478	431
Aluminum	0.128	0.113	0.13	0.136	0.14	0.139	<0.005	<0.005
Antimony	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050		
Arsenic	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	0.025	0.008
Barium	0.036	0.023	0.044	0.038	0.009	0.074	0.05	0.04
Boron	0.554	0.491	0.311	0.797	0.492	0.335		0.1
Cadmium	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007		<0.001
Calcium	58.1	54.8	80.5	455	18.4	56.5		63
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005
Cobalt	0.03	0.012	<0.007	<0.007	<0.007	<0.007		
Copper	0.008	<0.007	<0.007	<0.007	<0.007	<0.007	0.01	0.04
Gold	<0.02	<0.02	0.129	<0.02	<0.02	<0.02		
Iron	0.558	<0.008	<0.008	<0.008	<0.008	<0.008	0.05	0.03
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005
Lithium	0.207	0.219	0.12	0.076	0.168	0.011		
Magnesium	22.5	22	21	162	4.72	22.6	24	15
Manganese	0.01	0.006	<0.003	0.577	0.012	<0.003	0	0
Mercury	0.00541	<0.005	<0.005	<0.01	<0.01	<0.01		<0.0005
Molybdenum	0.017	<0.015	<0.015	0.05	0.025	<0.015		
Nickel	<0.02	<0.02	0.02	0.03	<0.02	<0.02		
Palladium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050		
Platinum	<0.120	<0.120	<0.120	<0.120	<0.120	<0.120		
Potassium	13.6	13.6	3.11	29.9	2.24	3.5		4
Selenium	0.017	0.007	<0.005	0.022	<0.05	0.007	0.001	0.004
Silicon	2.64	8.84	9.22	12.8	22.1	13.2		38
Silver	<0.02	<0.02	0.22	0.071	<0.02	<0.02		<0.005
Sodium	124	90.9	21.7	341	188	43.6		
Strontium	0.946	0.827	0.453	0.185	0.143	0.256		
Sulfur	90.2	64.2	34.1	516	54	39.6		
Tellurium	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075		
Tin	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130		
Thallium	<0.150	<0.150	<0.150	<0.150	<0.150	<0.150		
Titanium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Tungsten	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040		
Vanadium	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007		
Zinc	0.012	0.013	0.014	0.007	<0.005	<0.005	0.012	0.2
Temperature (deg C)			10.5					
Conductivity			875					
Ion Balance (%)	0.93	0.99	3.04	1.16	1.30	1.19		
HCO3/CL-								

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

Sample Name / Date Analysis	Dean Ranch 09/08/92	Hot Spring 09/09/92	BLM Windmill 09/09/92	Gold Acres 04/01/92	PL-40 at 820' 03/04/92	PL-42 at 620' 03/08/92	PL-42 at 860' 03/09/92	PL-45 at 540' 03/17/92	PL-45 at 800' 03/18/92
Alkalinity (Bicarb)	125	761	147		270	260	257	259	263
Alkalinity (Total)	125	761	147	288	270	260	257	259	263
Chloride	27.9	46.6	51.7	20.9	15.3	18.9	18.9	18.9	17.6
Cyanide (WAD)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	0.565	5.85	0.589	<0.005	<0.005	3.05	2.9	3.17	3.19
Nitrate Nitrogen	<1	<1	<1	0.3		0.1	<0.1	<0.1	0.2
pH (units)	7.75	6.86	7.75	7.92	8.16	8.22	8.22	8.17	8.3
Sulfate	44.4	119	56.7	117	109	129	132	120	125
TDS	236	1080	412	526		434	485	520	524
Aluminum				0.139	0.163	0.128	0.125	0.114	0.09
Antimony				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Arsenic	0.008	<0.005	<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	0.018
Barium	0.059	0.089	0.042	0.028	0.047	0.045	0.037	0.037	0.055
Boron				0.557	0.626	0.522	0.428	0.485	0.442
Cadmium	<0.005	<0.005	<0.005	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Calcium	30.1	63.6	35.1	66.3	50.1	46.7	47.8	52.3	55.3
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Cobalt				<0.007	<0.007	<0.007	<0.007	<0.007	0.011
Copper	<0.005	<0.005	<0.005	<0.007	<0.007	0.007	<0.007	<0.007	0.069
Gold				<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	<0.05	<0.05	0.197	<0.008	0.012	<0.008	<0.008	0.1	<0.008
Lead	<0.005	<0.005	<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lithium				0.295	0.328	0.264	0.149	0.334	0.29
Magnesium	6.1	34.8	7.2	22	21.1	21.2	22.5	21.2	20.7
Manganese	<0.005	0.06	0.039	<0.003	0.03	<0.003	<0.003	<0.003	<0.003
Mercury	0.0164	0.0005	0.0005	0.000718	<0.0005	0.00062	0.000659	0.00186	0.00169
Molybdenum				<0.015	<0.015	<0.015	0.024	<0.015	<0.015
Nickel				<0.02	<0.02	<0.02	<0.02	<0.02	0.03
Palladium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Platinum				<0.120	<0.120	<0.120	<0.120	<0.120	<0.120
Potassium	5.4	59	13	17.4	17.6	17	16.6	18.5	15.6
Selenium	0.022	<0.01	<0.01	<0.005	<0.005	<0.005	0.007	0.008	<0.005
Silicon				13.9	12.8	11.7	11	12	13.6
Silver	<0.01	<0.01	<0.01	<0.02	<0.02	0.02	0.02	0.026	0.048
Sodium	44.8	259	61.1	87	91	76.6	74.5	91.8	88.3
Strontium				1.09	1.07	0.969	0.943	1.01	1.04
Sulfur				42.9	41.1	38.4	39.3	42.7	44
Tellurium				<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
Tin				<0.130	<0.130	<0.130	<0.130	<0.130	<0.130
Thallium				<0.150	<0.150	<0.150	<0.150	<0.150	<0.150
Titanium				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tungsten				<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Vanadium				<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Zinc	0.025	0.013	0.07	0.011	<0.005	0.013	0.019	0.013	0.018
Temperature (deg C)	15.8	42.5	16.3		17				
Conductivity	456	1793	590		822				
Ion Balance (%)	1.09	1.16	1.06	3.08	1.21	1.05	1.05	1.21	1.17

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

Sample Name Date Analysis	BW-1 10/19/92	PL-67 10/16/92	Crescent Valley 09/22/92	Cotton Field 09/23/92	Fire Creek 09/24/92	PL-67 10/01/92	OW-3D 10/04/92	USGS 10/05/92	OW-1D 09/30/92	Major/Mud 09/30/92
Alkalinity (Bicarb)	267	305	113	267	128	318	256	232	274	245
Alkalinity (Total)	268	305	113	267	128	318	270	240	274	245
Chloride	46	20.1	74	15.4	35	21.7	24.4	25.7	28.8	23.7
Cyanide (WAD)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	3.21	3.34	0.117	2.65	0.337	1.04	3.09	1.37	1.94	3.07
Nitrate Nitrogen	<1	<1	4.85	<1	<1	<1	<1	<1	<1	<1
pH (units)	8.03	7.29	7.79	7.99	8.24	7.34	8.49	9.41	8.25	7.96
Sulfate	125	86.9	121	37.9	28.1	82.6	155	3.4	137	134
TDS	534	520	435	389	253	514	542	261	532	466
Aluminum			<0.05	<0.05	<0.05					
Antimony			<0.05	<0.05	<0.05					
Arsenic	0.019	<0.005	<0.05	0.006	<0.005	0.01	0.005	0.012	0.013	0.008
Barium	0.052	0.117	0.025	0.058	0.046	0.103	0.041	0.003	0.04	0.035
Boron			0.147	1.1	0.151					
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	59.3	67.1	169	17.7	37.4	55	52.8	2.11	44.5	48.3
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt			<0.005	<0.05	<0.005	<0.005				
Copper	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Gold			<0.01	<0.01	<0.01					
Iron	<0.05	0.253	<0.05	<0.05	<0.05	0.197	0.101	<0.05	<0.05	0.086
Lead	<0.005	<0.005	0.006	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Lithium			0.016	0.502	0.014					
Magnesium	20.4	21.7	15.1	6.2	11.2	17.6	19.6	6.04	0.024	0.098
Manganese	0.008	0.329	<0.005	<0.005	<0.005	0.26	0.032	<0.005	0.024	0.098
Mercury	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0037	<0.0005	<0.0005	<0.0005	0.0016
Molybdenum			<0.01	0.01	<0.01					
Nickel										
Palladium			<0.05	<0.05	<0.05					
Platinum			<0.01	<0.01	0.1					
Potassium	17.5	21.9	2.8	7.8	4.3	18.6	14.8	16.8	14.9	8.27
Selenium	<0.005	<0.005	0.008	<0.01	<0.005	0.009	<0.005	<0.005	<0.005	<0.005
Silicon			14.4	20.8	20.1					
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	90.4	113	47.4	132	36.9	93.6	112	107	110	100
Strontium			0.361	0.215	0.204					
Sulfur			36.6	12.5	10.7					
Tellurium			<0.05	<0.05	<0.05					
Tin			<0.10	<0.10	<0.10					
Thallium			<0.10	<0.10	<0.10					
Titanium			<0.005	<0.005	<0.005					
Tungsten			<0.04	<0.04	<0.04					
Vanadium			<0.010	0.028	0.01					
Zinc	0.013	<0.005	0.012	<0.005	<0.005	<0.005	0.008	<0.005	<0.005	0.469
Temperature (deg C)	39.3	31.4	16.3	23.9	12.5	35.3	29.3	19.2	30.3	22
Conductivity	845	820	713	659	433	832	915	558	851	830
Ion Balance (%)	1.09	1.44	1.81	1.31	1.23	1.16	1.17	1.24	0.91	0.93

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

Pipeline Water Quality Data

Element	GA Well	PG91-2	PL91-8	PL91-11	PL91-12	PG91-5	PG91-6	PG91-7	PL91-14	PL91-15	PL91-16	PR91-13	PR91-14	PL91-18	PL91-19	PL91-20	PG91-922	PG91-9	STD
Total CN	-.005	.086	-.005	-.005	-.005	-.005	-.005	-.005	-.005	-.005	-.005		-.005	-.005	-.005	-.005	-.005	-.005	.2
As GFAA		.055		.239	.06	.089	.325	.061	.543	.066	.2	.053	.346	.028	.101	.046	.115	.084	.05
Hg CVAA		.004		.149	.0008	.00137	.00642	.00082	.01105		.0064	-.0005	.00115	-.0005	-.0005	.00075	.0047	.00121	.002
Se GFAA		.007				-.005	-.005	-.005	.016	-.005	.009	-.005	-.005	-.005	-.005	.008	-.005	-.005	.01
Ag	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	.05
Al	1.07	1.68	20.3	16.9	1.68	.681	67.9	2.4	7.22	24	10.6	2.15	10.9	1.41	3.21	7	8.73	2.61	
As	-.18	-.18	2.96	1.11	-.18	-.18	1.32	-.18	.598	-.18	.562	-.18	.333	-.18	-.18	-.18	-.18	-.18	.05
Au	-.02	-.02	.059	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	
B	.612	.403	.492	.538	.555	.604	.541	.439	.455	.477	.456	.467	.453	.465	.419	.482	.536	.494	
Ba	.072	.109	.365	.257	.118	.031	1.04	.09	.147	.257	.291	.09	.216	.061	.171	.398	.474	.17	1
Be	-.001	-.001	.005	.002	-.001	-.001	.005	-.001	.001	.003	.002	-.001	.001	-.001	-.001	-.001	-.001	-.001	
Ca	66.9	128	97.2	94.7	68.7	41.9	250	89.4	130	104	169	73.9	84.9	56.1	79.5	84.7	145	106	
Cd	-.007	-.007	.09	.039	-.007	-.007	.036	-.007	.018	-.007	.015	-.007	.008	-.007	-.007	-.007	.008	-.007	.01
Co	-.007	-.007	.038	.015	.007	-.007	.014	-.007	.018	.011	.01	-.007	-.007	-.007	0	-.007	.02	-.007	
Cr	-.01	-.01	.06	.038	-.01	.024	.07	-.01	-.01	-.01	-.01	-.01	-.01	.04	.02	.025	.098	.015	.05
Cu	.012	.021	.067	.056	.011	-.007	.135	.013	.044	.066	.351	.009	.061	-.007	.027	-.007	.061	.018	1
Fe	16.8	6.41	86.5	45.5	6.39	5.19	69.8	7.44	14.9	24.8	19.3	2.43	15.6	9.09	7.72	4.69	36.8	13.9	.3
Hg	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	.002
K	18.8	18.3	27.4	25.3	19.5	15.8	50.5	18.6	19.7	26.8	20.6	18.2	23.1	16.6	15.5	17.2	19.5	18	
Li	.307	.312	.333	.328	.338	.294	.355	.326	.314	.321	.32	.336	.351	.257	.251	.264	.289	.285	
Mg	21.7	42.3	30.7	43	23.3	9.88	88.7	25	40.2	41.8	64.1	22.9	30.1	22.8	31.5	35.6	55.8	32.4	125
Mn	.123	.528	.838	.125	.279	.071	.698	.14	.407	.536	.246	.037	.202	.075	.314	.103	1.6	.089	.05
Mo	-.015	-.015	.062	.04	-.015	.024	.062	-.015	.035	.047	.04	-.015	.017	-.015	.017	-.015	.033	-.015	
	91.8	88.8	93.3	91.5	94.1	538	91.5	89.7	87.6	88.7	87.3	90.8	91.7	78.6	73.8	75.4	87.4	81.7	
Ni	-.015	.059	.038	.124	.045	-.015	.157	-.015	.102	.145	.063	-.015	.04	-.015	.045	.018	.136	.057	
Pb	-.05	.181	.069	.337	-.05	-.05	.206	.051	-.05	.088	1.54	-.05	.086	-.05	.131	.051	.106	.1	.05
Pd	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	
Pt	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	-.12	
S	43.3	43.9	50.2	45.4	43.2	47.6	41.8	42.6	45.4	44.8	44	41.5	41.5	44.2	38	42	43.2	38.4	250
Sb	-.05	-.05	-.05	.069	-.05	-.05	.435	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	-.05	
Se	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	-.13	.01
Si	19.1	16.2	38.8	39.6	16	14.1	150	16.4	13.9	57	27.6	17.1	28.1	14	19.1	23.1	33	14.9	
Sn	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	
Sr	1.16	1.17	1.29	1.18	1.15	.467	1.36	1.11	1.14	1.18	1.23	1.11	1.15	.937	.9	.919	1.01	1.01	
Te	-.075	-.075	-.075	-.075	-.075	-.075	.148	-.075	-.075	-.075	-.075	-.075	-.075	-.075	-.075	-.075	-.075	-.075	
Ti	.026	.038	.457	.633	.034	.008	2.6	.093	.128	.83	.355	.099	.484	-.05	.13	.326	.286	.036	
Tl	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	-.15	
V	.016	.031	.106	.21	.009	-.007	.641	.011	.072	.213	.132	.016	.142	.018	.049	.065	.1	.035	
W	-.04	.056	.119	.101	.052	.095	.067	-.04	-.04	.052	.075	-.04	-.04	-.04	.102	-.04	.044	-.04	
Zn	.04	.302	1.29	.331	.157	.038	1.11	.088	.369	.336	2.2	.082	.335	.066	.209	.076	.5	.2	5

All figures in mg/l

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

	EPA NATIONAL DRINKING WATER STANDARDS	GOLD ACRES WELL	HOLE PL40 AT 820 FT	HOLE PL42 AT 620 FT
ARSENIC	0.05	<0.010	<0.010	<0.010
LEAD	0.05	<0.010	<0.010	<0.010
MERCURY	0.002	0.000718	<0.0005	0.00062
SELENIUM	0.01	<0.005	<0.005	<0.005
NICKEL		<0.02	<0.02	<0.02
TOT. ALK		288	270	260
CHLORIDE	250	20.9	15.3	18.9
WAD-CN		<0.005	<0.005	<0.005
FLUORIDE	2.4	3.12	3.21	3.05
NITRATE NITROGEN	10	0.3	-	0.1
pH	6.5-8.5	7.92	8.16	8.22
TDS	500	526	-	434
SULFATE	250	117	109	129
SILVER	0.05	<0.020	<0.020	0.02
ALUMINUM		0.139	163	0.128
GOLD		<0.020	<0.020	<0.020
BORON		0.557	0.626	0.522
BORIUM	1.0	0.028	0.047	0.045
BERYLLIUM		<0.001	<0.001	<0.001
CALCIUM		66.3	50.1	46.7
CADMIUM	0.01	<0.007	<0.007	<0.007
COBALT		<0.007	<0.007	<0.007
CHROMIUM	0.05	<0.010	<0.010	0.01
COPPER	1.0	<0.007	<0.007	0.007
IRON	0.3	<0.008	0.012	<0.008
MERCURY		<0.500		
POTASSIUM		17.4	17.6	17
LITHIUM		0.295	0.328	0.264
MAGNESIUM		22.0	21.1	21.2
MAGNANESE	0.05	<0.003	0.03	<0.003
MOLYBDENUM		<0.015	<0.015	<0.015
SODIUM		87.0	91	76.6
NICKEL		<0.015	0.015	<0.015
PALLADIUM		<0.050	<1.051	<0.050
PLATIUM		<0.120	<1.120	<0.120
SULFUR		42.9	41.1	38.4
ANTIMONY		<0.050	<0.050	<0.050
SELENIUM		<0.130	<0.130	<0.130
SILICON		13.9	12.8	11.7
TIN		<1.30	<1.30	<1.30
STRONTIUM		1.09	1.07	0.969
TELLURIUM		<0.075	<0.075	<0.075
TITANIUM		<0.001	<0.001	<0.001
THALLIUM		<0.150	<0.150	<0.150
VANADIUM		<0.007	<0.007	<0.007
TUNGSTEN		<0.040	<0.040	<0.040
ZINC	5.0	0.011	<0.005	0.013

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

	EPA NATIONAL DRINKING WATER STANDARDS	HOLE PL42 AT 860 FT	HOLE PL45 AT 540 FT	HOLE PL45 AT 800 FT
ARSENIC	0.05	<0.010	<0.010	0.018
LEAD	0.05	<0.010	<0.010	<0.010
MERCURY	0.002	0.000659	0.00186	0.00169
SELENIUM	0.01	0.007	0.008	<0.005
NICKEL		<0.02	<0.02	0.03
TOT. ALK		257	259	263
CHLORIDE	250	18.9	18.9	17.6
WAD-CN		<0.005	<0.005	<0.005
FLUORIDE	2.4	2.9	3.17	3.19
NITRATE NITROGEN	10	<0.1	<0.1	0.2
pH	6.5-8.5	8.22	8.17	8.30
TDS	500	485	520	524
SULFATE	250	132	120	125
SILVER	0.05	0.02	0.026	0.048
ALUMINUM		0.125	0.114	0.09
GOLD		<0.020	<0.020	<0.020
BORON		0.428	0.485	0.442
BORIUM	1.0	0.037	0.037	0.055
BERYLLIUM		<0.001	0.002	0.002
CALCIUM		47.8	52.3	55.3
CADMIUM	0.01	<0.007	<0.007	<0.007
COBALT		<0.007	<0.007	0.011
CHROMIUM	0.05	<0.010	<0.010	<0.010
COPPER	1.0	<0.007	<0.007	0.069
IRON	0.3	<0.008	0.100	<0.008
MERCURY				
POTASSIUM		16.6	18.5	15.6
LITHIUM		0.149	0.334	0.29
MAGNESIUM		22.5	21.2	20.7
MAGNANESE	0.05	<0.003	<0.003	<0.003
MOLYBDENUM		0.024	<0.015	<0.015
SODIUM		74.5	91.8	88.3
NICKEL		<0.015	<0.015	<0.015
PALLADIUM		<0.050	<0.050	<0.050
PLATIUM		<0.120	<0.120	<0.120
SULFUR		39.3	42.7	44.0
ANTIMONY		<0.050	<0.050	<0.050
SELENIUM		<0.130	<0.130	<0.130
SILICON		11.0	12.0	13.6
TIN		<1.30	<0.130	<0.130
STRONTIUM		0.943	1.01	1.04
TELLURIUM		<0.075	<0.075	<0.075
TITANIUM		<0.001	<0.001	<0.001
THALLIUM		<0.150	<0.150	<0.150
VANADIUM		<0.007	<0.007	<0.007
TUNGSTEN		<0.040	<0.040	<0.040
ZINC	5.0	0.019	0.013	0.018

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

	EPA NATIONAL DRINKING WATER STANDARDS	HOLE PL45 AT 680 FT	HOLE PL49 AT 960 FT	MILL CREEK
ARSENIC	0.05	<0.010	<0.010	0.074
LEAD	0.05	<0.010	<0.010	<0.010
MERCURY	0.002	0.00541	<0.005	<0.0005
SELENIUM	0.01	0.017	0.007	<0.005
NICKEL		<0.02	<0.02	0.02
TOT. ALK		237	237	202
CHLORIDE	250	41.3	30.6	9.7
WAD-CN		0.021	0.023	<0.005
FLUORIDE	2.4	2.91	2.88	0.319
NITRATE NITROGEN	10	10.1	4.8	1.1
pH	6.5-8.5	8.08	8.23	8.28
TDS	500	872	692	380
SULFATE	250	293	197	92.8
SILVER	0.05	<0.020	<0.020	0.22
ALUMINUM		0.128	0.113	0.13
GOLD		<0.020	<0.020	0.129
BORON		0.554	0.491	0.311
BORIUM	1.0	0.036	0.023	0.044
BERYLLIUM		<0.001	<0.001	<0.001
CALCIUM		58.1	54.8	80.5
CADMIUM	0.01	<0.007	<0.007	<0.007
COBALT		0.030	0.012	<0.007
CHROMIUM	0.05	<0.010	<0.010	<0.010
COPPER	1.0	0.008	<0.007	<0.007
IRON	0.3	0.558	<0.008	<0.008
MERCURY				
POTASSIUM		13.6	13.6	3011
LITHIUM		0.207	0.219	0.12
MAGNESIUM		225	22	21
MAGNANESE	0.05	0.01	0.006	<0.003
MOLYBDENUM		0.017	<0.015	<0.015
SODIUM		124	90.9	21.7
NICKEL		<0.015	<0.015	<0.015
PALLADIUM		<0.050	<0.050	<0.050
PLATIUM		<0.120	<0.120	<0.120
SULFUR		90.2	64.2	34.1
ANTIMONY		<0.050	<0.050	<0.050
SELENIUM		<0.130	<0.130	<0.130
SILICON		2.64	8.84	9.22
TIN		<0.130	<0.130	<0.130
STRONTIUM		0.946	0.827	0.453
TELLURIUM		<0.075	<0.075	<0.075
TITANIUM		<0.001	<0.001	<0.001
THALLIUM		<0.150	<0.150	<0.150
VANADIUM		<0.007	<0.007	<0.007
TUNGSTEN		<0.040	<0.040	<0.040
ZINC	5.0	0.012	0.013	0.014

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Continued)

	EPA NATIONAL DRINKING WATER STANDARDS	FILIPPINI RANCH STREAM	FILIPPINI HOT SPRINGS	INDIAN CREEK
ARSENIC	0.05	<0.010	0.011	<0.010
LEAD	0.05	<0.010	<0.010	<0.010
MERCURY	0.002	<0.0005	<0.0005	<0.0005
SELENIUM	0.01	0.022	<0.005	0.007
NICKEL		0.03	<0.02	<0.02
TOT. ALK		359	163	148
CHLORIDE	250	512	898	33.7
WAD-CN		<0.005	<0.005	0.013
FLUORIDE	2.4	0.741	5.17	0.527
NITRATE NITROGEN	10	<0.1	<0.1	<0.1
pH	6.5-8.5	7.55	8.52	8.02
TDS	500	3433	3486	394
SULFATE	250	1440	106	106
SILVER	0.05	0.071	<0.020	<0.020
ALUMINUM		0.136	0.14	0.139
GOLD		<0.020	<0.020	<0.020
BORON		0.797	0.492	0.335
BORIUM	1.0	0.038	0.009	0.074
BERYLLIUM		<0.001	<0.001	<0.001
CALCIUM		455	18.4	56.5
CADMIUM	0.01	<0.007	<0.007	<0.007
COBALT		<0.007	<0.007	<0.007
CHROMIUM	0.05	<0.010	<0.010	<0.010
COPPER	1.0	<0.007	<0.007	<0.007
IRON	0.3	<0.008	<0.008	<0.008
MERCURY				
POTASSIUM		29.9	2.24	3.5
LITHIUM		0.076	0.168	0.011
MAGNESIUM		162	4.72	22.6
MAGNANESE	0.05	0.577	0.012	<0.003
MOLYBDENUM		0.05	0.025	<0.015
SODIUM		641	188	43.6
NICKEL		<0.015	<0.015	<0.015
PALLADIUM		<0.050	<0.050	<0.050
PLATIUM		<0.120	<0.120	<0.120
SULFUR		516	54	39.6
ANTIMONY		<0.050	<0.050	<0.050
SELENIUM		<0.130	<0.130	<0.130
SILICON		12.8	22.1	13.2
TIN		<0.130	<0.130	<0.130
STRONTIUM		1.85	0.143	0.256
TELLURIUM		<0.075	<0.075	<0.075
TITANIUM		<0.001	<0.001	<0.001
THALLIUM		<0.150	<0.150	<0.150
VANADIUM		<0.007	<0.007	<0.007
TUNGSTEN		<0.040	<0.040	<0.040
ZINC	5.0	0.007	<0.005	<0.005

TABLE C-3. SUMMARY OF WATER SAMPLING AND RESULTS (PPM) - PHASES I AND II (Concluded)

	EPA NATIONAL DRINKING WATER STANDARDS	HOLE PL49 AT 680 FT	CORTEZ MINE 26.42.5 8/90	CRESCENT VALLEY TOWN 28.47.33 11/89
ARSENIC	0.05	<0.010	0.025	0.008
LEAD	0.05	<0.010	<0.005	<0.005
MERCURY	0.002	0.00541		<0.0005
SELENIUM	0.01	0.017	0.001	0.004
NICKEL		<0.02		
TOT. ALK		237		146
CHLORIDE	250	41.3	34	67
WAD-CN		0.021		
FLUORIDE	2.4	2.91	1.61	0.2
NITRATE NITROGEN	10	10.1	6.3	6.3
pH	6.5-8.5	8.08	7.97	7.69
TDS	500	872	478	431
SULFATE	250	293		110
SILVER	0.05	<0.020	<0.005	<0.005
ALUMINUM		0.128		
GOLD		<0.020		
BORON		0.554		0.1
BORIUM	1.0	0.036	0.05	0.04
BERYLLIUM		<0.001		
CALCIUM		58.1		63
CADMIUM	0.01	<0.007	<0.001	<0.001
COBALT		0.030		
CHROMIUM	0.05	<0.010	<0.005	<0.005
COPPER	1.0	0.008	0.01	0.04
IRON	0.3	0.558	0.05	0.03
MERCURY				
POTASSIUM		13.6		4
LITHIUM		0.207		
MAGNESIUM		225	24.0	15.0
MAGNANESE	0.05	0.010	0.00	0.00
MOLYBDENUM		0.017		
SODIUM		124.0		48.0
NICKEL		<0.015		
PALLADIUM		<0.050		
PLATIUM		<0.120		
SULFUR		90.2		
ANTIMONY		<0.050		
SELENIUM		<0.130		
SILICON		2.64	97	38.0
TIN		<0.130		
STRONTIUM		0.946		
TELLURIUM		<0.075		
TITANIUM		<0.001		
THALLIUM		<0.150		
VANADIUM		<0.007		
TUNGSTEN		<0.040		
ZINC	5.0	0.012	0.012	0.2

TABLE C-4. HYDROGRAPHIC BASIN ABSTRACT - CRESCENT VALLEY, NEVADA

NEVADA DIVISION OF WATER RESOURCES
WATER RIGHTS DATABASE

HYDROGRAPHIC BASIN ABSTRACT
GROUND WATER

RUN DATE: 04/09/1992

HYDROGRAPHIC BASIN: 054 CRESCENT VALLEY

HYDROGRAPHIC REGION: 04 HUMBOLDT RIVER BASIN

APP#	CHANGE OF APP#	CERT#	FILING DATE	STAT	SRC	POINT OF DIVERSION QQ	QTR	SEC	TWP	RNG	DIV RATE (CFS)	TYPE OF USE	S U P	ACRES IRRIGATED	ANNUAL DUTY	CO	OWNER OF RECORD
10071		2599	01/11/1937	CER	UG	NW	SE	28	28N	47E	0.670	MM		0.00	39.83 MGS	LA	DESERT PLACERS INC.
10485		2773	04/04/1940	CER	UG	NE	NW	17	27N	47E	0.016	STK		0.00	3.77 MGA	LA	FILIPPINI, ED
10746		2908	10/14/1941	CER	UG	NE	NE	33	28N	47E	0.193	MM		0.00	45.52 MGA	LA	CONSOLIDATED GOLDACRES CO.
CHANGE BY:	52926			-RFA													
13233		4066	01/16/1950	CER	UG	SE	NE	08	28N	48E	0.031	STK		0.00	7.31 MGA	EU	FILIPPINI, DAN
13234		4067	01/16/1950	CER	UG	SE	SE	08	28N	48E	0.007	STK		0.00	1.65 MGA	EU	FILIPPINI, DAN
13235		3997	01/16/1950	CER	UG	SE	NE	17	28N	48E	0.015	STK		0.00	3.54 MGA	LA	CHILD, DOYLE F.
13236		3994	01/16/1950	CER	UG	NW	SW	16	28N	48E	0.015	STK		0.00	3.54 MGA	EU	FILIPPINI, DAN
13237		3995	01/16/1950	CER	UG	NE	SE	27	28N	48E	0.015	STK		0.00	3.54 MGA	EU	FILIPPINI, DAN
13238		3996	01/16/1950	CER	UG	NW	NE	28	28N	48E	0.015	STK		0.00	3.54 MGA	EU	CHILD, DOYLE F.
13239		3998	01/16/1950	CER	UG	NW	SE	19	28N	48E	0.015	STK		0.00	3.54 MGA	LA	CHILD, DOYLE F.
13240		3993	01/16/1950	CER	UG	NE	SW	03	28N	48E	0.015	STK		0.00	3.54 MGA	EU	FILIPPINI, DAN
13241		4249	01/16/1950	CER	UG	NE	NE	18	28N	48E	2.000	IRR		216.30	865.20 AFS	LA	CHILD, DOYLE F.
13243		4271	01/16/1950	CER	UG	NW	SE	14	28N	48E	3.000	IRR		300.10	1,200.00 AFS	EU	CHILD, DOYLE F.
13343		4845	03/29/1950	CER	UG	SW	NE	03	28N	47E	0.130	MM		0.00	30.66 MGA	LA	LITTLE GEM MINING CO.
13427		4224	06/26/1950	CER	UG	SE	NW	17	28N	48E	2.800	IRR		566.10	2,265.00 AFS	EU	CHILD, DOYLE F.
13965		4309	01/03/1952	CER	UG	SW	SW	34	29N	48E	0.016	STK		0.00	3.77 MGA	EU	FILIPPINI, DAN

TABLE C-4. HYDROGRAPHIC BASIN ABSTRACT - CRESCENT VALLEY, NEVADA
(Continued)

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HYDROGRAPHIC BASIN ABSTRACT
GROUND WATER

RUN DATE: 04/09/1992

HYDROGRAPHIC BASIN: 054 CRESCENT VALLEY

HYDROGRAPHIC REGION: 04 HUMBOLDT RIVER BASIN

APP#	CHANGE OF APP#	CERT#	FILING DATE	STAT	SRC	QQ	QTR	SEC	TWP	RNG	DIV RATE (CFS)	TYPE OF USE	S U P	ACRES IRRIGATED	ANNUAL DUTY	CO	OWNER OF RECORD
14310		4425	05/26/1952	CER	UG	NE	NE	33	28N	47E	0.666	MM		0.00	157.08 MGA	LA	THELONDON EXTENSION MINING CO.
CHANGE BY:	52927			-RFA													
14521		4127	09/15/1952	CER	UG	NE	NE	33	28N	47E	0.900	MM		0.00	212.26 MGA	LA	THE LONDON EXTENSION MINING CO.
CHANGE BY:	52928			-APP													
14726		4233	12/24/1952	CER	UG	NW	SW	11	29N	49E	0.023	STK		0.00	5.42 MGA	EU	CHILD, DOYLE F.
14973		5400	04/13/1953	CER	UG	NW	SW	24	28N	47E	2.230	IRR		40.00	160.00 AFA	LA	ALEXANDER, LEOTA F.
14974		5498	04/13/1953	CER	UG	NW	NW	24	28N	47E	2.450	IRR		48.40	193.60 AFA	LA	MAULDIN, J. M.
15178		5314	06/06/1953	CER	UG	NW	SW	35	28N	47E	2.000	IRR		54.86	219.44 AFA	LA	MC COY, FRANCES M.
15179		5315	07/06/1953	CER	UG	NW	NW	35	28N	47E	2.000	IRR		32.20	128.80 AFS	LA	MCCOY, J. B.
15570		5773	03/25/1954	CER	UG	NW	SW	13	28N	47E	2.230	IRR		151.20	604.80 AFA	LA	ALEXANDER, ROLLY W.
15590		5458	04/07/1954	CER	UG	NW	NE	13	28N	47E	2.230	IRR		97.90	391.60 AFA	LA	CALDWELL, BILLY DICK
17313		5044	06/25/1957	CER	UG	NW	SW	15	28N	48E	0.016	STK		0.00	3.77 MGA	EU	CHILD, DOYLE F.
17314		5045	06/25/1957	CER	UG		LT0107		28N	49E	0.002	STK		0.00	0.47 MGA	EU	CHILD, DOYLE F.
17315		5046	06/25/1957	CER	UG	NE	SW	14	28N	48E	0.018	STK		0.00	4.25 MGA	EU	CHILD, DOYLE F.

TABLE C-4. HYDROGRAPHIC BASIN ABSTRACT - CRESCENT VALLEY, NEVADA
(Continued)

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HYDROGRAPHIC BASIN ABSTRACT
GROUND WATER

RUN DATE: 04/09/1992

HYDROGRAPHIC BASIN: 054 CRESCENT VALLEY

HYDROGRAPHIC REGION: 04 HUMBOLDT RIVER BASIN

APP#	CHANGE OF APP#	CERT#	FILING DATE	STAT	SRC	QQ	QTR	SEC	TWP	RNG.	DIV RATE (CFS)	TYPE OF USE	SUP	ACRES IRRIGATED	ANNUAL DUTY		CO	OWNER OF RECORD
18570		6055	02/09/1960	CER	UG	SW	NW	16	31N	50E	2.629	IRR		345.80	1,037.40	AFA	EU	COLBURN, HARVEY J.
18998		5553	07/11/1960	CER	UG	NE	SE	33	29N	49E	2.000	IRR	Y	117.10	463.40	AFS	EU	DANN, DEWEY
19093		6656	08/03/1960	CER	UG	SW	NW	10	28N	47E	0.278	MM		0.00	32.90	MGS	LA	EAKIN, EMILY RALEIGH
20636		6245	08/15/1962	CER	UG	NE	NW	05	31N	49E	0.000	COM		0.00	0.00	MGA	EU	MILANO, ETHEL
24663		7292	08/28/1968	CER	UG	SE	NE	24	27N	47E	0.000	MM		0.00	0.00		LA	CORTEZ GOLD MINES
24664		7293	08/28/1968	CER	UG	SE	NE	24	27N	47E	1.300	MM		0.00	306.60	MGA	LA	CORTEZ GOLD MINES
25866		7927	11/16/1970	CER	UG	SW	SW	33	30N	48E	0.360	MUN		0.00	84.91	MGA	EU	TOWN OF CRESENT VALLEY
27782 CHANGE BY:	30782		09/21/1973	ABR -CER	UG	SE	NW	07	28N	49E	0.000	IRR		1,280.00	0.00	AFA	EU	CHILD, DOYLE F.
27783 CHANGE BY:	30784		09/21/1973	ABR -CER	UG	SE	NE.	07	28N	49E	0.000	IRR		1,280.00	0.00	AFA	EU	CHILD, DOYLE F.
28637		10558	08/28/1974	CER	UG	NW	NW	22	30N	47E	0.000	MM		0.00	0.00	MGA	LA	GILBERT, L. E.
29141		9151	01/13/1975	CER	UG	NW	NW	33	29N	49E	0.007	STK		0.00	1.65	MGA	EU	DANN, CLIFFORD
29478		9093	06/27/1975	CER	UG	SW	NE	27	28N	47E	3.000	IRR		160.00	640.00	AFA	LA	FILIPPINI, BILLIE I.
29479		9094	06/27/1975	CER	UG	NW	NE	27	28N	47E	3.000	IRR		160.00	640.00	AFA	LA	FILIPPINI, BILLIE I.
29905			01/09/1976	PER	UG	NW	SW	09	29N	48E	3.000	QM		0.00	43.80	MGA	EU	WALKER, SONIA S.

TABLE C-4. HYDROGRAPHIC BASIN ABSTRACT - CRESCENT VALLEY, NEVADA
(Continued)

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HYDROGRAPHIC BASIN ABSTRACT
GROUND WATER

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HYDROGRAPHIC BASIN: 054 CRESCENT VALLEY

HYDROGRAPHIC REGION: 04 HUMBOLDT RIVER BASIN

APP#	OF APP#	CERT#	DATE	STAT	SRC	POINT OF DIVERSION QQ	QTR	SEC	TWP	RNG	DIV RATE (CFS)	TYPE OF USE	S U P	ACRES IRRIGATED	ANNUAL DUTY		CO	OWNER OF RECORD
30782	27782	9470	10/26/1976	CER	UG	SE	NW	07	28N	49E	2.500	IRR		308.50	1,234.00	AFA	EU	CHILD, DOYLE F.
30784	27783	9471	10/28/1976	CER	UG	NE	SW	07	28N	49E	2.500	IRR		310.00	1,240.00	AFA	EU	CHILD, DOYLE F.
31855		12653	05/31/1977	CER	UG	NE	SE	34	29N	49E	5.000	IRR	Y	380.20	1,520.00	AFA	EU	DANN, MARY
32712			06/06/1977	PER	UG	NW	SW	36	28N	47E	2.700	IRR		160.00	640.00	AFA	LA	MCCLOUD, J.L.
37870			04/10/1979	PER	UG		LT0506		29N	48E	1.000	MM		0.00	62.04	MGA	LA	ASLETT, DALE
41107			04/16/1980	PER	UG	NE	SE	08	28N	47E	1.500	MM		0.00	62.40	MGA	LA	AARON MINING INC.
41141		11784	04/18/1980	CER	UG	NE	NE	24	29N	47E	0.840	MM		0.00	73.58	MGS	LA	MAJOR BARITE INC.
44092			06/29/1981	RFA	UG	SW	NW	16	31N	50E	2.000	IRR		345.80	0.00		EU	ZEDA CORPORATION
44757			10/29/1981	RFP	UG	NW	SW	08	27N	47E	0.010	STK		0.00	0.00	MGA	LA	BLM
45793			06/16/1982	RFA	UG	NW	NW	33	29N	48E	2.400	IRR		106.00	0.00		EU	WILSON, SYLVIA
46224		12482	10/14/1982	CER	UG	SE	NW	13	27N	47E	0.083	MM		0.00	19.55	MGA	LA	CORTEZ GOLD MINES
46225		12483	10/14/1982	CER	UG	SE	NW	13	27N	47E	0.083	MM		0.00	19.55	MGA	LA	CORTEZ GOLD MINES
47663			02/07/1984	PER	UG	SW	SW	33	30N	48E	2.000	QM	Y	0.00	400.00	MGA	EU	CRESCENT VALLEY - TOWN OF
47664			02/07/1984	ABR	UG	NE	SW	05	29N	48E	0.000	QM		0.00	0.00	MGA	EU	CRESCENT VALLEY - TOWN OF
CHANGE BY:	55371			-PER														
49594			12/18/1985	RFA	UG		LT0401		29N	49E	0.100	STK		0.00	0.00		EU	HALF CIRCLE CATTLE
50683			03/13/1987	PER	UG	SW	NW	10	28N	47E	2.000	MM		0.00	124.00	MGA	LA	KOMP, FANNIE

TABLE C-4. HYDROGRAPHIC BASIN ABSTRACT - CRESCENT VALLEY, NEVADA
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HYDROGRAPHIC BASIN: 054 CRESCENT VALLEY
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APP#	CHANGE OF APP#	CERT#	FILING DATE	STAT	SRC	POINT OF DIVERSION QQ	QTR	SEC	TWP	RNG	DIV RATE (CFS)	TYPE OF USE	SUP	ACRES IRRIGATED	ANNUAL DUTY		CO	OWNER OF RECORD
51247			09/01/1987	PER	UG	SE	NW	13	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51248			08/01/1987	PER	UG	NE	NW	13	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51249			09/01/1987	PER	UG	NE	NW	13	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51250			09/01/1987	PER	UG	SE	SW	12	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51251			09/01/1987	PER	UG	SE	SW	12	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51252			09/01/1987	PER	UG	SE	SW	12	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51253			09/01/1987	PER	UG	SE	SW	12	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51254			09/01/1987	PER	UG	SW	SE	12	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
51255			09/01/1987	PER	UG	SW	SE	12	27N	47E	0.111	OTH		0.00	26.18	MGA	LA	CORTEZ GOLD MINES
52619			10/20/1988	PER	UG	NE	SE	22	30N	47E	1.500	MM	Y	0.00	150.32	MGA	LA	BLACK BEAUTY GOLD INC.
CHANGE BY:	56053			-RFA														
52621			10/20/1988	PER	UG	NE	NE	22	30N	47E	1.500	MM	Y	0.00	150.32	MGA	LA	BLACK BEAUTY GOLD INC.
CHANGE BY:	56054			-RFA														
52926	10746		02/14/1989	RFA	UG	NE	NE	33	28N	47E	0.193	MM		0.00	0.00		LA	CORTEZ GOLD MINES
52927	14310		02/14/1989	RFA	UG	NE	NE	33	28N	47E	0.666	MM		0.00	0.00		LA	CORTEZ GOLD MINES
52928	14521		02/14/1989	APP	UG	NE	NE	33	28N	47E	0.900	MM		0.00	0.00		LA	CORTEZ GOLD MINES
53783			08/23/1989	RFA	UG	SE	SE	12	27N	47E	1.110	MM		0.00	0.00		LA	CORTEZ GOLD MINES

TABLE C-4. HYDROGRAPHIC BASIN ABSTRACT - CRESCENT VALLEY, NEVADA
(Continued)

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HYDROGRAPHIC BASIN ABSTRACT
GROUND WATER

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HYDROGRAPHIC BASIN: 054 CRESCENT VALLEY

HYDROGRAPHIC REGION: 04 HUMBOLDT RIVER BASIN

APP#	CHANGE OF APP#	CERT#	FILING DATE	STAT	SRC	POINT OF DIVERSION QQ	QTR	SEC	TWP	RNG	DIV RATE (CFS)	TYPE OF USE	SUP	ACRES IRRIGATED	ANNUAL DUTY	CO	OWNER OF RECORD
54179			11/17/1989	PER	UG		LT1230		29N	48E	0.046	STK		0.00	10.95 MGA	LA	ALVES, MAYNARD
55371	47664		10/12/1990	PER	UG	SW	SW	33	30N	48E	2.000	QM	Y	0.00	400.00 MGA	EU	CRESCENT VALLEY - TOWN OF
55707			02/01/1991	RFP	UG	NW	SW	08	31N	51E	10.000	MUN		0.00	2,359.05 MGA	EU	ECO-VISION INC.
55710			02/01/1991	RFP	UG	SE	NW	24	27N	47E	10.000	MUN		0.00	2,359.05 MGA	LA	ECO-VISION INC.
56053	52619		03/25/1991	RFA	UG	NE	SE	22	30N	47E	1.500	MM		0.00	0.00	LA	BLACK BEAUTY GOLD INC.
56054	52621		03/25/1991	RFA	UG	NE	NE	22	30N	47E	1.500	MM		0.00	0.00	LA	BLACK BEAUTY GOLD INC.
57133			02/04/1992	APP	UG		LT0731		28N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57134			02/04/1992	APP	UG	SW	NE	31	28N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57135			02/04/1992	APP	UG	SW	NW	32	28N	47E	4.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57136			02/04/1992	APP	UG	SW	NE	32	28N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57137			02/04/1992	APP	UG		LT0831		28N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57138			02/04/1992	APP	UG	SW	SE	31	28N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57139			02/04/1992	APP	UG	SW	SW	32	28N	47E	8.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE

TABLE C-4. HYDROGRAPHIC BASIN ABSTRACT - CRESCENT VALLEY, NEVADA
(Concluded)

NEVADA DIVISION OF WATER RESOURCES
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HYDROGRAPHIC BASIN ABSTRACT
GROUND WATER

RUN DATE: 04/09/1992

HYDROGRAPHIC BASIN: 054 CRESCENT VALLEY

HYDROGRAPHIC REGION: 04 HUMBOLDT RIVER BASIN

APP#	CHANGE OF APP#	CERT#	FILING DATE	STAT	SRC	POINT OF DIVERSION QQ	QTR	SEC	TWP	RNG	DIV RATE (CFS)	TYPE OF USE	S U P	ACRES IRRIGATED	ANNUAL DUTY	CO	OWNER OF RECORD
57140			02/04/1992	APP	UG	SW	SE	32	28N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57141			02/04/1992	APP	UG	SW	NW	06	27N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57142			02/04/1992	APP	UG	SW	NE	06	27N	47E	4.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57143			02/04/1992	APP	UG	SW	NW	05	27N	47E	4.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57144			02/04/1992	APP	UG	SW	NE	05	27N	47E	2.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57145			02/04/1992	APP	UG	SW	SW	06	27N	47E	1.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57146			02/04/1992	APP	UG	SW	SE	06	27N	47E	1.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57147			02/04/1992	APP	UG	SW	SW	05	27N	47E	1.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE
57148			02/04/1992	APP	UG	SW	SE	05	27N	47E	1.000	MM		0.00	0.00	LA	CORTEZ JOINT VENTURE

Reference: WMC (1992b).

Table C-5. SUMMARY OF NDEP STANDARDS FOR TOXIC MATERIALS IN DESIGNATED WATERS

Chemical	Municipal or Domestic Supply (μg/l)	Aquatic Life (μg/l)	Irrigation (μg/l)	Watering of Livestock (μg/l)
Antimony	146[a]	-	-	-
Arsenic	50[b]	-	100[c]	200[d]
Arsenic (III)	-	-	-	-
1-hour average	-	360[a]	-	-
96-hour average	-	190[a]	-	-
Barium	1,000[a,b]	-	-	-
Beryllium	0[a]	-	100[c]	-
hardness < 75 mg/l	-	-	-	-
hardness > = 75 mg/l	-	-	-	-
Boron	-	550[e]	750[a]	5,000[d]
Cadmium	10[a,b]	-	10[d]	50[d]
1-hour average	-	$\exp\{1.128 \ln(H)-3.828\}$[a]	-	-
96-hour average	-	$\exp\{0.7852 \ln(H)-3.490\}$[a]	-	-
Chromium (total)	50[b]	-	100[d]	1,000[d]
Chromium (VI)	-	-	-	-
1-hour average	-	16[a]	-	-
96-hour average	-	11[a]	-	-
Chromium (III)	-	-	-	-
1-hour average	-	$\exp\{0.8190 \ln(H)+3.688\}$[a]	-	-
96-hour average	-	$\exp\{0.8190 \ln(H)+1.561\}$[a]	-	-
Copper	-	-	200[d]	500[d]
1-hour average	-	$\exp\{0.9422 \ln(H)-1.464\}$[a]	-	-
96-hour average	-	$\exp\{0.8545 \ln(H)-1.465\}$[a]	-	-
Cyanide	200[a]	-	-	-
1-hour average	-	22[a]	-	-
96-hour average	-	5.2[a]	-	-
Fluoride	-	-	1,000[d]	2,000[d]
Iron	-	1,000[a]	5,000[d]	-
Lead	50[a,b]	-	5,000[d]	100[d]
1-hour average	-	$\exp\{1.273 \ln(H)-1.460\}$[a]	-	-
96-hour average	-	$\exp\{1.273 \ln(H)-4.705\}$[a]	-	-
Manganese	-	-	200[d]	-
Mercury	2[b]	-	-	10[d]
1-hour average	-	2.4[a]	-	-
96-hour average	-	0.012[a]	-	-
Molybdenum	-	19[e]	-	-
Nickel	13.4[a]	-	200[d]	-
1-hour average	-	$\exp\{0.8460 \ln(H)+3.3612\}$[a]	-	-
96-hour average	-	$\exp\{0.8460 \ln(H)+1.1645\}$[a]	-	-
Selenium	10[a,b]	-	20[d]	50[d]
1-hour average	-	20[a]	-	-
96-hour average	-	5.0[a]	-	-
Silver	50[a,b]	$\exp\{1.72 \ln(H)-6.52\}$[a]	-	-
Sulfide				
undissociated hydrogen sulfide	-	2[a]	-	-
Thallium	13[a]	-	-	-
Zinc	-	-	2,000[d]	25,000[d]
1-hour average	-	$\exp\{0.8473 \ln(H)+0.8604\}$[a]	-	-
96-hour average	-	$\exp\{0.8473 \ln(H)+0.7614\}$[a]	-	-
Acrolein	320[a]	-	-	-
Aldrin	0[a]	3[a]	-	-
Chlordane	0[a]	2.4[a]	-	-
24-hour average	-	0.0043[a]	-	-
2,4-D	100[a,b]	-	-	-
DDT & metabolites	0[a]	1.1[a]	-	-
24-hour average	-	0.0010[a]	-	-
Demeton	-	0.1[a]	-	-
Dieldrin	0[a]	2.5[a]	-	-
24-hour average	-	0.0019[a]	-	-
Endosulfan	75[a]	0.22[a]	-	-
24-hour average	-	0.056[a]	-	-
Endrin	0.2[b]	0.18[a]	-	-
24-hour average	-	0.0023[a]	-	-
Guthion	-	0.01[a]	-	-
Heptachlor	-	0.52[a]	-	-

Table C-5. SUMMARY OF NDEP STANDARDS FOR TOXIC MATERIALS IN DESIGNATED WATERS (Continued)

24-hour average	-	0.0038[a]	-	-
Lindane	4[b]	2.0[a]	-	-
24-hour average	-	0.080[a]	-	-
Malathion	-	0.1[a]	-	-
Methoxychlor	100[a,b]	0.03[a]	-	-
Mirex	0[a]	0.001[a]	-	-
Parathion	-		-	-
1-hour average	-	0.065[a]	-	-
96-hour average	-	0.013[a]	-	-
Silvex (2,4,5-TP)	10[a,b]	-	-	-
Toxaphene	5[b]	-	-	-
1-hour average	-	0.73[a]	-	-
96-hour average	-	0.0002[a]	-	-
Benzene	5[b]	-	-	-
Monochlorobenzene	488[a]	-	-	-
m-dichlorobenzene	400[a]	-	-	-
o-dichlorobenzene	400[a]	-	-	-
p-dichlorobenzene	75[b]	-	-	-
Ethylbenzene	1,400[a]	-	-	-
Nitrobenzene	19,800[a]	-	-	-
1,2-dichloroethane	5[b]	-	-	-
1,1,1-trichloroethane (TCA)	200[b]	-	-	-
Bis (2-chloroisopropyl) ether	34.7[a]	-	-	-
Chloroethylene (vinyl chloride)	2[b]	-	-	-
1,1-dichloroethylene	7[b]	-	-	-
Trichloroethylene (TCE)	5[b]	-	-	-
Hexachlorocyclopentadiene	206[a]	-	-	-
Isophorone	5,200[a]	-	-	-
Trihalomethanes (total)[f]	100[b]	-	-	-
Tetrachloromethane (carbon tetrachloride)	5[b]	-	-	-
Phenol	3,500[a]	-	-	-
2,4-dichlorophenol	3,090[a]	-	-	-
Pentachlorophenol	1,010[a]	-	-	-
1-hour average	-	exp{1.005 (pH)-4.830}[a]	-	-
96-hour average	-	exp{1.005 (pH)-5.290}[a]	-	-
Dinitrophenols	70[a]	-	-	-
4,6-dinitro-2-methylphenol	13.4[a]	-	-	-
Dibutyl phthalate	34,000[a]	-	-	-
Diethyl phthalate	350,000[a]	-	-	-
Dimethyl phthalate	313,000[a]	-	-	-
Di-2-ethylhexyl phthalate	15,000[a]	-	-	-
Polychlorinated biphenyls (PCBs)	0[a]	-	-	-
24-hour average	-	0.014[a]	-	-
Fluoranthene (polynuclear aromatic hydrocarbon)	42[a]	-	-	-
Dichloropropenes	87[a]	-	-	-
Toluene	14,300[a]	-	-	-

Footnotes and References

(1) Single concentration limits and 24-hour average concentration limits must not be exceeded. One-hour average and 96-hour average concentration limits may be exceeded only once every 3 years. See reference a.

(2) Hardness (H) is expressed as mg/l $CaCO_3$.

(3) If a criteria is less than the detection limit of a method that is acceptable to the division, laboratory results which show that the substance was not detected will be deemed to show compliance with the standard unless other information indicates that the substance may be present.

(4) If a standard does not exist for each designated beneficial use, a person who plans to discharge waste must demonstrate that no adverse effect will occur to a designated beneficial use. If the discharge of a substance will lower the quality of the water, a person who plans to discharge waste must meet the requirements of NRS 445.253.

a. U.S. Environmental Protection Agency, Pub. No. EPA 440/5-86-001, Quality Criteria for Water (Gold Book) (1986).

b. Federal Maximum Contaminant Level (MCL), 40 C.F.R. §§ 141.11, 141.12, 141.61 and 141.62 (1988).

Table C-5. SUMMARY OF NDEP STANDARDS FOR TOXIC MATERIALS IN DESIGNATED WATERS (Concluded)

c. U.S. Environmental Protection Agency, Pub. No. EPA 440/9-76-023. Quality Criteria for Water (Red Book) (1976).
d. National Academy of Sciences, Water Quality Criteria (Blue Book) (1972).
e. California State Water Resources Control Board. Regulation of Agricultural Drainage to the San Joaquin River: Appendix D, Water Quality Criteria (March 1988 revision).
f. The criteria for trihalomethanes (total) is the sum of the concentrations of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform). See reference b.

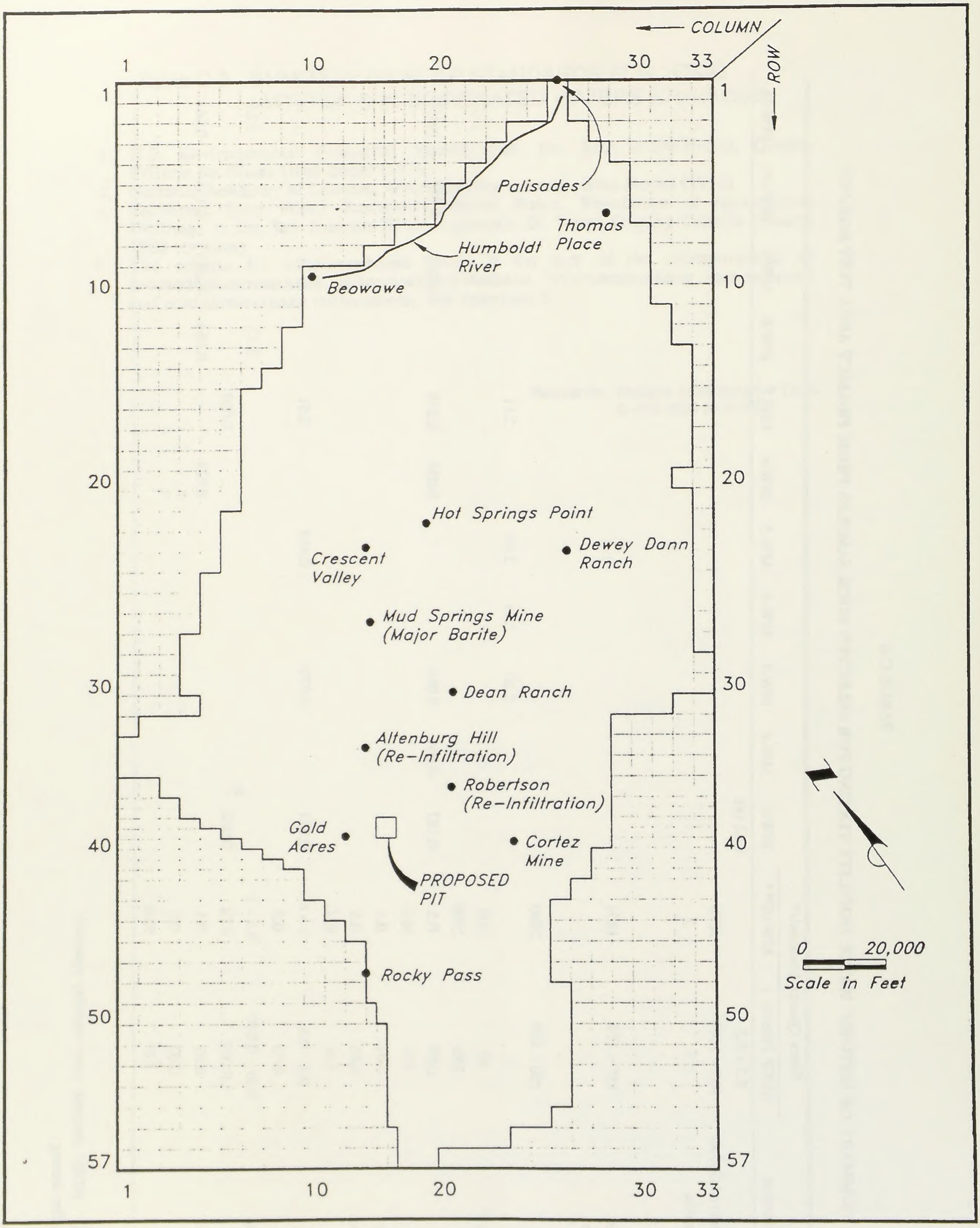
Reference: Nevada Administrative Code S 445.1339 (9-25-90).

TABLE C-6

SUMMARY OF METORIC WATER MOBILITY TESTING FOR SELECTED ROCK SAMPLES FROM PROJECT AREA TEST BORINGS

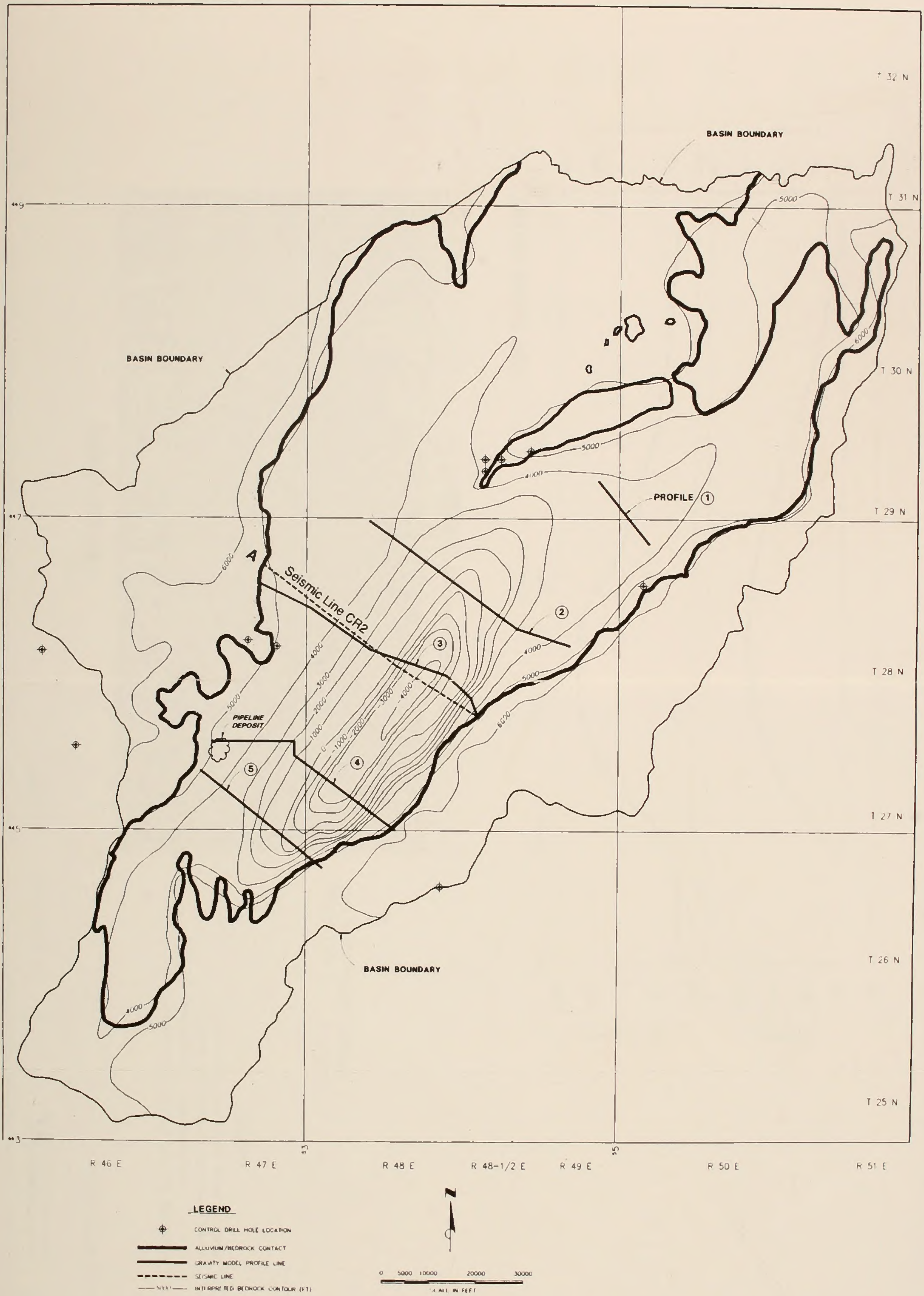
Parameters	Water Quality Standards*												
	NDEP Priority 1	MWMP**	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11
pH	6.5 - 8.5		8.62 (a)										
Total Dissolved Solids	500 - 1000	5000											
WAD Cyanide	0.2	2											
Alklinity	-												
Calcium	-												
Magnesium	125 - 150	1250											
Potassium	-												
Sodium	-												
Chloride	250 - 400	2500											
Fluoride	2				2.20	2.44	3.07		2.11				
Nitrate as N	10	100											
Sulfate	250	2500										435	
Arsenic	0.05	0.5	0.187	0.061	0.068			0.054	0.218		0.053	0.092	0.051
Barium	1.0	10.0											
Cadmium	0.01	0.1											
Chromium	0.05	0.5											
Copper	1.0	10.0											
Iron	0.3 - 0.6	3 - 6	0.991		0.979		0.665		2.51				
Lead	0.05	0.5											
Manganese	0.05 - 0.010	0.5 - 1								3.17			5.25
Mercury	0.002	0.02	0.002						0.003				
Selenium	0.01	0.1						0.023		0.064	0.031	0.132	0.064
Silver	0.05	0.5											
Zinc	5.0	50.0											

* mg/L
** MWMP - NDEP meteoric water mobility potential
a - Final after mixing



Reference: Water Management Consultants (1992b)

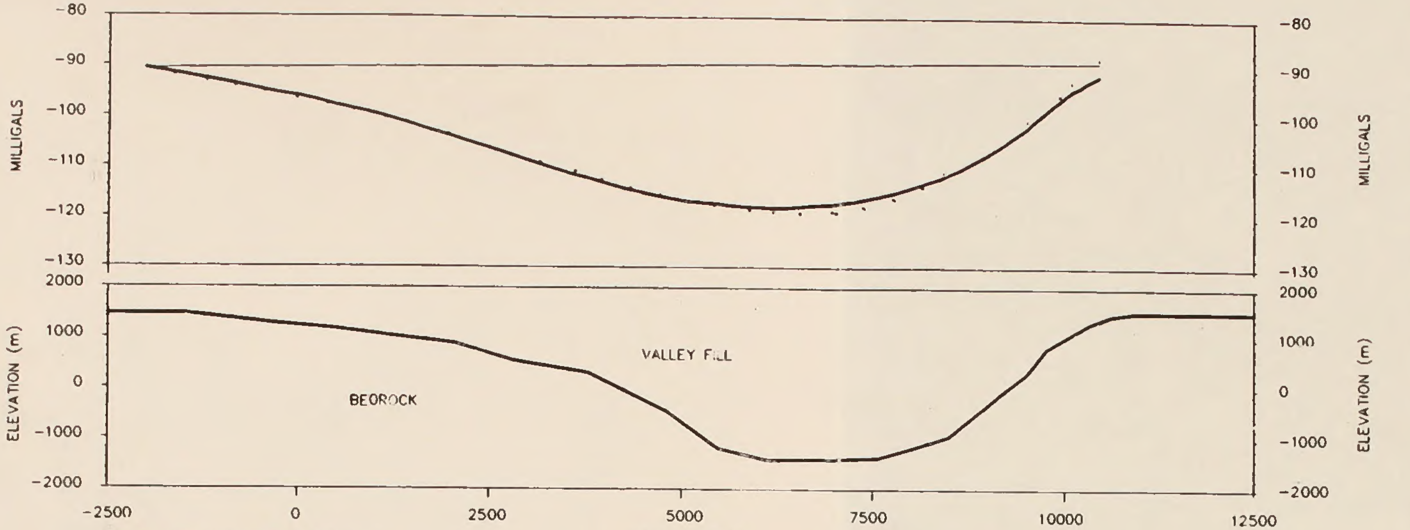
Project No. 92C0756A	Pipeline Deposit EIS	MAP SHOWING GROUNDWATER MODELLING DOMAIN	Figure C-1



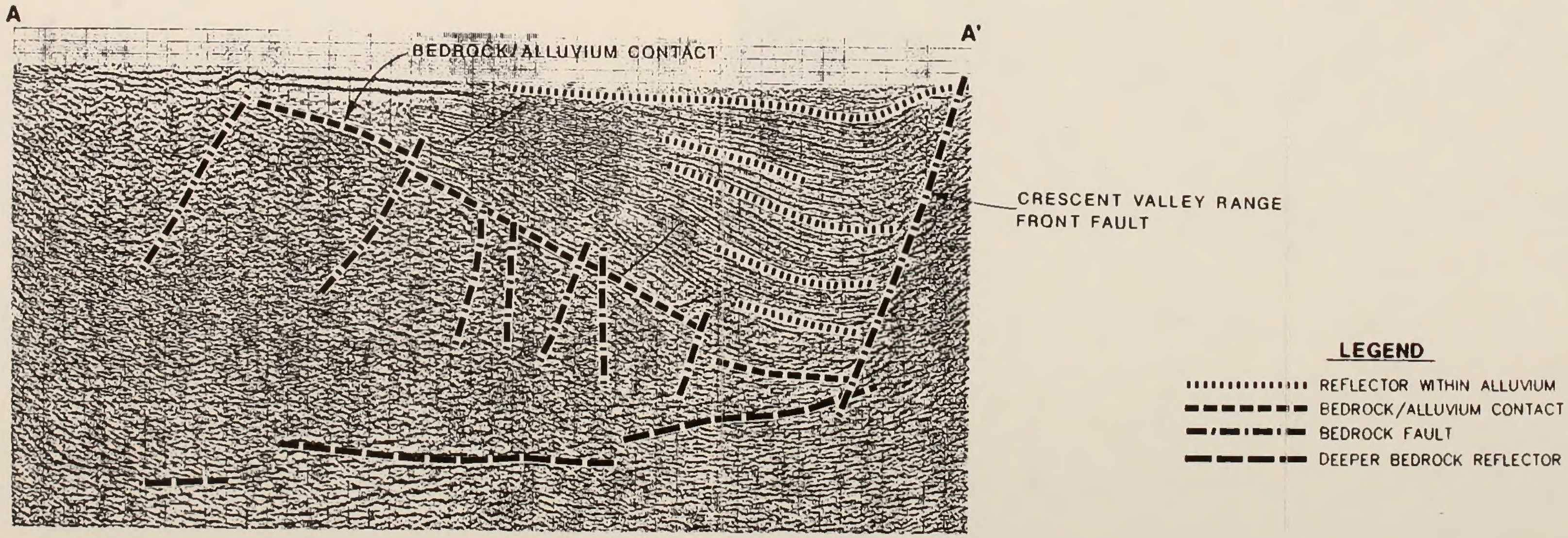
Reference: Water Management Consultants (1992b)

Project No. 92C0756A	Pipeline Deposit EIS	INTERPRETED BEDROCK ELEVATIONS CRESCENT VALLEY, NEVADA	Figure C-2

92C0756A-0004/032693



GRAVITY PROFILE NO.3

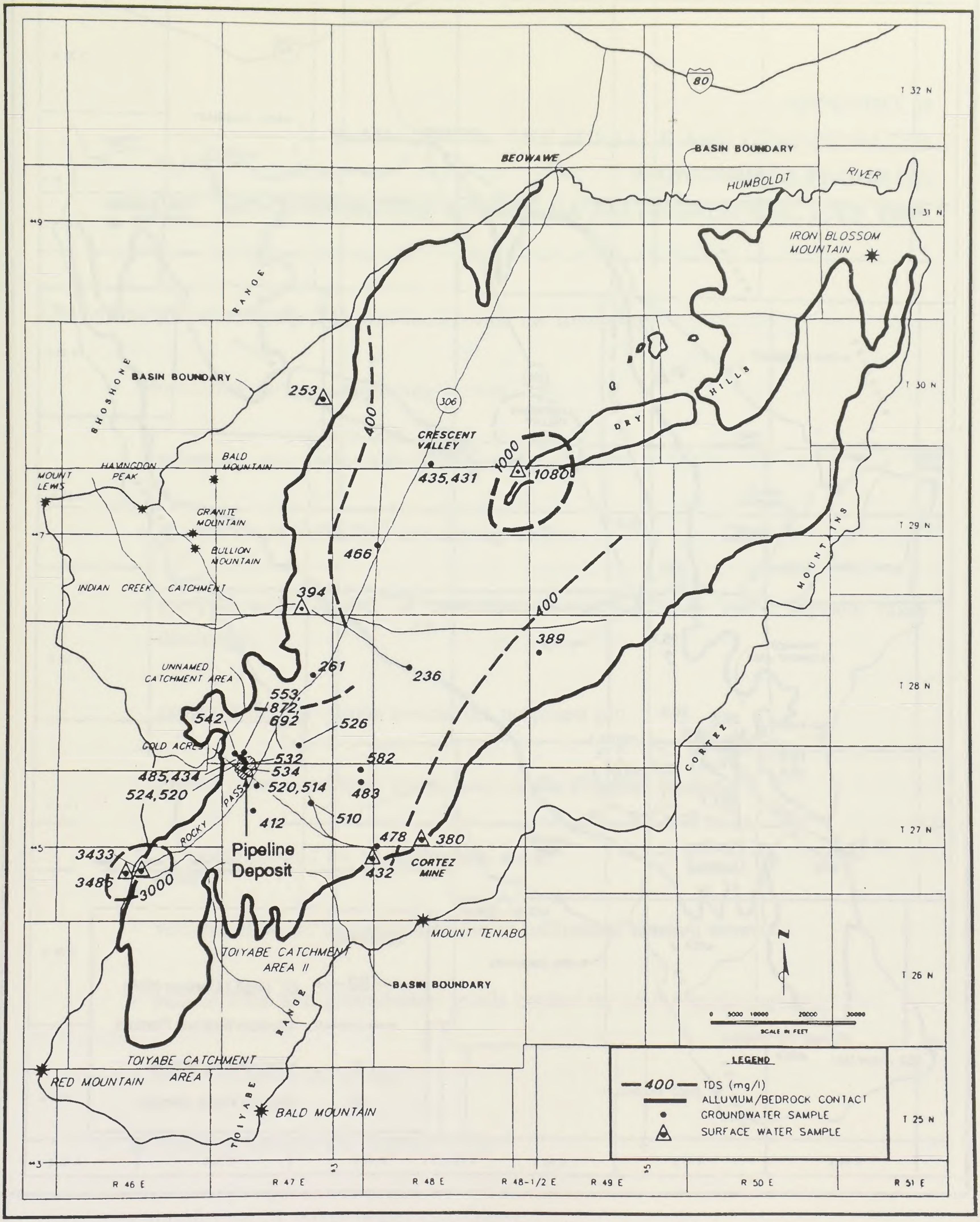


SEISMIC LINE CR-2

Reference: Water Management Consultants (1992b)

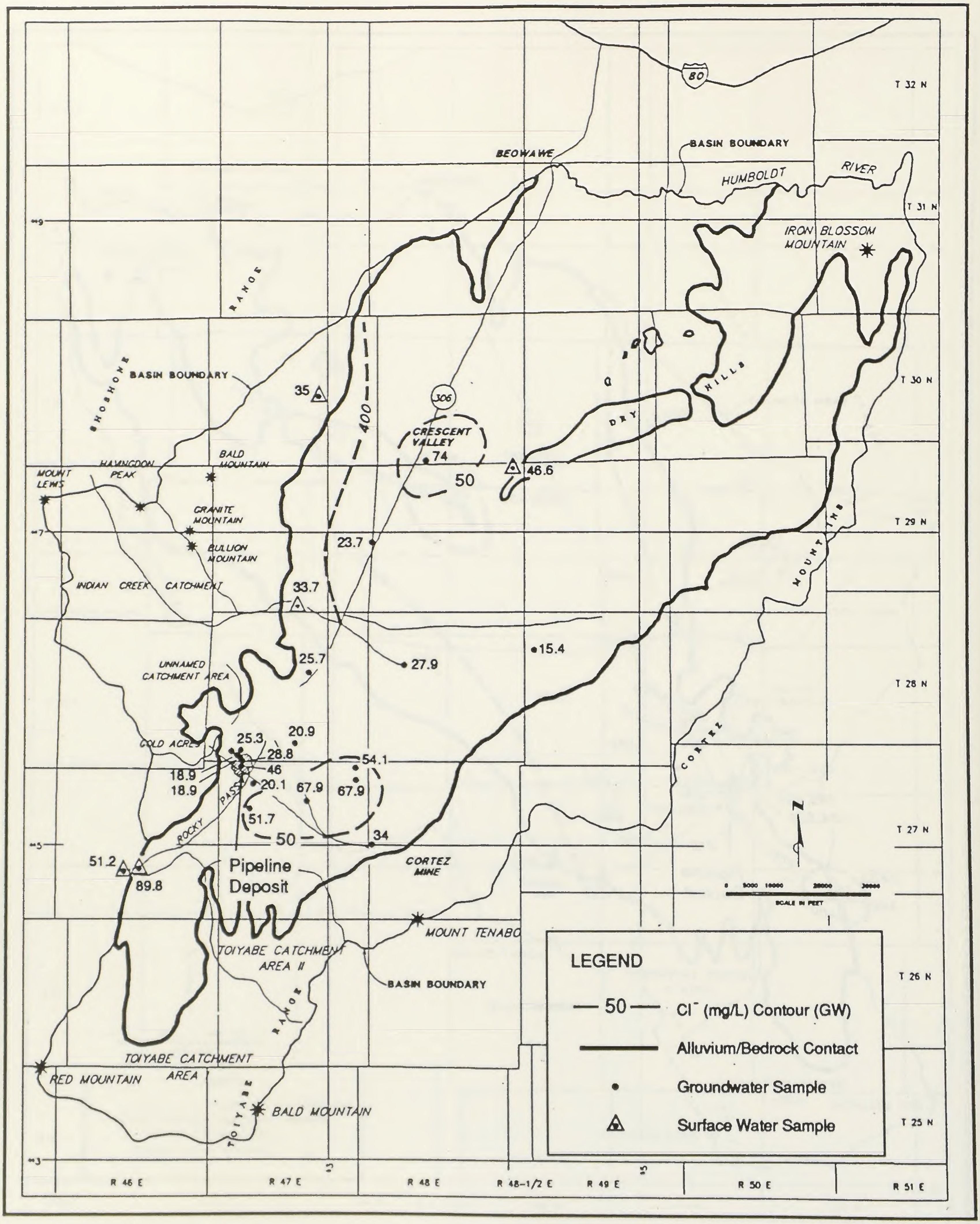
Project No. 92C0756A	Pipeline Deposit EIS	GRAVITY PROFILE 3 AND SEISMIC SECTION CR-2	Figure C-3

92C0756A-0004/032693



Reference: Water Management Consultants, (1993).

Project No. 92C0756A	Pipeline Deposit EIS	REGIONAL TDS (mg/L) VALUES IN SELECTED CRESCENT VALLEY WELLS	Figure C-4



Reference: Water Management Consultants, (1993).

Project No. 92C0756A	Pipeline Deposit EIS	REGIONAL CHLORIDE (mg/L) VALUES IN SELECTED CRESCENT VALLEY WELLS	Figure C-5

92C0756A-0010/110493

APPENDIX D
SUMMARY OF THE SURFACE AND GROUNDWATER MONITORING PROGRAM
(SUBMITTED TO NEVADA STATE ENGINEER JULY 1993)

The hydrologic monitoring plan will incorporate the following:

- *Monitoring for the dewatering system*

  - pumping rates from individual dewatering wells;

  - drawdown in individual dewatering wells;

  - pumped water quality of individual dewatering wells and composite mine discharge;

  - groundwater elevations around the proposed pit;

  - groundwater conditions to the west of the Pipeline Project.

- *Monitoring around the re-infiltration areas*

  - volume of water discharged to the re-infiltration area(s);

  - vadose zone and groundwater levels around the re-infiltration area(s);

  - hydrochemical sampling;

- *Monitoring around the process areas*

  - monitoring of groundwater conditions;

  - consumptive use of the process facilities;

- *Regional monitoring*

    - regional groundwater elevations throughout Crescent Valley;

    - flows in local drainages and springs;

    - regional groundwater quality throughout Crescent Valley.

MONITORING FOR THE DEWATERING SYSTEM

Pumping Rates From Individual Dewatering Wells

Each dewatering well will be equipped with a totalizing flowmeter, which records instantaneous and cumulative pumping rates. Readings from the flow meter at each well will be taken at least weekly. Records of individual pumping rates will be compiled monthly and will be submitted to the State Engineer's office on a six monthly basis. The information will be summed so that records of the total pumping rate from all wells combined are available.

The serial number, type, date and time of installation of each flowmeter will be recorded. Should it be necessary to change flowmeters, the date and time of removal of the old flowmeter will be recorded, together with the serial number, type, date and time of installation of the new meter.

Drawdown In Individual Dewatering Wells

Each dewatering well will be equipped with a water level sounding tube. The pumping water level in each well will be measured at least monthly. Records will be submitted to the State Engineer's office on a six monthly basis, at the same time as the pumping records.

Each well will also be equipped with a sanitary seal extending from the surface to a depth of at least 50 ft in the annulus of the well. If appropriate, a gravel fill tube will be installed to below the level of the sanitary seal. Should there be any settlement of the gravel pack, additional material will be added.

Pumped Water Quality of Individual Dewatering Wells and Composite Mine Discharge

A water sample of the composite mine discharge water will be collected at least quarterly, at the end of each quarter. The water will be analyzed for all parameters listed in the NDEP Profile 1, plus a 36 element ICP standard suite of metals, total suspended solids and turbidity.

Water samples from individual wells will be taken as required. It is expected that certain representative bedrock wells and certain alluvial wells will be sampled on an annual basis.

Groundwater Elevations Around the Proposed Pit

The eight permanent monitoring wells that have already been installed in the area around the proposed pit (OW-1S, OW-1D, OW-2S, OW-2D, OW-3S, OW-3D, OW-4S and PL49) are currently being monitored on a quarterly basis. Quarterly monitoring of the wells is to be continued. More frequent monitoring will occur as each new production well is brought onto line to aid in the assessment of well performance.

As part of the detailed monitoring network for the dewatering operation, it is expected that water elevations will be measured weekly at up to 20 or more locations around the pit area. The exact location of these and the frequency of measurements will depend on the actual dewatering design.

Groundwater Conditions to The West of Pipeline

Groundwater conditions beneath the flanks of the range to the west of the project area will be fully monitored during the life of the project. Three (3) new monitoring wells will be established in this area, initially two in carbonate rocks and one in siliceous rocks. The final number and locations of these monitoring points will depend on the nature of actual drawdowns observed in this area (see Table D-1 and Figures D-1 and D-2).

Groundwater Conditions Near Rocky Pass

Two new monitoring well locations are proposed to supplement the existing regional and sub-regional well group in the southwest area of the Crescent Valley Alluvial Aquifer near Rocky Pass (see Table D-1 and Figures D-1 and D-2).

MONITORING AROUND THE RE-INFILTRATION AREAS

Volume of Water Discharged to The Re-Infiltration Area(s)

Cumulative and instantaneous flow data from the individual dewatering wells and consumptive use records will be used to calculate the volume of water discharged from the site. If more than one re-infiltration area is used, the reticulation of the discharge lines will be set up in such a way so that the volume of discharge to each area can be calculated.

Vadose Zone and Groundwater Levels Around the Re-Infiltration Area(s)

The actual re-infiltration rate at each site during production would depend on site performance, the amount of lateral spreading and the amount of mounding.

Additional groundwater monitoring wells will be required around the re-infiltration area(s) to determine the rate of spreading of the water which is re-infiltrated. The location and number of these wells will be determined once the design of the system has been finalized. The wells will be installed prior to operation of the re-infiltration facility so that background water level and hydrochemical data for the receiving water can be collected.

A number of vadose zone monitoring wells will be established at each re-infiltration site. Exact locations will be chosen once the design is finalized.

Measurements of water elevation in these wells will be taken either weekly or quarterly, depending on their location relative to the re-infiltration area(s).

Hydrochemical Sampling

Water samples will be collected annually in any existing operated well or spring which shows a water level change of more than 10 ft in response to re-infiltration. The type of analysis performed on the samples will depend on actual site conditions and on-going monitoring of the composite mine discharge.

MONITORING AROUND THE PROCESS AREAS

Monitoring of Groundwater Conditions

Monitoring of groundwater elevations and groundwater quality around the process areas will be carried out in accordance with the terms of the operating permit. The exact location of the groundwater monitoring wells will be determined once the layout of the process facilities is finalized. The monitoring wells will be installed immediately prior to construction of the facilities.

Consumptive Use of The Process Facilities

The consumptive use of each of the main process areas will be recorded using totalizing flowmeters. Readings from each flowmeter will be taken at least weekly. Records of flows will be compiled monthly. The information will be summed so that records of the total consumptive use are available.

The serial number, type, date and time of installation of each flowmeter will be recorded. Should it be necessary to change flowmeters, the date and time of removal of the old flowmeter will be recorded, together with the serial number, type, date and time of installation of the new meter.

The above records will be submitted to the State Engineer's office at the same time as the pumping data for the individual dewatering wells.

REGIONAL MONITORING

Regional Groundwater Elevations Throughout Crescent Valley

Where these remain accessible, and depending on an on-going review of the data, the 21 regional wells listed in Table D-1 will be monitored for water level on a semi-annual basis (during the spring and fall) throughout the period of dewatering to confirm that the regional impacts are as predicted. Well locations are shown on Figure D-1. Water level in all of these wells was measured during the March/April 1993 sampling program.

In addition, all other open wells and cased holes within a 5- to 7-mile radius of the Pipeline Project, and within 3 miles of the re-infiltration areas, will be monitored on a quarterly basis during production dewatering.

Flows in Local Drainages and Springs

It is not expected that any local streams or springs will be impacted by the mining operation. However, to confirm this, the following monitoring will be carried out:

- the 24 spring or seep locations listed in Table D-2 and shown on Figure D-3 will be monitored semi-annually;

- instantaneous flows will be recorded on a quarterly basis in all known springs within 5 miles of the dewatering operation, and within 3 miles of the re-infiltration area(s). Preliminary measurements have already been taken in all of these;

- other monitoring of local drainages and springs as required, based on the results of the on-going monitoring program.

Regional Groundwater Quality Throughout Crescent Valley

Regional water sampling was carried out during March and April 1993. Hydrochemical data is now available from 20 regional sampling points (a total of 27 samples) at a distance greater than five miles from the proposed pit. This has provided sufficient data to enable an understanding of the natural hydrochemistry of Crescent Valley to be developed.

Additional regional water quality monitoring will probably not be necessary. However, should the on-going monitoring program indicate that additional samples would be beneficial, these would be obtained on an as-needed basis.

SUBMISSION OF RESULTS

Records of individual and total pumping rates, number and location of all dewatering and monitoring wells, pumping water elevations in each dewatering well, consumptive use, re-infiltration rates, evaporative losses from the re-infiltration area(s), water elevations around the pit and re-infiltration area(s), and regional water level data will be submitted to the State Engineer's office on a semi-annual basis, within 30 days of the last day of the second and fourth quarters. Records of the type of pump, number of stages, installed horsepower and running times will also available and this information will be submitted to the State Engineer's office upon request.

In addition, summary reports of the impact of mining on regional water resources will also be prepared annually, based on the results of the groundwater modeling and regional monitoring program. These will be submitted to the State Engineer's office upon request.

The monitoring plan will be reviewed annually, at the end of each calendar year, and modified based on the actual data obtained.

TABLE D-1

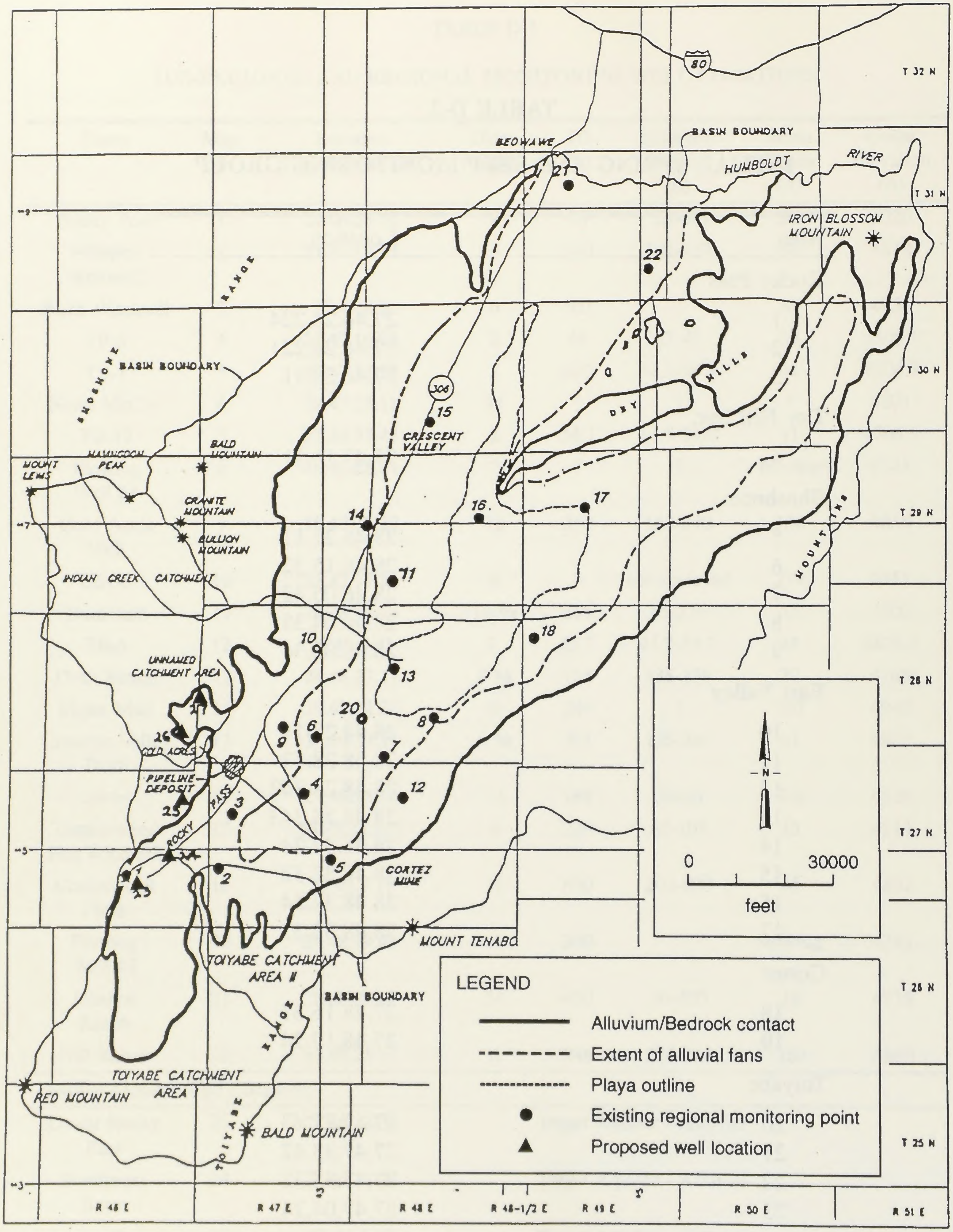
SUB-REGIONAL AND REGIONAL MONITORING WELL LOCATIONS

Name	Map #	Location Twp.Rng.Sec.QQ	Diam. (inches)	TD (ft)	Screened Interval (ft)	Water Depth (ft)	Collar Elevation (ft)
Rocky Pass	1	27.46.28.12	8	35	23-35	5-8	5020
Filippini Windmill	2	27.47.19.33	6	130	108-127	102	4872
BLM Windmill	3	27.47.8.3	6	103	?	69	4851
TB-5	4	27.47.10.23	2	45	35-45	35	4806.1
TB-1	5	27.47.23.23	2	40.3	32.3-39.8	31	4804.7
North McCoy	6	28.47.35.11	14	?	?	?	4801
TB-12	7	28.48.31.43	2	34.7	14.7-34.2	11	4766.5
Flowing Well #1	8	28.48.28.21	?	?	?	flowing	4741
Gold Acres Well	9	28.47.33.22	12	250	150-240	100	4868
"USGS"	10	28.47.15.14	6	?	not screened	214	4955
Buchenau	11	29.48.29.33	14 5/8	275	55-276	55	4800
TB-6	12	27.48.8.31	2	65.7	45.7-64.7	44	4826.3
Dean Ranch	13	28.48.17.11	8 5/8	158	138-158	27	4768
Major Mud	14	29.47.24.22	6	246	?	163	4940
Crescent Valley Town	15	30.48.33.11	8 5/8	301	136-286	61	4802
Levee	16	29.48.15.14	14	185	30-60	3-4	4726
Tumbleweed Flat Windmill	17	29.49.11.313	6	298	68-107	13	4814
Cottonwood Field	18	28.49.7.11	16	600	200-600	45	4802
Flowing Well #3	20	28.48.19.41	4	200	?	flowing	4755
Johnson Ranch	21	31.49.8.42	14	400	30-400	16	4715
Hill Ranch	22	31.49.25.31	6	246	224-244	164	4860
Possible Monitor Well Locations							
Lower Rocky Pass	23	27.46.22.33	Target Aquifer - Alluvial				
Southwest Basin	24	27.46.23.22	Target Aquifer - Alluvial				
Squaw Butte	25	27.46.1.12	Target Aquifer - Bedrock				
West Bedrock	26	28.47.30.31	Target Aquifer - Bedrock				
Northwest Bedrock	27	28.47.19.32	Target Aquifer - Bedrock				

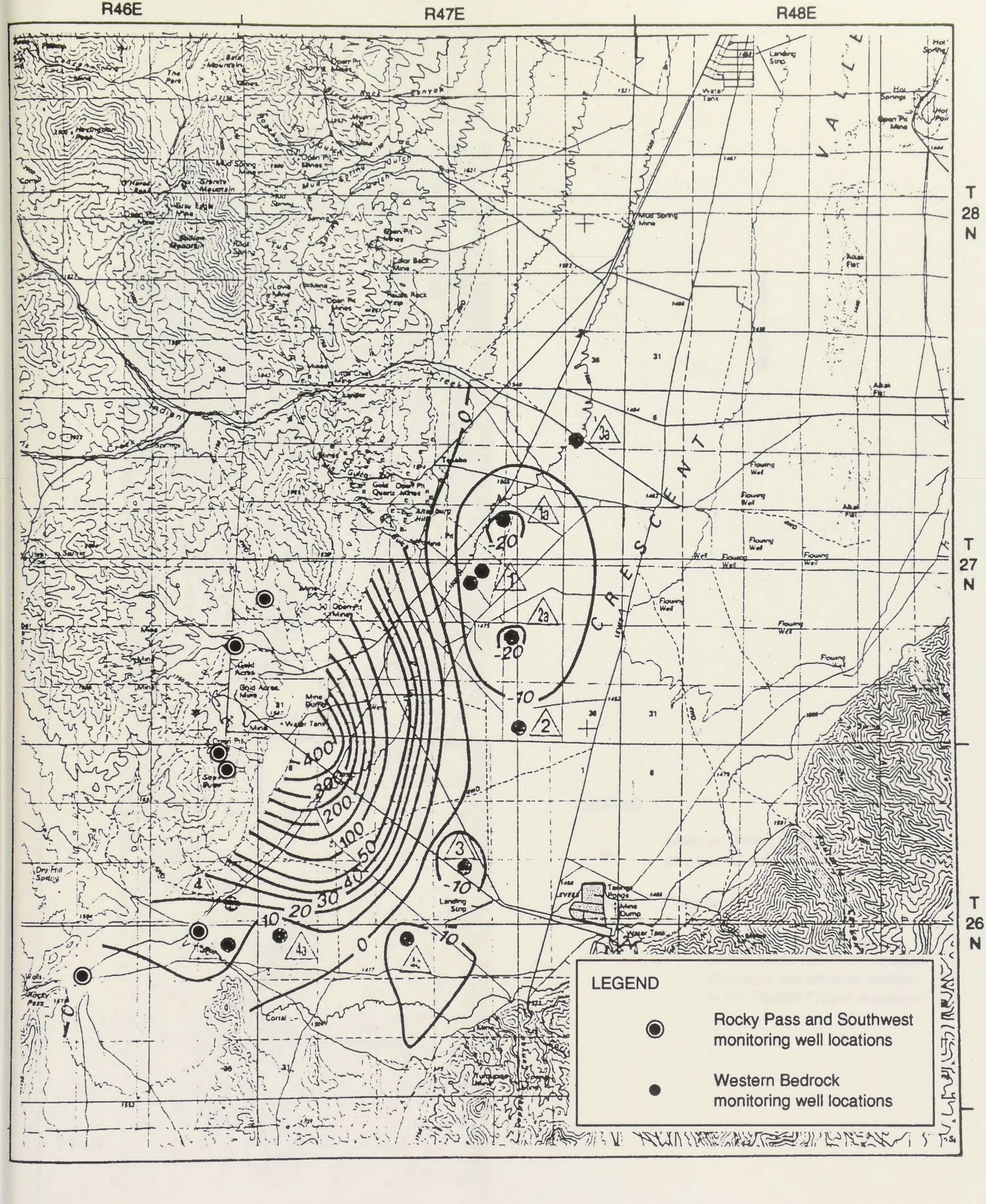
TABLE D-2

INITIAL SPRING AND SEEP MONITORING GROUP

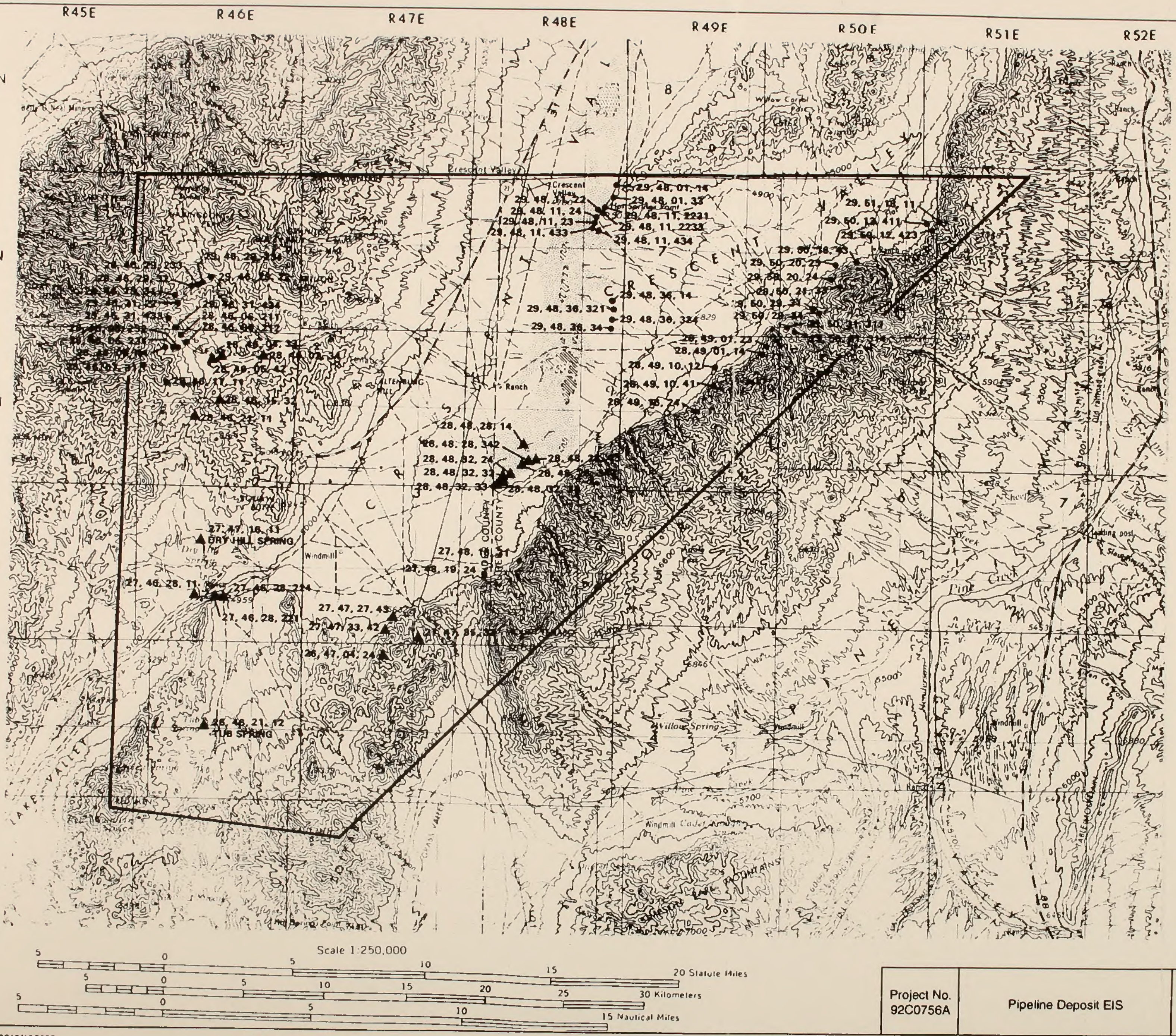
Area	Location
Rocky Pass	
1	27.46.28.224
2	27.46.28.221
3	27.46.28.11
Dry Hill Spr.	
4	27.47.16.11
Shoshone	
5	28.46.21.11
6	28.46.15.32
7	28.46.05.42
8	28.46.04.33
9	28.46.02.34
East Valley	
10	28.48.28.14
11	28.48.28.43
12	28.48.28.342
13	28.48.28.343
14	28.48.32.24
15	28.48.32.32
16	28.48.32.34
17	28.48.32.33
Cortez	
18	27.48.16.31
19	27.48.19.24
Toiyabe	
20	27.47.27.43
21	27.47.33.42
22	27.47.35.32
23	27.47.04.24
Tub Spr.	
24	26.46.21.12



Project No. 92C0756A	Pipeline Deposit EIS	SUB REGIONAL AND REGIONAL MONITORING WELL LOCATIONS	Figure D-1



Project No. 92C0756A	Pipeline Deposit EIS	MONITOR WELL LOCATIONS FOR PROPOSED SUB REGIONAL MONITORING PROGRAM	Figure D-2



LEGEND

● Seep or Spring location and identification

▲ Proposed for monitoring

Note: This map only shows those springs below 6000 feet elevation plus those that could be effected by the Pipeline Project drewdown

Project No. 92C0756A	Pipeline Deposit EIS	SEEPS AND SPRINGS TO BE MONITORED	Figure D-3

92C0756A-0010/120893

APPENDIX E
SUMMARY OF THE DRAFT MONITORING PLAN FOR WATER POLLUTION CONTROL PERMIT APPLICATION (SUBMITTED TO NDEP MAY 1993)

PURPOSE

Mining, mine dewatering, and mineral processing activities proposed for the Cortez Pipeline Project will require monitoring to evaluate the performance of operating systems and to prevent environmental degradation.

The monitoring program described herein is intended to address the broad requirements found in NAC 445.24296. Publications of the Nevada Division of Environmental Protection ("NDEP") provide additional guidance for the development of monitoring programs for facilities which are regulated within the scope of NAC 445.242 through 445.24388.

The objective of the monitoring plan is to establish:

- The manner in which water quality within the area of potential effect is adequately described prior to and throughout the proposed period of mine operations and closure;
- The location, identification, and description of proposed site monitoring and leak detection points;
- The effectiveness of the monitoring system with respect to process component integrity;
- The protocols for sampling at each point; and,
- The analytical profile proposed for use in evaluating the sample.

SITE HYDROGEOLOGIC CONDITIONS

The Pipeline Project site is located on the eastern flank of the Shoshone Range in the southern portion of the Crescent Valley Hydrographic Basin 4-54. The Pipeline Deposit occurs in a range front setting and is situated in a buried erosional window through the Roberts Mountain Thrust. The pit will be excavated through the overlying alluvium primarily into the Silurian Roberts Mountain Formation and, to a much lesser extent, in Devonian Wenban Limestone. With the exception of the western edge of the site, groundwater is encountered in alluvial sediments overlying the bedrock.

Two principal aquifer units occur in the project area: (1) the Crescent Valley alluvium (a basin-fill aquifer); and, (2) the Roberts Mountain bedrock (a carbonate rock aquifer). The basin-fill aquifer acts as a groundwater reservoir from which the majority of water development takes place in Crescent Valley. The Roberts Mountain limestone formation is largely undeveloped as an aquifer.

MONITORING SYSTEM

The Pipeline Project monitoring program will consist of two elements. The first element is a system (System 1) proposed to comply with NAC 445.242 through 445.24388 and would comprise the basis for monitoring requirements established in the Mining Water Pollution Control Permit. The second element of the monitoring program (System 2) is related to the mine dewatering operation and is not proposed for regulation under the permit herein applied for. A detailed description of System 1 is provided. System 2 is summarized here in general terms only and addressed further in Appendix D of the EIS.

System 1: PROCESS COMPONENT and SITE COMPLIANCE MONITORING

* process component leak detection
  - intervening between primary and secondary liners
  - interface of the liner system and native environment
* monitoring internal to the process component
  - piezometric measurement
  - process solution sampling and analysis

- process material/waste characterization
* site monitoring wells
  - monitoring for baseline conditions
  - monitoring for containment integrity
* mined materials characterization
  - overburden and waste rock
  - existing wastes from previous mining activities

The required description, location, and identification of proposed Monitoring Points is as follows:

Leak Detection

Description	Location	Identification
Reclaim Pond	Figure 12	RP
Reclaim Channel	"	RC
Pregnant Pond	"	PP
Pregnant Channel	"	PC
Barren Pond		"BP
Cell 1 Pad North	"	C1N
Cell 1 Pad South	"	C1S
Cell 1 Impoundment Sub-Grade	"	C1SG
Cell 1 Channel North	"	C1NSC
Cell 1 Channel South	"	C1SSC
Cell 2A Pad	"	C2A
Cell 2A Inner Channel	"	C2AIC
Cell 2A Outer Channel	"	C2AOC
Cell 2B Pad	"	C2B
Cell 2B Inner Channel	"	C2BIC
Cell 2B Outer Channel	"	C2BOC

Piezometric Measurements

Description	Location	Identification
Cell 1 Standpipe	Section 4, Sheet 25	W1
Cell 1 Pneumatic	"	1

Cell 1 Pneumatic	"	2
Cell 1 Pneumatic	"	3
Cell 1 Pneumatic	"	4
Cell 1 Pneumatic	"	5
Cell 1 Pneumatic	"	6
Cell 1 Pneumatic	"	7
Cell 1 Pneumatic	"	8
Cell 1 Pneumatic	"	9
Cell 1 Pneumatic	"	10
Cell 1 Pneumatic	"	11
Cell 1 Pneumatic	"	12
Cell 1 Pneumatic	"	13
Cell 1 Pneumatic	"	14
Cell 1 Pneumatic	"	15
Cell 2A Pneumatic	"	16
Cell 2A Pneumatic	"	17
Cell 2A Pneumatic	"	18
Cell 2A Pneumatic	"	19
Cell 2A Pneumatic	"	20
Cell 2A Pneumatic	"	21
Cell 2A Pneumatic	"	22
Cell 2A Pneumatic	"	23

Process Solution

Description	Location	Identification
Barren Pond Solution	Figure 11	BS
Pregnant Pond Solution	"	PS
Tailing Solution	"	TS
Decant Pond Solution	"	DS

Processing Waste

Description	Location	Identification
Tailing: Cell 1	Section 2, Figure 1	MT
Spent Leach Ore: Cell 2A	Section 2, Figure 1	SL

Mined Materials

Description	Location	Identification
Alluvial Overburden	Section 2, Figure 2	AO
Waste Rock	Section 2, Figure 2	WR-x
Carbon Ore-Stockpile	Section 2, Figure 1	CO
Low Grade Ore-Stockpile	Section 2, Figure 1	LO
Gold Acres Tailing	Section 8, Figure 2	GAT-x
Gold Acres Spent Leach	Section 8, Figure 2	GAL-x

Site Monitoring Wells

Description	Location	Identification
Alluvial Well: Tailing Cell 1	Figure 11	SMA-10
Alluvial Well: Preg/Reclaim Ponds	"	SMA-11
Alluvial Well: Preg/Reclaim Ponds	"	SMA-12
Alluvial Well: Cell 1, 2A, Ponds	"	SMA-13
Alluvial Well: Tailing/Heap Leach	"	SMA-14
Alluvial Well: Barren Pond	"	SMA-15
Alluvial Well: Upgradient	"	SMA-16
Bedrock Well: Tailing/Heap Leach	"	SMB-20
Bedrock Well: Plant Site Downgradient	"	SMB-21
Bedrock Well: Plant Site Upgradient	"	SMB-22
Bedrock Well: General Site	"	OW-4S

The compliance Monitoring Program (System 1) would be implemented and conducted in accordance with the conditions established in the NDEP Water Pollution Control Permit issued for the proposed mining operation.

Routine inspection and monitoring of other facility components not specifically identified within NAC 445.242 through 445.24388 would also be conducted. This category of inspected components includes: hydrocarbon fuel storage, containment, and transfer areas; and, liquid reagent storage, containment, and transfer areas.

Rationale

The proposed process components and facility site can be effectively monitored for compliance using the previously described System 1 monitoring elements. Conventional leak detection and piezometric indicators are proposed which enable primary liner integrity and operating performance to be monitored within the limits of the engineered component. However, these methods do not give a positive indication of the environmental performance of the composite liner system. Sub-grade monitoring of the vadose zone at the interface between the Tailing Cell 1 composite liner and native environment is therefore proposed. The composite liner system exceeds NDEP containment criteria for tailing impoundment; however, the system has finite permeability and, considering the probability of standard defect occurrence and the time scale of proposed operations, solution is expected to report to the detection system. Sub-grade leak detection of Cell 1 is the limit of vadose zone monitoring proposed.

Effective compliance monitoring of groundwater requires a definition of baseline conditions and an understanding of the hydraulic conditions which will exist through the period of mine operations and closure. The existing groundwater gradient is from the west to the east across the site. This gradient will be reversed as mine dewatering operations stress the bedrock/alluvial aquifer system (see Figures E-1 and E-2). Under these conditions, suitable monitoring points may be required to function as both upgradient and downgradient locations through the life of the monitoring program.

The plantsite is situated upon a sequence of unsaturated alluvium; groundwater at this location occurs in the underlying bedrock formation at a depth of approximately 350 feet. The western extent of saturated alluvium lies approximately 500 feet east of the CIL plant. Saturated alluvium extends through the eastern third of the proposed open pit and underlies the entire Tailing/Heap Leach Facility at a minimum depth of approximately 210 feet (see Figures E-3 and E-4).

The alluvium is the main groundwater storage unit local to the proposed mine site as well as throughout the basin. Localized clay zones and cemented horizons are known to be present in the alluvial sediments adjacent to and beneath the process facility site creating conditions of limited vertical conductivity; however, the alluvium is laterally continuous on the global scale. Under the induced potential created by alluvial interceptor wells and shallow bedrock dewatering wells around the pit, water within the saturated alluvium will flow from beneath the Tailing/Heap Leach facility site (and beyond) toward the dewatering array (Figure E-4). Upon cessation of mine dewatering operations, groundwater levels will rebound as recovery takes place, and the pre-pumping gradient direction will be restored.

Figure E-3 shows the location of existing dewatering monitor wells, a possible arrangement of production dewatering wells, and the location of proposed site compliance monitor wells. Table E-1 describes the construction of the existing dewatering monitor wells. Eleven locations containing discrete monitor points are proposed for site compliance monitoring (System 1). Monitoring locations SMA-16 and SMB-22 will remain upgradient throughout the life of the program, while all other proposed locations will serve as both upgradient and downgradient monitoring points depending upon the artificial gradient conditions imposed by mine dewatering. Of the existing wells, only OW-4S is proposed as a site compliance monitoring well.

Proposed monitoring wells would be completed in alluvium or bedrock according to the artificial groundwater conditions imposed by mine dewatering operations. Groundwater occurs from approximately 210 feet below the surface at the lower tailing impoundment and process pond location to approximately 350 feet below the surface at the plant site. Groundwater elevations at the site will be observed from the onset of dewatering operations. As shown in Figure E-4, the static water level would be suppressed an estimated 260 to 350 feet below the pre-pumping water level at the west edge of the Tailing/Heap Leach facility site requiring the monitoring wells located in that area to be completed in shallow bedrock. Unless perched water conditions persist below the process facility site, the proposed alluvial monitoring wells would be fully penetrating and completed throughout the saturated zone from the prepumping water level to bedrock contact. In the event of perched water conditions, multiple well completions which isolate the perched water sequence(s) would be constructed at the identified monitoring points . Monitoring well construction will be similar to that described in Table E-1 and shown on the completion logs for OW-4S (bedrock) and OW-2S (alluvial) (Figures E-5 and E-6).

It is proposed that the location and design of monitoring wells described herein as System 1 constitutes effective monitoring and offers sufficient probability for the earliest detection of groundwater contamination as a result of a release from the built facility or failure of engineered containment. In addition, routine monitoring of mine dewatering operations (System 2) will result in a detailed understanding of local groundwater hydraulics and serve to identify preferential flow pathways. The availability of this information will provide the opportunity to adjust the prescribed compliance monitoring system to increase effectiveness.

System 2: Mine Dewatering Monitoring

* on-site monitoring
  - observation/monitoring wells for mine dewatering
  - production dewatering wells

* off-site monitoring
  - dewatering drawdown observation
  - area-of-influence groundwater quality
  - dewatering/infiltration system water quality effects
  - springs, streamflow, sub-regional and hydrologic basin effects

The production dewatering well and existing observation/monitoring well layout is shown in Figure E-3.

The dewatering monitoring program would be conducted in accordance with the conditions established by the Nevada State Engineer and any other regulatory authorization for the diversion and discharge of groundwater. Should System 2 monitoring indicate degradation of the waters of the State, the NDEP Bureau of Mining Regulation and Reclamation would be notified.

PLAN IMPLEMENTATION

Compliance monitoring activity is proposed for leak detection points, piezometric indicators, process solutions, spent process materials, mined materials, and site groundwater monitoring wells as identified in the previous section. The monitoring plan will be implemented according to the conditions established by NDEP in the Mining Water Pollution Control Permit as issued.

Leak Detection

Leak Detection Sumps will be monitored on a weekly basis under the supervision of the Environmental Department. The individual detection point will be observed and recorded for the presence of accumulated solution. Threshold volumes are proposed as action levels for each sump. With the exception of C1SG (tailing Cell 1 sub-grade), the threshold volume is calculated based on the available storage volume in each detection sump which will not result in the transfer of hydraulic head through a failure in the primary liner. It is proposed that these volumes are verified as-built. Should inspection and evacuation of an individual sump indicate that the threshold volume has been exceeded, continuous evacuation or pumping will be undertaken to maintain hydraulic relief. C1SG will be observed to monitor for sub-grade seepage flow rates which correspond with theoretical liner performance based on hydraulic head distribution, liner permeability, and standard defect occurrence.

Description	Identification	Volume
Reclaim Pond	RP	186 gallons
Reclaim Channel	RC	13 gallons
Pregnant Pond	PP	186 gallons
Pregnant Channel	PC	13 gallons
Barren Pond	BP	1,264 gallons
Cell 1 Pad North	C1N	69 gallons
Cell 1 Pad South	C1S	65 gallons
Cell 1 Impoundment Sub-Grade	C1SG	850 gpd*
Cell 1 Channel North	C1NSC	15 gallons
Cell 1 Channel South	C1SSC	57 gallons
Cell 2A Pad	C2A	71 gallons
Cell 2A Inner Channel	C2AIC	38 gallons
Cell 2A Outer Channel	C2AOC	30 gallons
Cell 2B Pad	C2B	69 gallons
Cell 2B Inner Channel	C2BIC	29 gallons
Cell 2B Outer Channel	C2BOC	15 gallons

* 34 gallons per acre per day (gpad) based on EPA synthetic liner standard defect and 1 to 10 feet of hydraulic head resulting in 7 gpad to 60 gpad distributed over 25 acres.

Piezometric Measurements

Piezometric monitoring will be conducted monthly under the administration of the Environmental Department. The described Standpipe and Pneumatic Sensors will be observed and recorded. Should individual pressure or level readings warrant further investigation of internal hydraulic head conditions, the frequency of piezometric observation and recording will be increased.

Process Solution

Monitoring of the described Process Solutions will be conducted quarterly under the supervision of the Environmental Department. Pregnant Solution, Barren Solution, and Reclaim Solution will be monitored as a discrete un-filtered grab sample taken from the respective storage pond location described. Tailing Solution will be monitored as a discrete un-filtered grab sample taken from the supernatant pool at the location described. Sampling will be conducted in accordance with the Sampling Plan. NDEP Profile II is proposed as the analytical suite for Process Solution samples. All analytical work will be performed by a laboratory certified for such work by the State of Nevada. Analytical results will be reviewed after 4 quarters of data are available to determine if a reduction in sampling frequency and analytical scope is justifiable.

Processing Wastes

Processing Wastes will be sampled and analyzed quarterly to monitor the characteristics of these materials with respect to short and long term chemical stability. This activity will be conducted under the supervision of the Environmental Department. Meteoric Water Mobility analysis will be performed on representative samples of Tailing Solids and spent Heap Leach Ore. Sampling will be conducted in accordance with the Sampling Plan. All analytical work will be performed by a laboratory certified for such work by the State of Nevada. Analytical results will be reviewed after 4 quarters of data are available to determine if a change in sampling frequency and analytical scope is justifiable. Monitoring results will also contribute to the waste assessment necessary in developing final closure plans.

Mined Materials

As production takes place, Alluvial Overburden, Waste Rock types, Low Grade Ore Stockpile, and Carbonaceous Ore Stockpile will be sampled quarterly and analyzed for the potential to mobilize pollutants (MWMP) and acid generating potential (ABA) to verify the characteristics indicated in Section 8. The monitoring frequency for Gold Acres Tailing and Gold Acres Heap Leach materials will depend upon NDEP review of information presented in Section 8. Sampling will be conducted in accordance with the Sampling Plan administered by the Environmental Department. All analytical work will be performed by a laboratory certified for such work by the State of Nevada. Analytical results will be reviewed after 4 quarters of data are available to determine if a change in sampling frequency and analytical scope is justifiable.

Site Monitoring Wells

Site Monitoring Wells will be monitored quarterly under the supervision of the Environmental Department. Sampling will be conducted in accordance with the Sampling Plan. Temperature, conductivity, and pH will be measured at the well head and recorded. Samples will be field filtered (0.45 um) and analyzed for NDEP Profile I constituents. All analytical work will be performed by a laboratory certified for such work by the State of Nevada. Analytical results will be reviewed after 4 quarters of data are available to determine if a change in sampling frequency and analytical scope is justifiable.

Sampling Plan

The Sampling Plan will direct the process of sample collection, handling, transfer, and documentation to assure, to the extent practicable, that a representative sample is acquired and maintained in an uncompromised state for quantitative analysis. The plan will establish recording and Chain-of-Custody protocol as well as specify procedures for the unique sampling requirements of the proposed Monitoring Plan. The exact procedures which are developed will depend upon the type of sample to be collected, the prevailing conditions at the monitoring station, and the type of sampling equipment employed.

Elements of the Sampling Plan are:

* Personnel and Responsibilities
* Monitoring Points/Sampling Stations
* Sampling Methods
  - procedures for sampling overburden and waste rock
  - procedures for sampling processing wastes
  - procedures for compositing individual samples
  - procedures for sampling process solutions and measuring field parameters
  - monitoring well purging procedure and specific equipment needs
  - well head field parameter measurements
  - field QA/QC and equipment decontamination
* Sample Treatment
  - filtration requirements
  - preservation requirements
* Sample Handling
  - field transport procedures
  - on-site temporary storage
  - preparation for delivery
* Sample Documentation
  - positive identification of sample
  - field logs and record keeping
  - Chain-of-Custody requirements
* Laboratory Analysis
  - regulatory certification requirements
  - identification of analytical method
  - laboratory QA/QC

The items which will be recorded for documentation purposes are:

* Identity and responsibilities of sampling personnel
* Purpose of the sampling activity (compliance or surveillance)
* Sampling location or station ID
* Date and time of sample collection
* Weather/site conditions and field observations

* Pertinent station observations (pool level in pond, well water level)
* Well purging data
* Sampling device or equipment information
* Wellhead parameter measurements (Temp., pH, conductivity)
* Sample observations (appearance, odors)
* Sample filtration
* Sample containers: sample ID and specified analysis
* Sample preservation (chemical and temp.)
* Deviations from standard sampling protocol
* Special QC measures (decontamination practices or field blanks)
* Transfer of custody (internal and external)

Reporting

Monitoring data will be collected and maintained for reporting to NDEP on a quarterly basis or other interval as established by permit condition. Laboratory Certificates of Analysis and internal data collection forms will be maintained on file. A computer database will be used to facilitate QA/QC screening and data analysis. Regulatory notification of apparent noncompliance as indicated by site monitoring activities will be in accordance with permit conditions and limitations as issued.

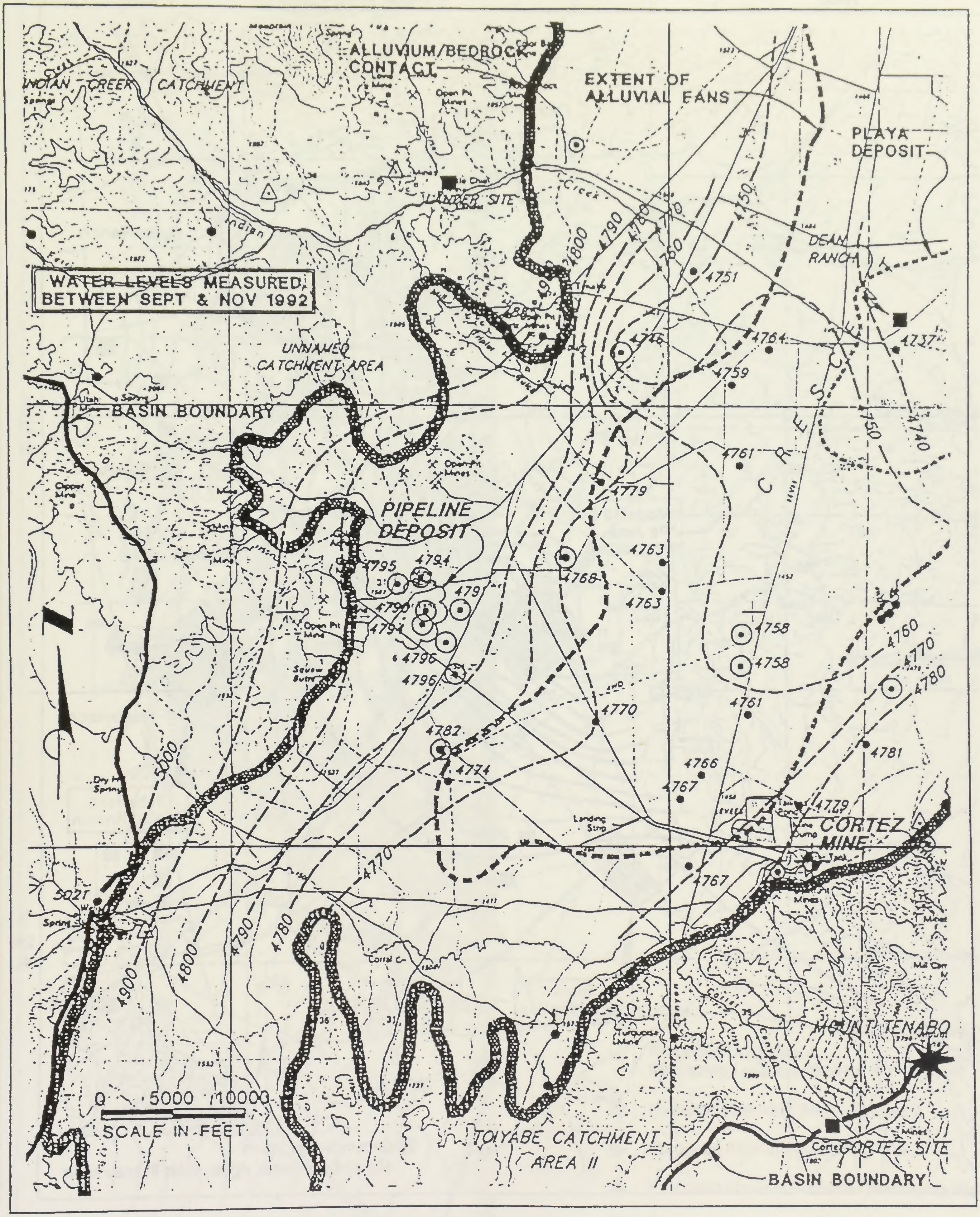
Interaction with Operating Plans

Monitoring of leak detection points or other elements of System 1 which gives indication of a condition requiring immediate attention, action, or response will require interaction with the appropriate Operating Plan. In the case of excess solution reporting to an individual leak detection sump, the responsible department, as identified in the Draft Fluid Management Plan, will be notified in order to initiate the planned response. In the case of an impending or evident spill or release, notification will be made which initiates the appropriate action(s) described in the Draft Emergency Response Plan and Draft Fluid Management Plan. All monitoring data will be used to the extent possible in supporting the development of the Draft Final Closure Plan and to assist in modeling final pit lake conditions.

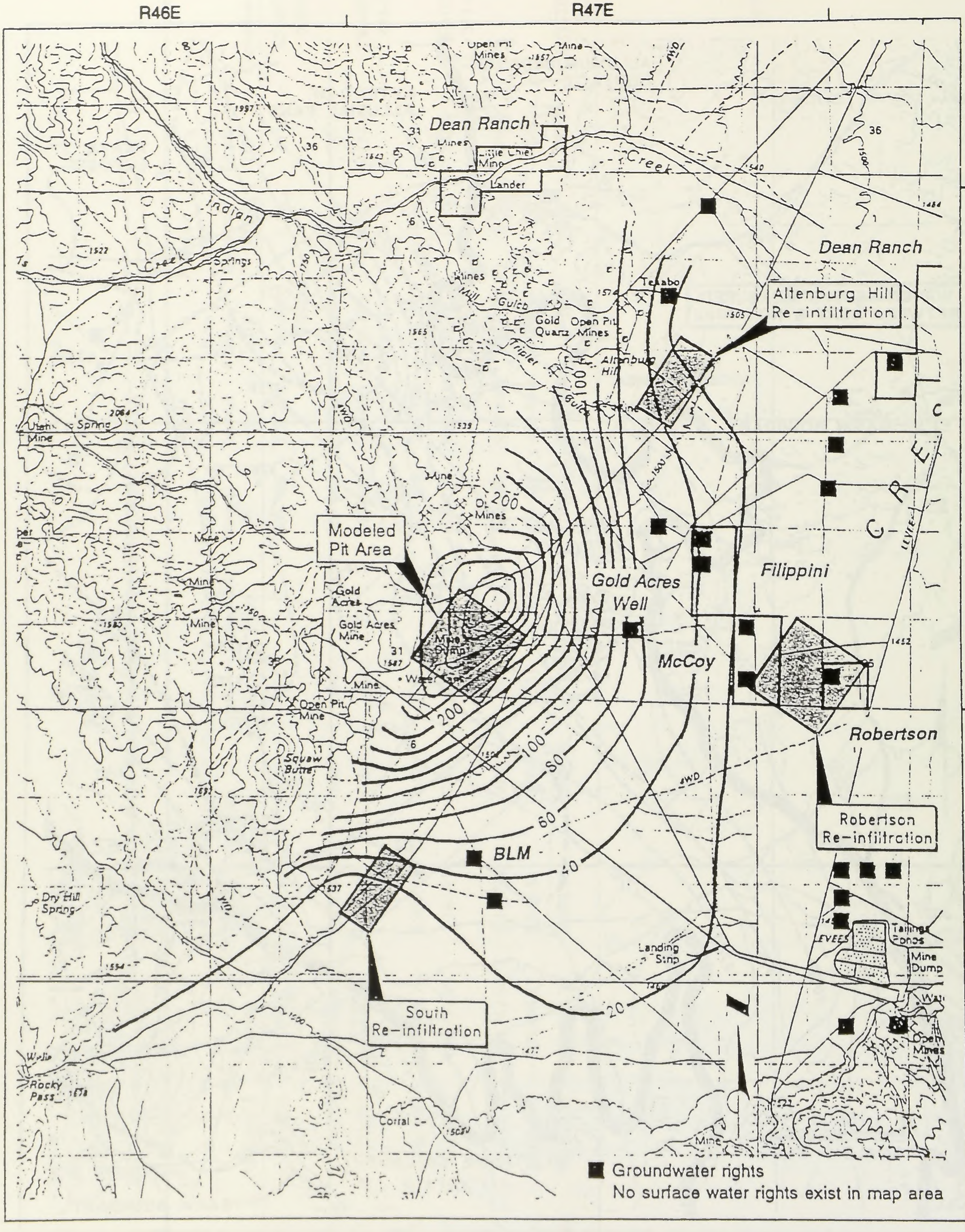
TABLE E-1

CONSTRUCTION DATA FOR THE EXISTING MONITORING WELLS

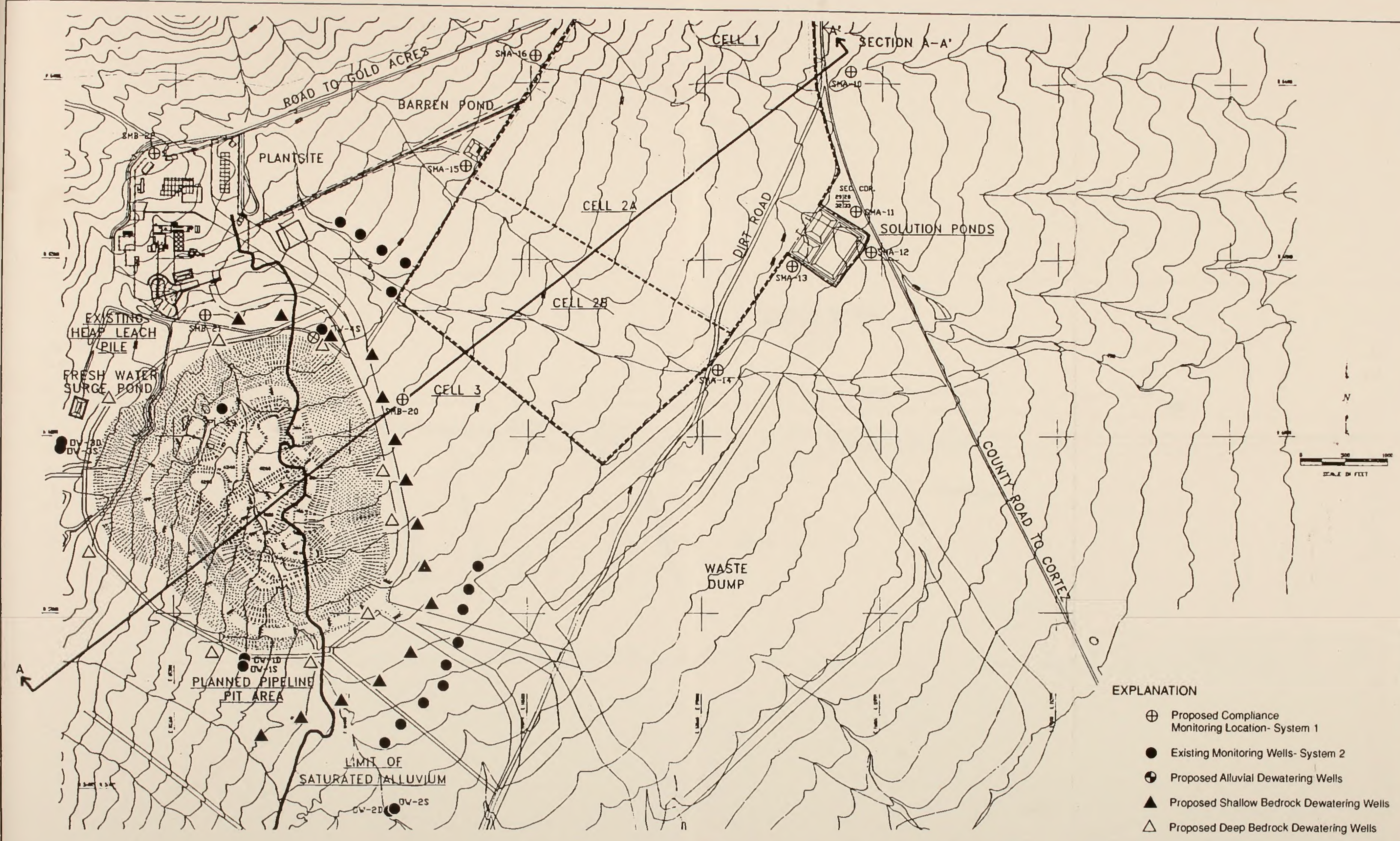
Well #	Date	Northing	Easting	Collar Elev (ft)	Drilled Depth (ft)	Completed Depth (ft)	Completed Diameter (in)	Screened Interval (ft)	Sand Packed Interval (ft)	Bent Seal (ft)	Surface Seal (cement) (ft)	Water Depth (ft)	Comments
OW-1D	09/23/92	57,472.56	102,800.23	5,031.85	700	700	2	640-700	620-700	50-590 610-620	0-50	241.5	CEMENT 590-610
OW-1S	09/29/92	57,442.10	102,792.80	5,031.84	440	440	2	380-440	363-440	50-363	0-50	241.5	
OW-2D	10/17/92	55,766.37	104,448.66	4,969.57	600	600	2	540-600	530-600	50-475 525-530	0-50	174.4	CEMENT 475-525
OW-2S	10/08/92	55,775.82	104,479.78	4,969.58	340	333	2	273-333	260-333	50-260	0-50	174.4	
OW-3D	10/04/92	59,897.35	100,779.99	5,144.11	740	718	2	658-718	640-718	488-577 630-640	0-50	348.9	CEMENT 577-630
OW-3S	10/05/92	59,884.76	100,767.94	5,143.94	460	460	2	400-460	380-460	265-380	0-50	348.9	
OW-4S	10/20/92	61,196.61	103,695.77	5,093.38	560	531	2	471-531	460-531	440-460	0-50	300.2	
PL-49	11/05/92	60,300.33	102,548.79	5,078.40	1,200	410	2	310-410	290-410	270-290	0-50	283.8	EXISTING HOLE



Project No. 92C0756A	Pipeline Deposit EIS	HYDRAULIC MAP OF THE AREA AROUND PIPELINE	Figure E-1

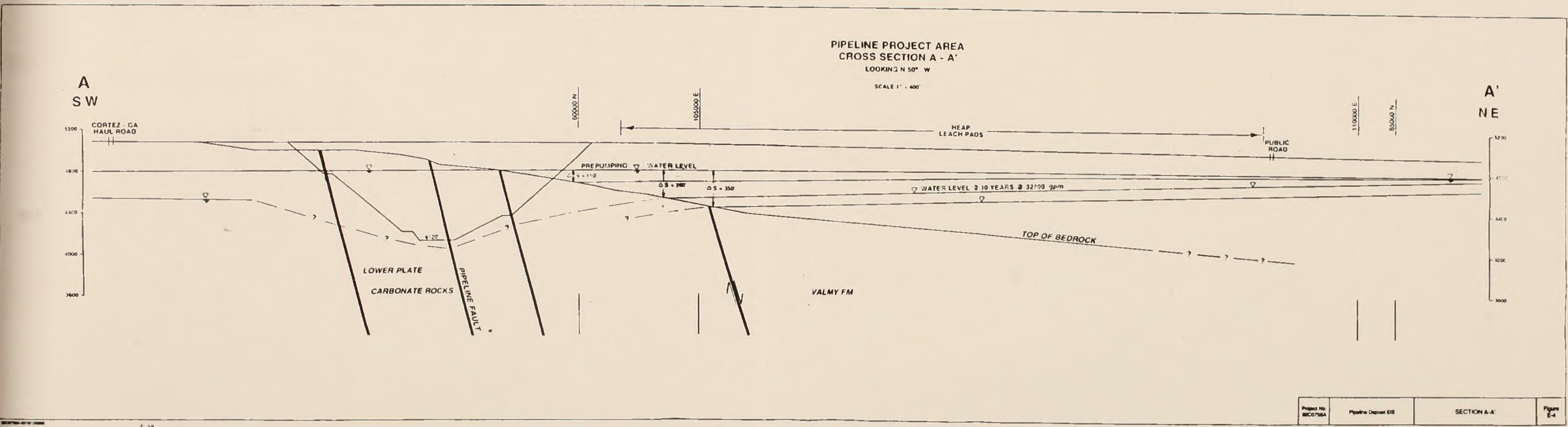


Project No. 92C0756A	Pipeline Deposit EIS	MODELLED DRAWDOWN AFTER 10 YEARS PUMPING AT 32,700 GPM USING THREE RE-INFILTRATION AREAS	Figure E-2

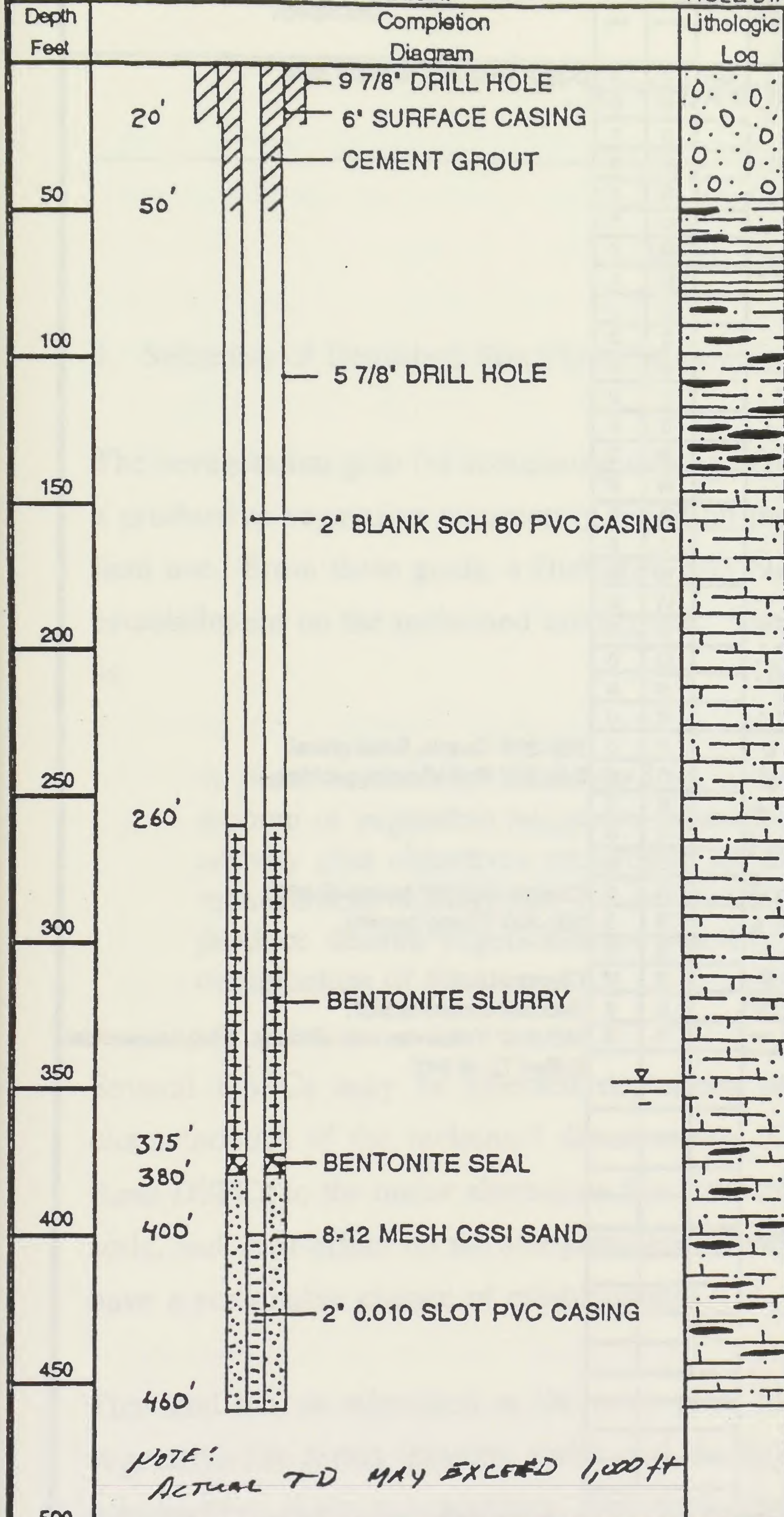


Project No. 92C0756A	Pipeline Deposit EIS	CORTEZ JOINT VENTURE SITE MONITORING AND DEWATERING WELL LAYOUT	Figure E-3

92C0756A-0010/120893


PIPELINE PROJECT AREA
CROSS SECTION A - A'
LOOKING N 50° W
SCALE 1" = 400'
A
SW
A'
NE
CORTEZ - GA
HAUL ROAD
60000 N
105000 E
HEAP
LEACH PADS
110000 E
65000 N
PUBLIC
ROAD
PREPUMPING
WATER LEVEL
ΔS = 350'
WATER LEVEL @ 10 YEARS @ 32700 gpm
TOP OF BEDROCK
LOWER PLATE
CARBONATE ROCKS
PIPELINE FAULT
VALMY FM
SECTION A-A'

WATER MANAGEMENT CONSULTANTS	DRILL HOLE COMPLETION LOG	HOLE# Example: Deep Completion
LOGGED BY: DDH	DRILLER: Drilling Services	SHEET 1 OF 1
PROJECT: Pipeline	LEGAL DESCRIP:	DRILLED DEPTH: 460'
NORTHING: 59884.76	EASTING: 100767.94 — ELEV: 5143.94	COMPLETED DEPTH: 460'
START: 10/4/92	FINISH: 10/5/92 — HOLE DIAMETER: 5 7/8"	CASING SIZE: 6" surface, 2" PVC production



[illegible]	[illegible]	[illegible]	Description
		W	0-45' Alluvium composed of gray chert, black
		M	argillite, and quartzite gravel.
		M	
		W	
		W	45-120' Valmy Fm? - Gray chert and black argillite
	0	W	
S	0	M	60-60' Yellowish-white clay.
S	0	S	
0	0	W	
0	0	W	
0	0	W	
0	0	M	120-140' Very fine grained flinty silica (jasperoid?).
0	0	0	Lower Plate below 120' (?).
0	0	0	
W-M	0	0	140-370' Buff to medium gray calc-siltstone.
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	0	0	
W-M	W	0	
W-M	W	0	270-320' Calcite veinlets.
W-M	W	0	
W-M	W	0	
W-M	W	0	
W-M	W	0	
W-M	W	0	320-340' Dark gray calc-siltstone with orange-
W-M	W	0	brown fracture oxidation.
0	0	0	SWL at 348.9'
0	0	0	
0	W	0	370-450' Same as above, but with black cherty
0	W	0	laminae.
M	W	0	
M	W	0	
W	0	0	
W	0	0	
0	0	0	
0	0	0	
0	0	0	
M	0	0	450-460' Tan calc-siltstone.
			TD at 460'.
			Water chemistry at end of development:
			T=25.6 deg C; pH= 8.35 su; Eh=-86 mv;
			Cond=1606 uS/cm - See note below.

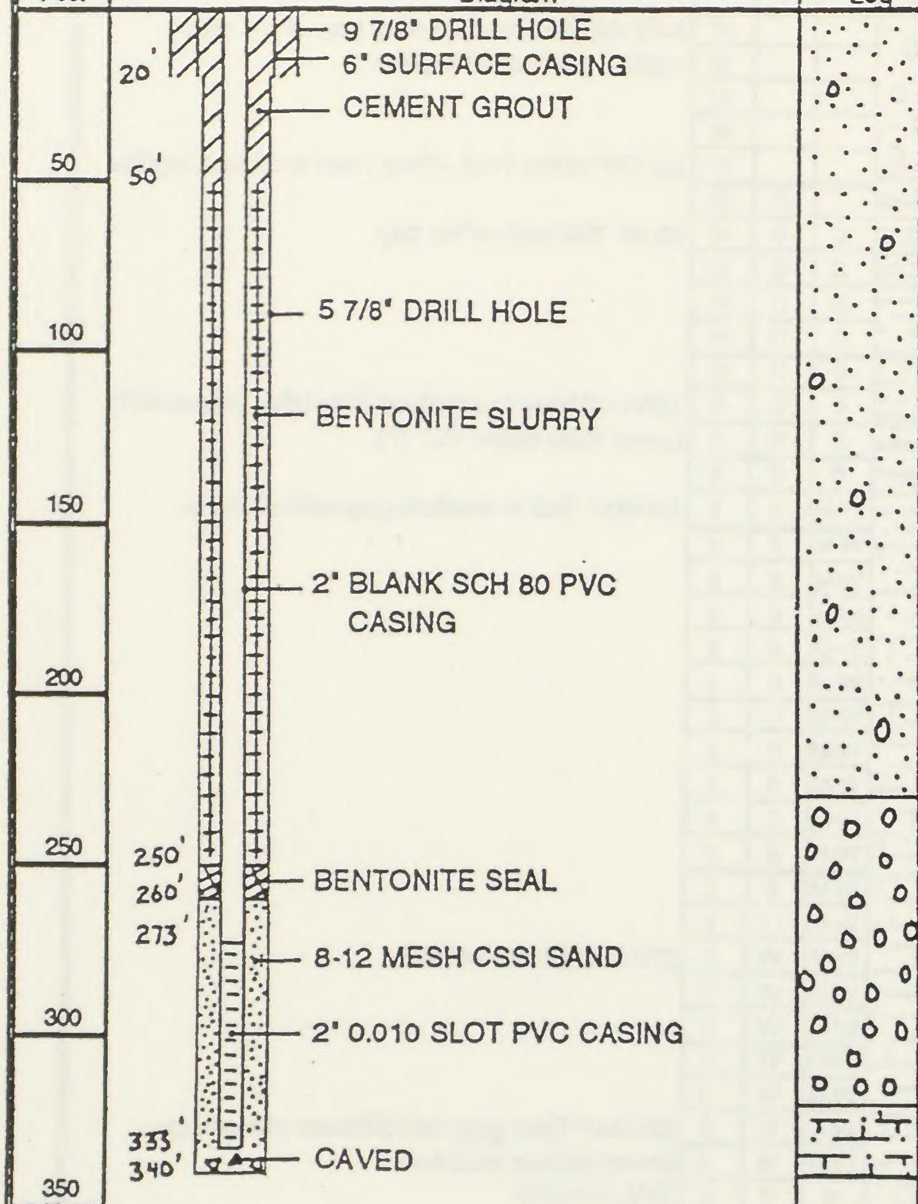
Water was not clear at end of development, clouded with bentonite which was used to stabilize hole prior to completion.

Project No. 92C0756A	Pipeline Deposit EIS	COMPLETION LOG FOR WELL OW-4S	Figure E-5

WATER MANAGEMENT CONSULTANTS	DRILL HOLE COMPLETION LOG	HOLE# Example: Shallow Completion
	LOGGED BY: DDH DRILLER: Drilling Services	SHEET 1 OF 1

PROJECT: Pipeline	LEGAL DESCRIP:		DRILLED DEPTH: 340'
NORTHING: 55775.82	EASTING: 104479.78	ELEV: 4969.58	COMPLETED DEPTH: 333'
START: 10/6/92	FINISH: 10/8/92	HOLE DIAMETER: 5 7/8"	CASING SIZE: 6" surface, 2" PVC production

Depth Feet | Completion Diagram | Lithologic Log



			Description
N/R	0	0	0-320' Alluvium - Gravelly sand.
	0	0	
	0	0	
	M	0	
	S	0	
	M	0	
	M	0	
	M	0	
	0	0	
	0	0	
	0	0	
	0	0	
	0	0	
	0	0	
	W	0	
	0	0	
	0	0	
	W	0	
	W	0	
	W	0	
	M	0	
	S	0	
	S	0	
	0	0	230-280' Coarse, loose gravel.
	0	0	240-250' Red siliceous pebbles.
	0	0	
	0	0	
	0	0	
	0	0	Change to 5 3/8" tricone @ 280'.
	S	0	290-320' Strong cement.
	S	0	
	S	M	Clayey at 320'.
	0	0	Bedrock contact at 320'.
	0	0	320-340' Yellow-tan calc-siltstone. Flinty/jasperoidal.
			Drilled TD at 340'.

Note:

Actual TD may be less than 100 feet.

Shallowest completions may require waiver of 50 seal.

Project No. 92C0756A	Pipeline Deposit EIS	COMPLETION LOG FOR WELL OW-2S	Figure E-6

APPENDIX F
REVEGETATION STANDARDS FOR NEVADA'S SURFACE MANAGEMENT PROGRAM

MINE PLANS

1. Selection of Disturbed Site Plant Community

The revegetation goal for reclaiming mining disturbance is to stabilize the site and establish a productive vegetative community based on the land use plan and designated post-mining land use. From these goals, a Disturbed Site Plant Community (DSPC) will be selected for establishment on the reclaimed mining site. The Disturbed Site Plant Community is defined as:

> A plant community established on a disturbed area which produces the kind and amount of vegetation necessary for meeting or exceeding the land use plan goals and activity plan objectives established for the site. The DSPC becomes the vegetation management objective for the site and must be consistent with the site's capability to produce desired vegetation and stability through management, land treatment, or a combination of the two.

Several DSPCs may be selected depending on the reclamation goals and variable site characteristics of the reclaimed disturbances. Consideration will be given when selecting these DSPCs to the major alterations that have taken place to the reconstructed mine site and soils, and their effect on the site potential for vegetation. DSPCs need to be selected which have a reasonable chance of establishment.

The seed list, as stipulated in the mine plan, must contain species from each of the three vegetative life forms (grasses, forbs, and shrubs). Initial seed selection can be based on the surrounding plant communities, the ecological range site descriptions, and/or various recommendations approved by the BLM and the State. Test plots or demonstration areas can be used to determine the most successful species to be used for final reclamation.

The following represent the three methods by which DSPCs would be selected:

1. Select existing vegetation types around the mine site to represent the varied DSPCs for reestablishment.

2. Use test plots or demonstration areas on the mine site or from representative areas from adjacent mines to serve as the DSPCs as long as they meet the reclamation goals.

3. For those mine sites that are in woodland communities or are in areas where the existing vegetation has been severely disturbed and the test plots are not a reasonable alternative, DSPCs may then be based on ecological or range site descriptions.

II. Release Criteria

The reclamation plan will state a goal for perennial vegetative cover. This will be 50 percent of an adjacent undisturbed area or 50 percent of the ecological or range site description cover. Test plots or demonstration areas approved by the BLM and the State may be used to determine the best method to achieve these goals of perennial vegetative cover. When using test plots to determine the DSPCs, the goal for bond release will be to attain 75 percent of the vegetative cover of the most productive test plot. In the interest of biodiversity, all three of the vegetative life forms (grasses, forbs, and shrubs) must be present in the line intercept evaluation of cover described below.

III. Data Collecting Methods

For methods 1 and 2, permanent transects would be set up to measure cover within the DSPCs (existing vegetative types or test plots). Foliar and basal cover would be determined by the line intercept method as described in the BLM Rangeland and Monitoring Technical Reference 4400-4, page 42. For method 3, cover would be determined by the ecological or range site description. Evaluation of plant cover must coincide with the active growing season.

IV. Timeframes

The BLM and State will evaluate the success of the vegetative growth of a reclaimed mine site after two full growing seasons have elapsed since earthwork and seeding have been completed. Interim progress of the revegetation will be monitored. Where it has been determined that revegetation success has not met the reclamation goal, the BLM, the State, and the mining operator will meet to decide on the best course of planned actions necessary to meet the reclamation goal.

V. Bond Release

A reclamation bond or surety (bond) may be released, either in part or in whole, at the request of the mine operator.

For reclamation plans in which revegetation is part of the plan for reclamation, partial release of the bond may be granted prior to completion of the mining project. That portion of a bond covering a discrete area of disturbance may be released when the reclamation requirements for that area have been completed. Sixty percent of the calculated bond amount may be released upon completion of earthwork. An additional 25 percent may be released after revegetation requirements have been satisfied. One hundred percent of the bond amount calculated for a discrete area may be released if no other reclamation activities (fencing, removal of fencing, signing, etc.) are proposed for the area.

When all requirements of the reclamation plan have been satisfied, including detoxification of leachates, the reclamation bond held for a particular mining operation may be released.

EXPLORATION PLANS

The same bond release criteria will hold for exploration plans with the deletion of test plots. Bond release will be based on achieving 50 percent of the cover of the surrounding vegetation or 50 percent of the ecological range site description.

NOTICES

Revegetation standards for notice-level activity will be based on the same criteria as exploration plans. However, notices may be closed as soon as reclamation is completed to the satisfaction of the authorized officer.

If earthwork reclamation and seeding have been completed on a project area, this acreage will not count in the total disturbance. This will be called monitored reclamation. The monitored reclamation will not be released until the revegetation requirements have been met as described above. The operator may create additional disturbance as long as the active unreclaimed disturbance does not exceed 5 acres and the total monitored reclamation does not exceed 10 acres.

APPENDIX G
HAZARDOUS MATERIALS, EMERGENCY RESPONSE, AND SPILL PREVENTION AND CONTAINMENT PLAN

APPENDIX G-1
DRAFT HAZARDOUS MATERIALS SPILL AND EMERGENCY RESPONSE PLAN

CORTEZ GOLD MINES

Pipeline Project

DRAFT HAZARDOUS MATERIALS SPILL AND EMERGENCY RESPONSE PLAN

Written: T. Davis
M.E. Isto

April, 1993

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HAZARDOUS MATERIALS SPILL EMERGENCY RESPONSE PLAN

Purpose

The Hazardous Materials Spill Emergency Response Plan is a list of procedures that will be followed for the prevention, response, containment and safe cleanup of all spills or discharges that may potentially degrade the environment. The plan has been prepared to comply with NAC 445.24296, 29 CFR 1910.38, 29 CFR 1910.120 and 40 CFR 300.

The plan is intended to minimize health risks and environmental impacts of accidental spills or discharges.

Procedures are defined in the plan to restore a spill area to an environmentally acceptable state as quickly as possible.

Materials Covered by the Hazardous Materials Spill Emergency Response Plan

Any material spilled or discharged that has the potential to degrade the environment or adversely affect human health is addressed under this plan.

The following specific materials are addressed:

Sodium cyanide, caustic soda beads (sodium hydroxide), lime, hydrochloric acid, soda ash, ammonium nitrate, gasoline, diesel fuel, bulk oils, waste oil and arsenic.

If a new hazardous material is introduced the MSDS and emergency response will be incorporated into this plan prior to it's delivery and use.

Spill Prevention

Cortez Gold Mines requires that:

Tanks, pipelines and process components shall be visually inspected for leaks and/or damage on a routine basis. All leaks and damage shall immediately be reported to the working supervisor and the Environmental Engineer for assessment and or sampling. The working supervisor will schedule and implement the necessary repairs as soon as possible and inform the Environmental Engineer of the intended schedule and manner of repair in writing if any discharge has or will occur.

Transfer of any petroleum products:

Any person responsible for transfer of petroleum products shall not leave the fill point at any time until fill procedures are completed and the transfer line is placed back in its proper storage location. Any spillage shall immediately be reported to the maintenance supervisor or the Environmental Engineer where plans and a time frame for cleanup will be scheduled. All petroleum spills will be remediated within 24 hours.

Any employee causing a spill through negligence and not reporting the spill immediately will face disciplinary action.

Preventive Maintenance:

Preventive maintenance will be performed to maintain the integrity of all systems. Any faulty valves, joints, elbows etc., that could cause the release of possible contaminants outside a containment structure (i.e., cement or lined area) will be repaired or replaced immediately and reported to the Environmental Engineer.

Spill Containment Structures

Containment structures will be provided at locations where any spill or discharge will contaminate the environment. Containment structures will have the capacity to contain at least 110% of the largest container within the structure.

Reporting Procedures

Notification

Notification to the Environmental Engineer is required for any size spill or discharge located outside a lined (synthetic or cement) containment area (i.e., on the ground).

The mine's policy is that all spills or discharges will be reported to the shift supervisor and the Environmental Engineer as soon as possible.

Information Collection

Once the spill or release is safely under control the Spill/Discharge Report will be filled out by the Emergency Response Team ("ERT") captain or supervisor with copies sent to the Environmental Engineer and the mine manager. A sample spill reporting form is shown in Table 1.

Table 1. Sample Spill/Discharge Report.

SPILL/DISCHARGE REPORT
MINE FACILITY ______________

1. **Date and time of spill: ________________,_________________**

2. **Material spilled: (Example: oil, cyanide, tails solution, etc.).**
____
____

3. **Quantity and concentration of spill: (Write down dimensions - for example: 2'x 10'x 3" deep) including saturated soil depths.**
____
____
____
____

4. **How long did the spill last before it was stopped?**
Spill started at: _____________ (a.m./p.m.)
Source of spill disconnected at: __________________ (a.m./p.m.)
Spillage stopped at: _______________ (a.m./p.m.)

5. **For liquids: What was the average flow rate of the discharged material?**
Gallons per minute: ________________

6. **Exact Location of Spill: (Draw a map on the back of this form.)**

7. **Circumstances leading up to the spill: (Example: failed pump, power bump, vehicle accident, etc.).**
____
____
____
____

SPILL/DISCHARGE REPORT CONT'D

8. **Who initially reported the spill:**

____

9. **Material contaminated: (Example: vehicle, soil, parts, etc.).**

____

____

____

10. **Cleanup actions taken in response to the spill: (Explain step-by-step what happened throughout the cleanup. What equipment was used, who was helping with the cleanup, what was done with the spilled material, what if any additional work needs to be performed to stabilize the area?)**

____

____

____

____

____

____

____

____

What actions have been taken and are planned to prevent this spill or discharge from recurring?

____

____

____

____

____

11. Name of person responsible for spill remediation? (Please include job title).

____

Signature ______________________________ Date ______________

Assessment of the Spill or Release

The ERT and shift supervisor are responsible for assessing the scene for hazards and implementing the procedures outlined in the emergency response plan. The Environmental Engineer will advise or direct the ERT or shift supervisor to specific requirements of spill management if necessary.

The area will be assessed by the Environmental Engineer to determine the effect and extent of the spill or release. Every effort will be taken to:

(1) Minimize the endangerment of the public health and safety which arises from the spill or release;

(2) Minimize any adverse impact to the environment arising from the release; and

(3) Minimize the effect of the spill or release upon domestic animals and wildlife.

After the assessment has been made, the Mine Manager will be informed of the situation by the Environmental Engineer.

Notification of Agencies

(The Environmental Engineer will access the spill site to determine if a reportable quantity of a substance has been spilled. Reportable quantities of common materials at Cortez Gold Mines is shown in Table 2.)

Table 2. Reportable Quantities of Common Materials.
(Dry Lbs.)

Hazardous Material	Reportable Quantity
Cyanide	10
Sodium Hydroxide	1,000
Hydrochloric Acid	5,000
Petroleum Products	25 gallons
Arsenic	1
Calcium Hypochlorite	10

If the release is determined to be a reportable quantity the spill will be reported by telephone not later than 5 p.m. of the next regular work day from the time of the incident to:

(1)	National Response Center	Phone: 1-800-424-8802
(2)	Nevada Division of Emergency Management	Day Phone: (702) 687-4240 Night Phone: (702) 687-5300
(3)	Nevada Division of Environmental Protection:	
	Waste Bureau Management	(702) 687-5872
	Water Quality Bureau	(702) 687-4670
(4)	SARA spills (spills which cross the fence line):	
	Local Emergency Coordinator - Jerry Mooney	Phone: (702) 635-2860
	Nevada Division of Emergency Management	See phone listing above.
(5)	Placer Dome U.S. Inc. - Operations Office (Elko)	
	Manager, Environmental Affairs - Bill W. Upton	Phone: (702) 738-4277
(6)	BLM Battle Mountain District Dispatcher	Phone: (702) 635-4117

Once the National Response Center (NRC) has been notified, all of the other contacts should be given the EPA number which the NRC has assigned to the spill.

The report shall include the following information:

(1) Name, address and telephone number of the operator;

(2) Name, address and telephone number of the facility;

(3) Date, time and type of incident;

(4) Name and quantity of materials involved;

(5) Human and animal mortality or injury;

(6) An assessment of actual or potential hazard to human health and the environment outside the facility;

(7) The estimated quantity and proposed disposition of recovered and waste material resulting from the incident.

Cortez Gold Mines known materials that could contaminate the environment if discharged/spilled and not cleaned up in an efficient and expedient manner are:

Cyanide	(solid and liquid 30 wt%)
Caustic Soda	(solid and liquid 50 wt%)
Hydrochloric Acid	(liquid 30 wt%)
Lime	(100% solid)
Soda Ash	(solid)
Calcium Hypochlorite	(solid)
Gasoline	
Diesel Fuel	
Oil	
Used Oil	
Litharge	(100% Lead Powder)
Ammonium Nitrate	(Blasting Agent)

Written Summary (only required for reportable spills).

A written summary shall be provided to the Nevada Division of Environmental Protection within 10 days of the oral report with copies provided to the BLM, Battle Mountain District HAZMAT specialist and the local Emergency Planning Committee for Lander County. The written summary shall include the following:

(1) Description of the spill or release and its cause;

(2) Periods of the spill or release (dates and times);

(3) Action taken to correct its cause and consequences;

(4) Result of actions (successful or unsuccessful); and

(5) Steps to be taken to reduce, eliminate and prevent recurrence of the event.

Personnel Responsibilities

In most cases, the emergency response team and area foreman where a spill or release occurs will be responsible to stop the leak and coordinate the initial containment. Once the spill or release is controlled, the foreman will notify the Environmental Engineer and the Safety Department. Administering a spill or release will involve the Environmental Engineer, the Safety Coordinator, and possibly the Corporate Environmental Coordinator and Mine Manager. The general duties of these individuals are as follows:

Mine Manager

The Mine Manager will be notified as soon as possible when a **reportable spill or release** occurs. The Mine Manager will direct all public statements to the media, if required.

Emergency Response Team

The Emergency Response Team includes employees who have been specially trained to work with hazardous materials in a safe and orderly manner. They are trained in the use of all safety gear and will promote and demonstrate safe remediation practices. The team's prime responsibility is to assess a scene for hazards, act professionally, and conduct cleanup procedures as outlined in the emergency response plan.

Environmental Engineer

The Environmental Engineer will determine or verify pertinent facts about the incident, including amount and location of the spill or release, probable direction and time of travel of the spill, resources required at the scene, and the property which may be affected. He may advise, instruct, an/or direct containment, countermeasures, and cleanup of the release. The Environmental Engineer will assess the area to determine the effect and extent of the spill or release and report the information to the Mine Manager.

Safety Coordinator

The Safety Coordinator will insure the safety of all persons involved with a spill or release. Once on the scene, the Safety Coordinator will evaluate the area for dangers and will insure that all persons involved are attired in the appropriate safety gear and have received the proper training. He may also determine if tests for toxic gases are required prior to the handling of the spilled material.

Corporate Environmental Coordinator

The Corporate Environmental Coordinator will assist company personnel in the resolution of any problems regarding a reportable release.

Foreman

The area Foreman where a spill or release occurs is responsible for coordinating the initial containment. It is up to the Foreman to decide if the spill will require the ERT. Once the spill or release is controlled, he must verify that it is, or is not a reportable spill and notify the Environmental and Safety Departments.

Standard Operating Procedure (Spill/Discharge Response)

The most important objective of the emergency response plan is to emphasize SAFETY and then containment. The following containment actions and countermeasures shall be safely employed by the Supervisor in charge in the case of any spill or release outside contained areas:

(1) Once notified of a spill/discharge the supervisor will request the following information:

- (a) Location of the spill\discharge;
- (b) Source of spill;
- (c) Description of material spilled (slurry, clear solution, solid briquettes, etc.);
- (d) Volume or velocity on material; and
- (e) Direction of flow.

(2) The shift supervisor will contact the safety coordinator or ERT Captain to find out if the spill or discharge remediation requires special protective equipment.

(3) If the material spilled is extremely toxic (i.e., hydrochloric acid, concentrated cyanide solution, concentrated sodium hydroxide, or concentrated calcium hypochlorite) evacuation of the area may be necessary.)

(4) If the Emergency Response Team is required the Environmental Department must be notified.

(5) The source to the spill\discharge will be stopped as quickly as possible.

(6) Using authorized equipment and materials the spill/discharge will be contained (bermed) to minimize the area of contamination as quickly as possible.

(7) Remove the spilled material to its approved storage area. Refer to Section 3.7 for specific materials. Liquid spills will not be left overnight or for an extended period of time. If material is unknown, it will be placed in the runoff collection pond for temporary storage.

(8) A sample of the discharge solution or spilled material will be retrieved if there is any question of its contents. Label the sample bottle with date, time of sampling and person retrieving the sample. Sample bottles are available at the Security Office. Samples of unknown and potentially hazardous materials may only be taken by properly trained, certified, and suited-up HAZMAT specialists.

(9) The "Hazardous Materials Spill Reporting Form" contained in this plan will be completed and distributed to the Mine Manager and the Environmental Engineer before the end of your shift.

Note: The release of gas and vapors should be minimized as much as practicable, but only when it is safe to do so. If not certain of the properties of the gas, withdraw from the area of influence and obtain knowledgeable advice before attempting further measures.

The following properties of liquids, solids, or gases will be considered before containment and cleanup activities begin:

(1) Toxicity;
(2) Corrosiveness;
(3) Flammability; and
(4) Reactivity.

Any questions regarding containment and cleanup activities will be directed to the Environmental Engineer or Safety Department.

If the Environmental or Safety Departments or any personnel from the ERT or the Mine Manager are not available, then only as a last resort, call CHEMTREC at 1-800-424-9300 for emergency information.

Available Equipment and Neutralizing Chemicals

The following is a list of equipment available for containing a spill or release:

- Mobile Equipment
  - Road Grader
  - Front End Loaders
  - Trucks
  - Rubber-tired Dozer
  - Dozer
  - Backhoe

- Drums
  - Empty cyanide drums - all cyanide drums are triple-rinsed when emptied.
  - Absorbent booms, towels and dikes (particularly useful for containing petroleum releases). Contact the safety office or security for location.

The following is a list of neutralizing chemicals that can be used to respond to specific events:

- Lime - neutralizes acids.
  - Located at lime silo behind mill or between the crusher and mill.
- Soda Ash - neutralizes acids.
  - Located in reagent storage warehouse.
- Sodium or Calcium Hypochlorite - oxidizes Sodium Cyanide (NaCN).
  - Located in liquid form next to liquid cyanide storage tanks.
- Soil - absorbs oil spills.
- Floor Dry - absorbs oil spills.
  - Located in maintenance shop.

Available Personal Protection Equipment

The following is a list of available personal protection equipment to be used when responding to a spill or release: (This equipment must be checked out through Security or the Safety Department.).

Protective Gear

- Rubber gloves;
- Suits;
- Goggles; and
- Face shields.
- Respirators

	Approved Cartridge
Comfo II or Glendale F-950	MSA Organic Vapors # 464031
	MSA Mersorb (Mercury) # 466204
	MSA Combination Filter # 464027
• MSA Industrial Gas Mask	Cartridge Canister GMC-SS

- 3M Dust and Mist Respirators 8710
- Self-contained Breathing Apparatus
- Gas Analyzer
- Gas Detection Tubes
  - Hcl
  - Sulfur Dioxide (SO_2)
  - Cyanide (CN)
  - Mercury (Hg)
  - Carbon Monoxide (CO)
  - Arsenic (As)
  - Oxygen
  - Hydrogen Cyanide (HCN)
- Hydrogen Cyanide Gas Detector (Monotox)
- Jerome Mercury Analyzer

All of this equipment can be obtained in the mine rescue vehicle or at the Safety Office, with one (1) exception: the hydrogen cyanide gas detectors are located in the Mill Building and in the Safety Building.

Emergency Cleanup Procedures

The following are procedures to follow when responding to a specific spill or release:

Sodium Cyanide

Specifications

Shipped in drums in briquette form of uniform size averaging 1/2 oz. in weight, overall dimensions of approximately 1-3/8 x 1-3/8 x 1/2 inch, and are white in color. They are resistant to breakage and dusting and are readily soluble in water.

Also shipped as a bulk liquid, 30%NaCN, 4%NaC, 2%NaOH, pH = 13.

Personal Safety

Do not breathe the dust or gas. Wear an approved dust respirator, rubber gloves, suit, and boots when handling cyanide. Wash hands and gloves thoroughly with water after handling cyanide.

Take every precaution to keep acids and weak alkalies from contacting sodium cyanide.

Do not eat, drink or smoke in areas where cyanide is present.

Immediate Response

- Report the spill/discharge to the Environmental and Safety Departments and request instructions for personnel safety during cleanup.
- Evacuate the area for 500 feet if concentrated liquid cyanide has been discharged.

For a small spill of cyanide briquettes:

- Follow Standard Operating Procedures defined earlier.

Cleanup

- Scoop up any spilled cyanide and place in a clean marked container.
- Treat contaminated area with Sodium Hypochlorite to destroy any remaining cyanide. **(DO NOT USE SODIUM HYPOCHLORITE NEAR OIL OR PETROLEUM PRODUCTS I.E., SOIL CONTAMINATED AREAS.).**
- Excavate the contaminated soil and transport it to the tailing pond.

Caustic Soda Beads

Specifications

Caustic soda is produced as small white beads and shipped in drums.

Personal Safety

Stay upwind, wear an approved dust respirator, goggles, rubber gloves, suit, and boots.

Be careful to keep this material off your skin at all times. If skin contact occurs a burning sensation will result. Wash with a large quantity of water.

Immediate Response

- Notify the Environmental and Safety Departments of the spill and request special instructions for personnel safety during cleanup.
- Follow Standard Operating Procedure.

Cleanup

- Scoop or sweep up any dry caustic soda beads and place them in a plastic or metal container.
- If dry caustic soda is spilled into or makes contact with a small quantity of water scoop up the dry material and treat the contaminated area with a large quantity of water (50 gallons of water per 1 pound of caustic soda beads spilled).
- Excavate the contaminated soil and dispose of in the tailings pond.
- The reclaimed dry caustic soda beads can then be put directly into the mill circuit. Deliver recovered caustic soda beads to the Mill Supervisor. Make sure the container is properly marked with its new contents and is securely covered.

Sodium Hydroxide

Specifications

Shipped by tanker truck at 50% sodium hydroxide. NaOH is a water white to slightly turbid liquid with no odor, and is classified as a corrosive material.

Personal Safety

Wear an approved acid gas respirator, goggles, rubber suit, rubber gloves, and boots. Stay upwind, corrosive action causes severe burns. Avoid contact of NaOH with organic materials and concentrated acids as violent reactions may occur. NaOH reacts with many metals generating Hydrogen gas, which is explosive.

Immediate Response

- Notify the Environmental and Safety Departments of the spill and request special instructions for personnel safety during cleanup.
- Follow Standard Operating Procedure.
- Evacuate and isolate immediate area to avoid personnel exposure.
- For a pipeline leak, adjust appropriate valves to isolate the system and stop the leak.
- Dike the area to contain the spill.

Cleanup

- Reclaim as much spilled material as possible.
- Dilute the remaining solution and flush the contaminated area with large amounts of water.
- Put reclaimed solution in the mill circuit.
- Excavate the contaminated soil and place it in the tailing pond.

Lime - Calcium Oxide

Specifications

Shipped by trailer truck. White, odorless solid pebbles or powder.

Personal Safety

Wear an approved dust respirator, work gloves, goggles, and a full covering of clothing. Do not use water.

Cleanup

- Follow Standard Operating Procedure.
- Scoop or sweep up any spilled lime and place it in a suitable container.
- Excavate the contaminated soil and place it in the tailing pond.
- The reclaimed lime may be put into the mill circuit.

Hydrochloric Acid

Specifications

Shipped in a tanker truck as 35.2% hydrochloric acid in water. Clear, colorless, or slightly yellow fuming liquid. Pungent, biting odor.

Personal Safety

Wear a SCBA or an approved respirator, goggles, rubber suit, rubber gloves, and boots. Avoid contact with metals and sulfides as these will produce hydrogen gas which may cause fire or explosion, and is poisonous. Stay upwind, the respirator will not protect you from hydrogen gas.

Immediate Response

- Notify the Environmental and Safety Departments of the spill and request special instructions for personnel safety during cleanup.
- Follow Standard Operating Procedure.
- Evacuate and isolate immediate 50 foot area to avoid personnel exposure.

- For a pipeline leak, adjust appropriate valves to isolate the system and stop the leak.
- Dike the area to contain the spill.

<u>Cleanup</u>

- Neutralize all pooled solution with water, soda ash, or lime. Verify that the solution is neutralized with a pH tester.
- If possible place any neutralized solution back in the mill circuit.
- Excavate the contaminated soil and mix with lime. Contact the Environmental or Safety Department for disposal options.
- Neutralized material may be placed in the tailing pond.

Soda Ash

<u>Specifications</u>

Shipped in bags. Soda ash is a white, odorless, granular solid.

<u>Personal Safety</u>

Wear an approved dust respirator, and goggles.

<u>Cleanup</u>

- Follow Standard Operating Procedure.
- Scoop or sweep up spilled soda ash and place it in a suitable container.
- Excavate the contaminated soil and place it in the tailing pond.
- Reclaimed soda ash may be put into the mill circuit.

Gasoline and Diesel Fuel

Specifications

Shipped by tanker truck, large amounts at a time.

Personal Safety

Stay upwind, out of fumes, and keep out of low areas. Wear rubber gloves and boots. (No Smoking or open flames.).

Immediate Response

- Notify the Environmental and Safety Departments of the spill and request special instructions for personnel safety during cleanup.
- Follow Standard Operating Procedure.
- Remove all sources of ignition.
- Evacuate and isolate immediate area to avoid personnel exposure.
- Stop the leak.
- Dike the area to contain the spill.

Cleanup

- Remove all diesel contaminated soil and place it in the diesel contaminated soil stockpile area. Contact the Environmental Department if there are any questions.
- All diesel or gasoline liquids recovered from a spill will be placed in drums for proper disposal.

Bulk Oils

Specifications

Shipped in 55 gallon drums or in bulk by tanker truck.

Personal Safety

Wear rubber gloves and boots.

Immediate Response

- Follow Standard Operating Procedure.
- Remove all sources of ignition.
- Stop the leak.
- Dike the area if the spill is large.

Cleanup

- Pump any pooled oil into 55 gallon drums. Contact the environmental Department for additional instruction.

Ammonium Nitrate

Specifications

Shipped in tanker truck. Ammonium nitrate is white in color, small round pearl-like granules.

Personal Safety

Wear an approved dust respirator, gloves, and boots. Ammonium nitrate is not compatible with wood, sulfur, chlorides, phosphorus, fine metals, acids, organics, or solvents.

Immediate Response

- Follow Standard Operating Procedure.

Cleanup

- If the ammonium nitrate is spilled on an area that has hydrocarbon contamination DO NOT REMOVE. Contact the Environmental Department.

- If spilled on clean ground, then contain the spill and scoop or sweep up the spilled material and place it in a clean plastic container and mark the container of its new contents. The container must not have any petroleum products in it prior to use.

- Place the marked container by the ammonium nitrate silo and notify the Environmental Department.

Response to a Seismic Event

Seismic events vary greatly in magnitude. For emergency response purposes the following procedures will be followed after a seismic event has been felt at the Project site:

(1) All milling facilities and process pipelines will be visually inspected for signs of deformation or failure. If facilities are found to be a threat to safety or the environment, the affected facility will be shutdown and repaired.

(2) The tailing storage heap leaching facility will be visually inspected for embankment failure. All monitor parts will be checked for leakage. Inspections will be done daily for a period of 7 days after a seismic event to monitor for any changing conditions in the facility.

If embankment deformation or failure is observed, the facility will be shut down if safety to personnel or the environment was likely. A professional engineer with expertise in evaluating earthen structures will inspect the facility to determine if the facility is safe to operate and develop a repair plan, if applicable.

(3) In the event that hazardous materials are released to the environment, the reporting and emergency response procedures for addressing spills will be implemented.

APPENDIX G-2

HAZMAT MANAGEMENT AND SARA TITLE III REPORTING

ILLER
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STATE OF NEVADA

JAMES P. WELLER
Director

DEPARTMENT OF
MOTOR VEHICLES AND PUBLIC SAFETY
STATE FIRE MARSHAL DIVISION
Capitol Complex
No. 107 Jacobsen Way
Stewart Facility
Carson City, Nevada 89710
(702) 687-4290
Fax (702) 687-5122

Dear Facility Owner/Operator **January 1994**

Our records indicate you currently hold a 1993 State Fire Marshal Hazardous Materials Storage permit. It is now time to renew this permit as it is an annual permit based on the calendar year.

Enclosed is your hazmat permit renewal package. Pages **1, 2, 3 & 4 must be completed even if you completed these pages last year.** You will note that Page 4, the Hazardous Substances Information Financial Worksheet has changed this year. Carefully read this page before you complete it.

Review and complete page 3. Fill out pages 5, 6 and/or 7 **as necessary.**

Mail **all** completed forms with your payment to:

Nevada State Fire Marshal
Capitol Complex
Carson City, Nevada 89710

If you have any questions or need assistance, feel free to call (702) 687-4290.
Please ask for Hazardous Materials Permit assistance.

Ray E. Blehm, Jr.
State Fire Marshal

STATE OF NEVADA

EMERGENCY RESPONSE COMMISSION

Dear Facility Owner/Operator: **January 1993**

Numerous State and Federal laws establish requirements regarding the reporting of hazardous substances at facilities within Nevada. These laws mandate that several state agencies collect information, assess fees and enforce proper management practices. IN ORDER TO REDUCE THE REPORTING PAPER FLOW FOR YOUR FACILITY, the State Emergency Response Commission (SERC), the Division of Emergency Management (NDEM), the State Fire Marshal Division (SFMD) and the Division of Environmental Protection (NDEP) have prepared the enclosed consolidated reporting forms. Completion and submittal of the forms will satisfy reporting requirements as mandated by: (SARA), Title III, PL 99-499, NRS 477, Statutes of the State Fire Marshal and Registration of SARA Facilities and Substances.

A registration and hazardous material process fee has been mandated by Nevada law. If your facility meets the SARA Title III, Tier II (Chemical Information Sheet) criteria. see fee schedule on page 24.

If your facility meets the criteria of the State Fire Marshal Hazardous Materials Permit requirements, a fee payable to the State Fire Marshal is required by NRS 477.045. See the fee schedule on page 24.

Federal, State or local government owned or occupied facilities are required to report and obtain the annual permit from the State Fire Marshal, but they are exempt from the fee.

THESE FORMS MUST BE COMPLETED AND RETURNED TO:

NEVADA STATE FIRE MARSHAL DIVISION
CAPITOL COMPLEX
CARSON CITY, NEVADA 89710

PHONE : 702-687-4290
FAX: 702-687-5122

REMEMBER TO PROVIDE A COPY TO YOUR LOCAL FIRE DEPARTMENT !!!

Director
Emergency Management

State Fire Marshal

Chairman, State Emergency
Response Commission

INSTRUCTIONS

STOP!! BEFORE YOU START TO FILL OUT FORMS MAKE AS MANY COPIES OF THE MASTERS IN THIS PACKET AS YOU NEED.

PLEASE READ THE ATTACHED INSTRUCTIONS CAREFULLY BEFORE YOU BEGIN FILLING OUT THE REPORTING FORMS. If your facility does not meet any of the hazardous substances reporting requirements, you must still complete and return **PAGES 19 AND 23.**

DO NOT LEAVE ANY SECTIONS ON THE CHEMICAL INFORMATION SHEETS BLANK! If you don't have the information put UNK (for unknown) or N/A if not applicable, in the blank.

CHEMICAL SPECIFIC INFORMATION CAN BE OBTAINED FROM THE *MATERIAL SAFETY DATA SHEET* (MSDS) OR FROM THE CHEMICAL SUPPLIER.

NEVADA CHEMICAL INFORMATION SHEET - PAGE 20

The top left corner of the Chemical Information Sheet has a blank after the "Chemical Report No." Start with a number 1 in the first box and number the chemicals in sequence, with a new number and blank form for each chemical.

1. Enter the Chemical Abstract Service (CAS) number. For mixtures, enter the CAS number of the mixture as a whole. If the mixture has no assigned CAS number, enter the CAS number of the active ingredient and the percentage amount in section 6. If added room is needed, continue to the next chemical report section and indicate by entering "cont'd" above the Chemical report number space. If the material has no CAS number and is only reported for purposes of the Uniform Fire Code, disregard items 1 and 6.

2. Enter the chemical name of the chemical reported.

3. Enter the common name of the chemical if there is one.

4. Enter the DOT guide number for emergency response to an incident involving this chemical. This can be found in the "Department of Transportation Emergency Response Guide Book". The guide book is available from the U. S. Department of Transportation, Research and Special Programs Administration, Office of Hazardous Materials Transportation (DHM-51), Washington, D.C., 20590-0001.

5. Physical state. Check the appropriate box.

6. Please note in the space provided, the percentages of mixture of the chemical. If it is pure, check the box.

7. If you meet the provisions of SARA, Title III, Section 322 and are claiming a trade secret, check this box.

8. If a toxic warning is supplied on the MSDS it will be given in terms of acute or immediate or in terms of chronic or delayed. Please check the appropriate box.

9. Physical hazard. Check the box for any and all hazards noted on the MSDS.

10. Chemical amount.
    A. Maximum quantity on site at any one time
    B. Average daily amount stored
    C. Enter total number of days chemical was present on site

IF THIS CHEMICAL DOES NOT MEET THE QUANTITY AMOUNTS REQUIRED FOR REPORTING AS AN EXTREMELY HAZARDOUS OR A HIGHLY HAZARDOUS SUBSTANCE, BUT MEETS FIRE MARSHAL'S REPORTING REQUIREMENTS, THE QUANTITY MAY BE REPORTED IN COMMON TERMS SUCH AS GALLONS OR CUBIC FEET.

11. Container type. Enter proper letter code designator.
    A. Above ground tank
    B. Below ground tank
    C. Tank inside building
    D. Steel drum
    E. Plastic or non-metal drum
    F. Can
    G. Carboy
    H. Silo
    I. Fiber drum
    J. Bag
    K. Box
    L. Cylinder
    M. Glass bottles or jugs
    N. Plastic bottles or jugs
    O. Tote bin
    P. Tank wagon
    Q. Railcar
    R. Other (ie: aerosol cans, etc.)

12. Temperature. Enter the number code.
    7. Cryogenic conditions (Materials maintained below 0 degrees Fahrenheit)
    6. Less than ambient temperature but not cryogenic
    5. Greater than ambient
    4. Ambient temperature (Same temperature as surrounding area)

13. Pressure conditions. Enter the number code.
    3. Less than ambient pressure
    2. Greater than ambient pressure
    1. Ambient pressure (Same pressure as surrounding area)

14. Note the location of this chemical on the site plan, page 22, and record the buildings, areas, tanks or other places of storage here. Use the letter and number designation for the site plan coordinates. Multiple 8-1/2 x 11 sheets for a composite will be acceptable.

15. If this chemical is listed as an "Extremely Hazardous Material" and is manufactured for transport in an amount greater than the threshold quantity, note the amount manufactured in tons each year. Check the appropriate box if this is a seasonal operation or year round operation.

NOTE: ONLY THE "NEVADA CHEMICAL INFORMATION SHEET" SHOULD BE USED FOR LISTING CHEMICALS. THE "NEVADA STATE FIRE MARSHAL UNIFORM FIRE CODE SUPPLEMENTAL MATERIALS REPORT" PAGE SHOULD BE USED FOR THE REPORTING OF NON-CHEMICAL MATERIALS SUCH AS COMBUSTIBLE FIBERS, TIRES, LUMBER AND SIMILAR ITEMS FOUND IN THE LISTINGS ON PAGES 3 AND 4.

STATE FIRE MARSHAL
UNIFORM FIRE CODE HAZARDOUS MATERIALS INVENTORY

A PERMIT IS REQUIRED FOR THE STORAGE OF ANY OF THE FOLLOWING MATERIALS PER NEVADA REVISED STATUTE 477.045. Questions about this listing should be referred to the Nevada State Fire Marshal Division. Phone (702) 687-4290 and request HazMat Permit assistance.

An * after the item number means use the Nevada State Fire Marshal Uniform Fire Code Supplemental Materials Report for non-chemical items.

ITEM	DESCRIPTION
C.2 *	Cellulose nitrate materials. More than 25 pounds.
C.4 *	Combustible fibers. More than 100 cubic feet.
C.5 *	Combustible material. More than 2500 cubic feet gross volume of empty packing cases, boxes, barrels, tires or containers of rubber, cork, or similar products or store lumber in excess of 100,000 board feet.
C.6	Compressed gases at normal temperatures and pressures, in excess of the following:

TYPE OF GAS	AMOUNT
Flammable (except cryogenic or L. P. G.)	200 cubic feet
Oxidizing (includes oxygen)	500 cubic feet
Corrosive (acids or caustics)	any amount
Toxic (pesticides, herbicides, etc..)	any amount
Radioactive	any amount
Inert (pressure cylinder, no MSDS provided)	6000 cubic feet

Your supplier must inform you of the amount, in cubic feet, of the cylinders delivered or filled for you. An MSDS sheet will also be provided by the supplier.

C.7 Cryogens. Except where Federal Regulations apply and except for fuel systems of vehicles, storage in excess of the following:

TYPE OF CRYOGEN	INSIDE OF BUILDING	OUTSIDE OF BUILDING
Flammable	over one gallon	over 60 gallons
Oxidizer	over 50 gallons	over 50 gallons
Corrosive or toxic	over one gallon	over one gallon
Nonflammable	over 60 gallons	over 500 gallons

D.1 Dry cleaning plants which store or use a hazardous cleaning solvent.

E.1 Explosives or blasting agent storage: any amount. Includes ammonium, potassium or similar solid nitrates.

F.3 Flammable or combustible liquids.
Flammable liquid: Flash point below 100 degrees F. Includes gasoline, kerosene, white gas, coleman fuels, waste oils and solvents, alcohol or similar flammables. To store more than 5 gallons inside of a building or 10 gallons outside of a building, except that a permit is not required for the following:

(i) In a vehicle fuel tank or the tank of a mobile heating or power plant;

or
(ii) Temporary storage, not to exceed 30 days, of paints, oils, varnishes or similar flammable mixtures when they are used for maintenance or similar purpose.

Combustible liquid: Flash point from 100 to 200 degrees F. Includes diesel fuels, mineral spirits, solvents, and similar petroleum products. To store more than 25 gallons in a building or more than 60 gallons outside of a building, except for underground heating oil used to heat the buildings. Includes spraying or dipping processes. Does not include new motor oil storage in containers of 1 gallon or less used for retail sales.

F.5 Fumigant. To store any amount of toxic or flammable fumigant.

L.1 Liquified Petroleum Gas. To store for sale or commercial use in a tank exceeding 2000 gallons water capacity or tanks of more than 4000 gallons aggregate.

L.2* Lumber yards. Storage in excess of 100,000 board feet.

M.1* Magnesium. Storage of more than 10 pounds of casted, heat treated or ground metal per working day.

M.3* Matches. To store more than 864,000 matches (60 matchman's gross @ 14,400 matches per gross).

HAZARDOUS MATERIALS SUMMARY TABLE

TYPE OF MATERIAL	AMOUNT (more than)
Cellulose nitrate	25 pounds
Combustible liquids	25 gallons
Corrosive gases	any amount
Corrosive liquids	55 gallons
Cryogens	see C.7
Flammable gases	200 cubic feet
Flammable liquids	see F.3
Toxic gases, liquids, solids	any amount
Liquified Petroleum Gas	2000 gallons
Magnesium	10 Pounds
Oxidizing gases	500 cubic feet
Oxidizing liquids, solids	any amount
Organic peroxides	any amount
Poisons, pesticides, antifreeze, etc.	any amount
Pyrophorics (ignites in air)	any amount
Radioactive materials (gas, solid, liquid)	any amount
Unstable (reactive) materials	any amount
Water-reactive liquids or solids	any amount

HAZARDOUS MATERIALS PERMIT APPLICATION

If your facility stores or uses any of the materials or chemicals listed on pages 3 through 16, in the amounts exceeding those listed, you must completely fill out the appropriate forms and submit the proper fees as noted on page 24.

NEVADA COMBINED AGENCY HAZARDOUS SUBSTANCES INFORMATION

FACILITY REPORT

STATE FIRE MARSHAL OFFICE USE ONLY			
COUNTY	YEAR	FACILITY #	P/X

NV FACILITY I.D. NUMBER

ATTACHED PLEASE FIND FORMS MEETING THE REQUIREMENTS OF:

SARA TITLE III, TIER II ☐ HIGHLY HAZARDOUS SUBSTANCES ☐

FIRE MARSHAL HAZARDOUS MATERIALS STORAGE PERMIT ☒

NEVADA LOCATION

FACILITY NAME: Cortez Gold Mines

18 miles south of Crescent Valley, Nevada
Box HC66-50
NUMBER & STREET OR OTHER PHYSICAL ADDRESS

CITY	STATE	ZIP	COUNTY
Beowawe	NV	89821-9708	Lander

Crescent Valley Fire Dept.
PUBLIC FIRE DEPARTMENT SERVING THIS FACILITY

TOWNSHIP	RANGE	SECTION	FDID #
29 N	48 E	5	0 7 8 5 1

FACILITY PHONES

BUSINESS	EMERGENCY
468-0505	468-0505

STANDARD INDUSTRIAL CODE OR PRINCIPAL BUSINESS ACTIVITY: 1 0 0 0

MAIL PERMIT TO:

BUSINESS NAME	ATTENTION
Cortez Gold Mines	Environmental Engineer

ADDRESS	CITY	STATE	ZIP
Box HC66-50	Beowawe	NV	89821-9708

LOCAL OWNER OR MANAGER

NAME	PHONE
Cortez Joint Venture Q. C. Lusty, Mine Manager	468-0505

PARENT COMPANY

NAME	PHONE
Placer Dome US,Inc.	(415) 986-0740

ADDRESS	CITY	STATE	ZIP
One California St., Ste. 2500	San Francisco	CA	94111

EMERGENCY CONTACT	PHONE
B. W. Upton, PDUS-Elko	738-4277

LOCAL 24 HR. FACILITY EMERGENCY CONTACTS

	NAME	TITLE	(W) PHONE	(H) PHONE
1	John Bunch	Safety Director	468-0505	753-6051
2	Chuck Buus	Environmental Engineer	468-0505	468-0505

STATE FIRE MARSHAL OFFICE USE ONLY

RECD $ ______ DATE ______ CK# ______ RECEIPT # ______

HAZARDOUS SUBSTANCES INFORMATION
FACILITY REPORT CONTINUED
FACILITY FEATURES

BUSINESS NAME: Cortez Gold Mines

ADDRESS: Box HC66-50, Beowawe, NV 89821-9708

Do you have outside hazmat storage areas: YES [X] NO [ ]

Is this facility placarded with the NFPA 704 system? YES [ ] NO [X]

IF YES SHOW RATING

FIRE SUPPRESSION SYSTEMS: CHECK LIST

- FIRE SPRINKLERS [ ]
- DRY CHEMICAL SYSTEMS [X]
- PORTABLE FIRE EXTINGUISHERS [X]
- HALON SYSTEMS [ ]

EMPLOYEES PER SHIFT: ENTER NUMBER

DAYS	110
EVENINGS	40
NIGHTS	40

DETECTION FEATURES: CHECK LIST

- GAS DETECTORS [X]
- SMOKE DETECTORS [ ]
- FIRE ALARM SYSTEM [ ]
- HEAT DETECTION [ ]

WATER SUPPLY

PRIVATE WATER SOURCE [X]
GALS. PER MINUTE: 800

PUBLIC WATER SYSTEM [ ]

CONTAINMENT FEATURES

- CABINETS FOR GAS CYCLINDERS [X]
- DRAINAGE TO CONTAINMENT AREA [X]
- DIKES [X]
- SCRUBBER SYSTEMS FOR GAS CYCLINDERS [ ]

EXPLAIN ANY SPECIAL REQUIREMENTS FOR SECURITY OR ENTRY INTO THIS FACILITY IN CASE OF EMERGENCY RESPONSE: Notify Cortez Response Team personnel, Cortez Security, or Cortez Duty Engineer upon entry.

I CERTIFY, UNDER PENALTY OF LAW, THAT I HAVE PERSONALLY EXAMINED AND AM FAMILIAR WITH THE INFORMATION SUBMITTED ON THE FACILITY REPORT AND PAGES ONE THROUGH NA OF THE CHEMICAL INFORMATION SHEETS, AND THAT BASED ON MY INQUIRY OF THOSE INDIVIDUALS RESPONSIBLE FOR SUPPLYING THIS INFORMATION, I BELIEVE THAT THE SUBMITTED INFORMATION IS TRUE, ACCURATE AND COMPLETE.

For Cortez Gold Mines
NAME OF OWNER / MANAGER

Sr. Environmental Engineer
TITLE

Mark H. List
SIGNATURE

January 4, 1994
DATE

1994 HAZARDOUS MATERIALS PERMIT INFORMATION UPDATE FORM

CORTEZ GOLD MINES
STAR ROUTE HC66-50
BEOWAWE NV 89821-9708

18 M S OF CRESCENT VALLEY
BEOWAWE

PERMIT #: 07-93-0003-P
FDID #: 07851

DO YOU HAVE ANY CHANGES IN KINDS OF MATERIALS, QUANTITIES OR TYPES OF STORAGE?

IF "NO" CHECK HERE [ ] .

IF "YES" CHECK HERE [ ] AND COMPLETE PAGE(S) 5 AND/OR 6 AS NEEDED.

IF YOU HAVE ANY CHANGES IN YOUR BUILDINGS OR EXTERIOR STORAGE FACILITIES, COMPLETE PAGE 7.

HAZARDOUS SUBSTANCES INFORMATION
FINANCIAL WORKSHEET

REPORTING CRITERIA:

1. S.A.R.A., TITLE III, Registration of SARA Facilities and Substances, NRS 459.

A. Storage of EHS Materials.

If your facility stores any extremely hazardous substances (EHS) in amounts greater than the TPQ, you are required to register at an annual fee of $100.

Filing Fee: If you qualify, enter $100 in the column at right............. ________

If your facility stores any materials from 1. A. above, in an amount above one ton at any time, you will be required to pay a fee of $100 per ton for each ton above the initial ton

Storage Fee:

Maximum no. of tons, ____X $100.= ____ ________

B. Manufacturing EHS Materials for Transport.

If your facility manufactures for transport, an extremely hazardous substance in an amount greater than the TPQ, you are required to register at an annual fee of $100.

Filing Fee:

If you qualify, enter $100 in the column at right.............. ________

If your facility manufactures EHS materials in excess of one ton, each and every ton requires a surcharge fee of $100 per ton.

Manufacturing Surcharge Fee:

Maximum no. of tons, _____X $100=___ ________

2. STATE FIRE MARSHAL, Hazardous Materials Storage Permit and Fee. If your facility stores, dispenses, uses or handles any of the items at or above the amounts listed in the U.F.C., or in paragraph 1 above, you are required by NRS 477 to have a hazardous materials permit for each facility. The annual fee is $150 per facility. ENTER FEE........... $ 150.00

TOTAL OF FEES FROM 1 AND 2 ABOVE......... $ 150.00

The fees received in items number 1-A and B above are designated to be distributed by the STATE EMERGENCY RESPONSE COMMISSION, (S.E.R.C.). These funds are distributed as grants to each county and it's local planning and emergency response agencies for the special equipment, training and planning needs for preparation to respond to emergencies involving hazardous materials. Grants are applied for through the Local Emergency Planning Committee, (L.E.P.C.) to the S.E.R.C., to meet the local needs. The funds also provide for the administration of the S.E.R.C. as required by Federal Law.

The fees received in item number 2 are designated to be used by the State Fire Marshal for establishing and maintaining programs for the training of Emergency Responders to hazardous materials incidents and to compile and transmit information on the hazardous materials in each community to the local fire authorities. General training is made available to private industry for hazardous materials. Specialized training for specific chemicals can be arranged on request. Information on hazardous materials, which is reported on these forms, is provided directly to those fire departments and is also made available to the statewide law enforcement network via the Nevada Highway Patrol. Advice and code requirements for hazardous process, construction, fire and life safety, as well as operating practices, are available as part of the local training programs for industry and emergency responders.

NEVADA CHEMICAL INFORMATION SHEET

CHEMICAL REPORT NO. [1]	7 TRADE SECRET [ ]	INVENTORY AMOUNT	LOCATION
1 CAS NUMBER: 7647-01-0	HEALTH HAZARD	10 A. MAXIMUM QUANTITY ON SITE: 100,000 lbs. (FOR OPTIONAL UNITS SEE DIRECTIONS)	14 SITE PLAN COORDINATES: A1 PAGE: 1
2 CHEMICAL NAME: Hydrochloric Acid	8 ACUTE OR IMMEDIATE [X]	B. AVERAGE DAILY STORAGE: 50,000 lbs.	DESCRIBE LOCATION: 100 ft. west of CIL Mill Building. North tank inside concrete containment area.
3 COMMON NAME: Same	CHRONIC OR DELAYED [ ]	C. # OF DAYS ON SITE: 365	CONFIDENTIAL [ ]
4 DOT GUIDE NUMBER: 60	PHYSICAL HAZARD	11 CONTAINER TYPE ENTER CODE: A	MANUFACTURE OR PROCESS INFORMATION
5 PHYSICAL STATE: SOLID [ ] LIQUID [X] GAS [ ]	9 FIRE [ ]	12 TEMPERATURE ENTER CODE: 4	15 Average amount mfg for transport ____ Tons / yr.
6 IF A MIXTURE - DESCRIBE PERCENTAGES: 35.2 % HCl - Aqueous	SUDDEN RELEASE OF PRESSURE [ ]	13 PRESSURE ENTER CODE: 1	Year around [ ] or if seasonal, when? ____
PURE SUBSTANCE [ ]	REACTIVITY [X]		Other pertinent information ____ NFPA 704 RATING IF AVAILABLE

CHEMICAL REPORT NO. [ ]	7 TRADE SECRET [ ]	INVENTORY AMOUNT	LOCATION
1 CAS NUMBER:	HEALTH HAZARD	10 A. MAXIMUM QUANTITY ON SITE: ____ lbs. (FOR OPTIONAL UNITS SEE DIRECTIONS)	14 SITE PLAN COORDINATES: ____ PAGE: ____
2 CHEMICAL NAME:	8 ACUTE OR IMMEDIATE [ ]	B. AVERAGE DAILY STORAGE: ____ lbs.	DESCRIBE LOCATION: ____
3 COMMON NAME:	CHRONIC OR DELAYED [ ]	C. # OF DAYS ON SITE: ____	CONFIDENTIAL [ ]
4 DOT GUIDE NUMBER:	PHYSICAL HAZARD	11 CONTAINER TYPE ENTER CODE: [ ]	MANUFACTURE OR PROCESS INFORMATION
5 PHYSICAL STATE: SOLID [ ] LIQUID [ ] GAS [ ]	9 FIRE [ ]	12 TEMPERATURE ENTER CODE: [ ]	15 Average amount mfg for transport ____ Tons / yr.
6 IF A MIXTURE - DESCRIBE PERCENTAGES:	SUDDEN RELEASE OF PRESSURE [ ]	13 PRESSURE ENTER CODE: [ ]	Year around [ ] or if seasonal, when? ____
PURE SUBSTANCE [ ]	REACTIVITY [ ]		Other pertinent information ____ NFPA 704 RATING IF AVAILABLE

BUSINESS NAME Cortez Gold Mines

ADDRESS Box HC66-50, Beowawe, NV 89821-9708

MAKE COPIES AS NEEDED

Please use the following symbols on all General Site, Facility, Floor and Area Maps. If it becomes necessary to use any other symbol on any of the maps that you submit, be certain to include a reference (i.e. the meaning) of the symbol on the appropriate map, or on your site map cover page. Please include the product name, quantity and appropriate hazard class identification diamond for each storage tank. Additionally, please identify all fire alarm devices.

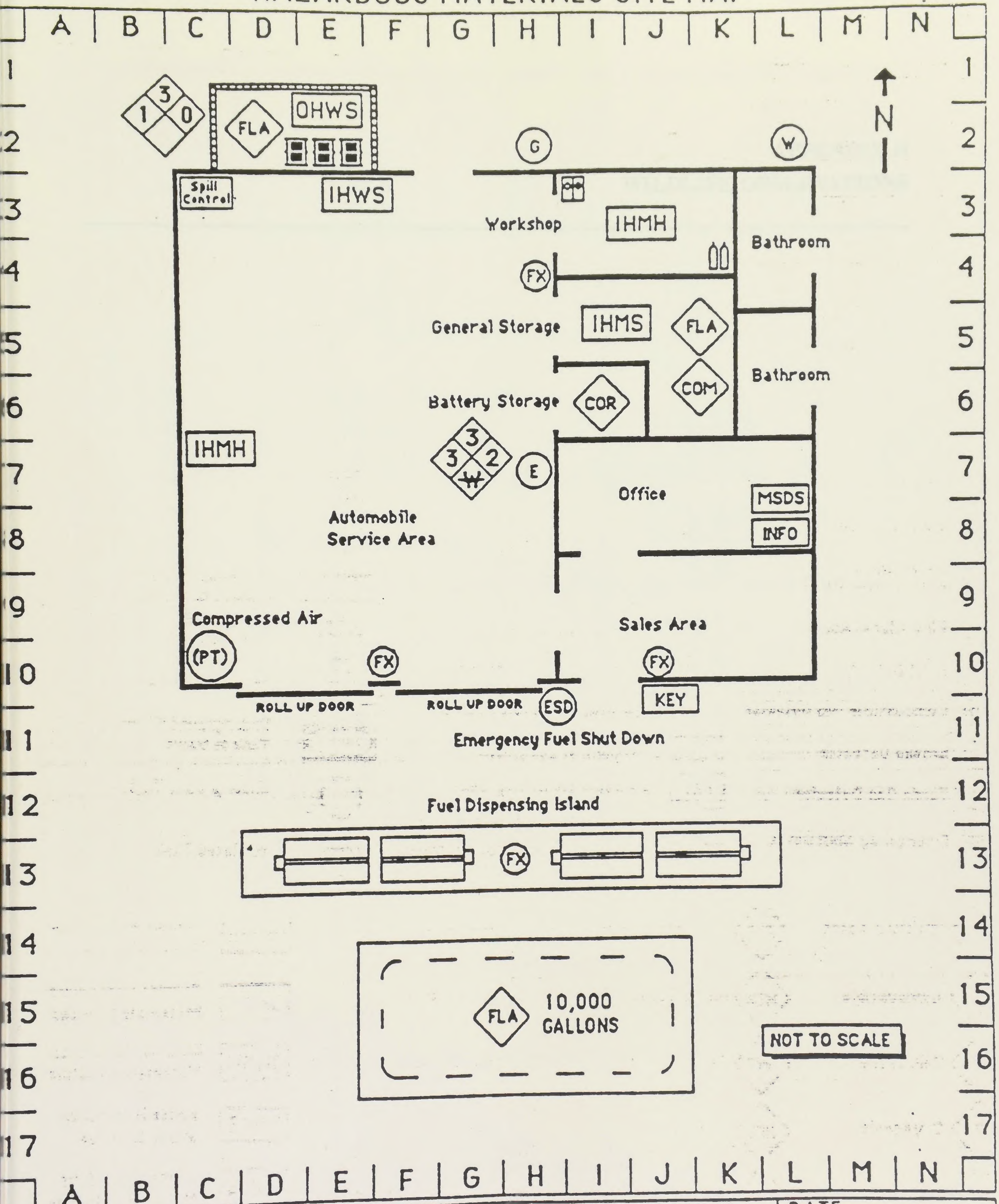
	Fire Department Connection
	Outside Screw and Yoke, Rising Stem (OS&Y Valve)
	Post Indicator Valve
	Fire Hydrant
	Fire Pump
FX	Fire Extinguisher
FH	Fire Hose
	Risers for Sprinklers
FA	Fire Alarm Annunciator Panel
R	Fire Alarm Reset
HD	Heat Detector
CD	Combustible Gas Detector
SD	Smoke Detector
TD	Toxic Gas Detector
ESD	Emergency Shut Down
HVAC	Heating, Ventilation & Air Conditioning Shut-Off
E	Electrical Shut-Off
G	Gas Shut-Off
W	Water Shut-Off
	Drain
	Evacuation/Staging Area
—E→	Evacuation Route
G	Guard Station
ECS	Emergency Control Station
	Hazardous Materials Cabinet
	Compressed Gas Cabinet
	Compressed Gas Cylinders
	Hazardous Materials Drums
Spill Control	Spill Control Equipment
KEY	Fire Department Key Box
MSDS	Manufacturer Safety Data Sheets
INFO	Emergency Information, Business Plan, Chemical Inventory and Maps
XXXXX	Wire Fence
^^^	Berms and Dikes
	Railroad Track
- - Case Rd - -	Streets, Alleys, Roads Indicate By Name
	Powerlines
E	Elevator
T	Trash / Refuse Storage
A/A	Attic Access
R/A	Roof Access
1 … 4	Stairways: Indicate highest to lowest
WT	Water Tank
(PT)	Pressurized Tank
	Underground Storage Tank in Vault
	Underground Tank
IT	Insulated Tank
N	(North arrow)

BLA	Blasting Agent	FLS	Flammable Solid	OXY	Oxidizer
COM	Combustible	HTX	Highly Toxic	PYR	Pyrophoric
COR	Corrosive	INT	Inert	RAD	Radiological
CRY	Cryogenic	NFL	Non Flammable	TOX	Toxic
EXP	Explosive	OHH	Other Health Hazard	URE	Unstable Reactive
FLA	Flammable	ORG	Organic Peroxide	WRE	Water Reactive

OHWS	Outside Hazardous Waste Storage
OHMS	Outside Hazardous Materials Storage
OHMH	Outside Hazardous Materials Handling
IHWS	Inside Hazardous Waste Storage
IHMS	Inside Hazardous Materials Storage
IHMH	Inside Hazardous Materials Handling

EXAMPLE

HAZARDOUS MATERIALS SITE MAP



BUSINESS NAME Mike's Service Station

DATE 09-28-90

ADDRESS 124 Sandy Way CITY Buellton

PAGE 1 OF 1

APPENDIX H
WILDLIFE OBSERVATIONS

Table H-1. WILDLIFE OBSERVATIONS

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsur-face	Surface	Midstory	Tree Bole	Tree Canopy			
26/46-21,12 Tub Spring	shallow pond	burrows	grasses	big sagebrush, rubber rabbitbrush			exclusion fence, pipe/trough, road	spring flowing over trough	pocket gopher, black-tailed jackrabbit, coyote, horned lark, Brewer's sparrow, Brewer's blackbird, western meadowlark
****** ****									
26/47-4,24	cascading steep rocky drainage	stony site	grass/ forb	holodiscus, ephedra, rose	juniper/ pinyon	juniper/ pinyon	steep rock-walled canyon	waterfall	bushy-tailed woodrat, cottontail rabbit, bobcat, coyote, mule deer, rock wren, ledge-nesting raptors

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
****** ****									
27/46-16,11 Dry Hill Spring	dried up seep		bulrushes, bluegrass	rubber rabbitbrush, big sagebrush			hummock/ peat bog in center of seep	fence and trough in disrepair	black-tailed jackrabbit, coyote, horned lark, Brewer's sparrow, raven, chukar
27/46-28,11	large irrigated wet meadow along intermittent stream	burrows	sedge, bulrushes bunchgrass	none	cottonwood tree	cottonwood tree	close proximity to ranch buildings, equipment, and hay storage		pocket gopher, ground squirrel, mountain vole, coyote, savannah sparrow, red-winged and Brewer's blackbirds, killdeer, barn swallow, flycatcher spp., marsh hawk, red-tailed hawk

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
27/46-28,221	large wet meadow along stream	burrows	grass	big sagebrush			spring piped into stock trough	large rock outcrops to the south and north, fences	pocket gopher, ground squirrel, cottontail rabbit, woodrat, coyote, mule deer, Brewer's blackbird, killdeer, chukar, mourning dove

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
27/46-28,224	spring complex in large wet meadow along stream	burrows	bulrushes, grass	big sagebrush, rubber rabbitbrush			several seeps in meadow, spring in rocks farthest to west is warm	nearby rock outcrops, fences	ground squirrel, cottontail rabbit, montane vole, bushy-tailed woodrat, coyote, killdeer, spotted sandpiper, savannah sparrow, red-winged blackbird, meadowlark, raven, western wood pewee, robin, marsh hawk, chukar
****** ****									

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
27/47-33,44	seep and spring complex with small pond		sparse grass/forbs	black greasewood, rubber rabbitbrush	2 choke-cherry trees	2 choke-cherry trees	spring headbox, 2 troughs, small pond, road		black-tailed jackrabbit, coyote, horned lark, raven, Brewer's sparrow

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
27/47-35,32 Copper Cn. Spring	foothill spring feeding large wetland complex in stream channel	burrows dens	forbs, spike rush, cattails, wiregrass	rose, willow, big sagebrush	willow, scattered pinyon	willow, scattered pinyon	pipeline and dilapidated headbox, dam, road	old mine adit nearby (potential bat habitat)	ground squirrel, cottontail rabbit, black-tailed jackrabbit, mule deer, coyote, badger, rufous-sided towhee, yellow warbler, song sparrow, western flycatcher, robin, dark-eyed junco, Brewer's sparrow
****** ****									

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
27/48-16,31	foothill spring, steep riparian drainage		bunchgrass, wiregrass	rose, coyote willow, big sagebrush, mountain brush	willow, dogwood choke-cherry	willow, dogwood, choke-cherry	narrow dense riparian scrub drainage	rock outcrops above within 300 yards	ground squirrel, cottontail rabbit, bushy-tailed woodrat, mule deer, coyote, yellow warbler, song sparrow, lazuli bunting, chukar, ledge-nesting raptors
**********									
28/48-28,14	alkali flat pothole/ meadow	burrows	saltgrass	rubber rabbitbrush, black greasewood			spring piped to trough and concrete tank	barrel headbox in disrepair	black-tailed jackrabbit, coyote, horned lark, Brewer's sparrow, black-throated sparrow

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
28/48-28,342	alkali flat pothole/ meadow		saltgrass	rubber rabbitbrush, big sagebrush			boggy pothole spring	road nearby	black-tailed jackrabbit, coyote, horned lark, meadowlark, Brewer's sparrow
28/48-28,343	alkali flat pothole/ shallow pond/ meadow	burrows	saltgrass	rubber rabbitbrush, black greasewood				site dug out	black-tailed jackrabbit, coyote, killdeer, horned lark
28/48-28,43	alkali flat pothole/ shallow pond/ meadow		sedge/grass	rubber rabitbrush			nearly dry	old wooden fence-posts	black-tailed jackrabbit, coyote, horned lark, black-throated sparrow

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
28/48-32,24	alkali flat pothole		grass	black greasewood, rubber rabbitbrush	big sagebrush 7 ft. tall (near water)		adjacent to large saltgrass meadow	cow skeleton in drainage below spring	black-tailed jackrabbit, coyote, horned lark
28/48-32,32	alkali flat pothole	burrows dens	sedge, bulrushes, grass	black greasewood, rubber rabbitbrush, big sagebrush			very shallow standing water	cow skeleton in middle of pothole	black-tailed jackrabbit, coyote, spotted sandpiper, killdeer, western meadowlark, sage sparrow

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
28/48-32,33	alkali flat pothole/ pond/ drainage		grass/sedge	rubber rabbitbrush, black greasewood, big sagebrush			2 shallow excavated pools; spring near edge of large saltgrass meadow	3 cow carcasses along drainage; dilapidated stock tank and fence	black-tailed jackrabbit, coyote, spotted sandpiper, horned lark, meadowlark
28/48-32,34	alkali flat pothole		bulrushes	black greasewood			circular barren area surrounding small bull-rush clump		black-tailed jackrabbit, horned lark, raven
****** ****									

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
28/49-1,14	intermittent hillside drainage	burrows	grass, bulrushes, spikerush	rose, big sagebrush, black sagebrush				nearby rock outcrops at mouth of canyon	pocket gopher, ground squirrel, cottontail rabbit, mule deer, coyote, chukar, Brewer's sparrow, western meadowlark
28/49-1,23	intermittent foothill drainage	burrows	grass	rose, sagebrush					ground squirrel, cottontail rabbit, mule deer, coyote, northern flicker, dark-eyed junco, chukar, mourning dove, song sparrow, raven

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
28/49-10,12	hillside hot spring		mostly barren; some grass in overflow area	big sagebrush, black greasewood			intensive human use for bathing	spring excavated and piped to a bathing tub; small camp trailer and excavated pond below tub	ground squirrel, black-tailed jackrabbit

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
28/49-10,41	intermittent hillside drainage	burrows	grass/forb	willow, Wyoming big sagebrush			small rocky pool	many rock outcrops within 1/4 mi. up this drainage	ground squirrel, cottontail rabbit, mule deer, coyote, chukar, rock wren, scrub jay, dark-eyed junco, ledge-nesting raptors
28/49-16,24	intermittent hillside drainage seep	burrows	grass	rose, big sagebrush					ground sguirrel, mule deer, coyote, Brewer's sparrow, western meadowlark, raven, chukar
**********									

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsur-face	Surface	Midstory	Tree Bole	Tree Canopy			
29/48-1,1	hot spring on bench above alkali flat		grass, bullrushes	black greasewood			spring piped into swimming pool near residence	overflow wetland area across county road west of residence	black-tailed jackrabbit, ground squirrel, western meadowlark, raven, Brewer's blackbird
29/48-1,3	sidehill seep		bulrushes, grass	black greasewood, rubber rabbitbrush			adjacent to large wetland complex (29/48-11,22)		black-tailed jackrabbit, coyote, western meadowlark

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/48-11,22	expansive hot spring/ meadow complex on bench above alkali flat	burrows	bulrushes, spikerush, grass	black greasewood			very unique wetland community		black-tailed jackrabbit, mountain vole(?), coyote, killdeer, spotted sandpiper, California gull, red-winged blackbird, long-billed curlew, marsh hawk
29/48-11,2231	hot spring pothole above alkali flat		saltgrass	black greasewood			adjacent to large wetland complex (29/48-11,22)		black-tailed jackrabbit, coyote, killdeer

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/48-11,2233	moderately deep (3-4 ft.) bubbling hot spring pothole with small hillside hot spring above		saltgrass	black greasewood				next to well traveled public road	black-tailed jackrabbit, horned lark
29/48-11,23	bench spring above alkali flat		sedge, bulrushes, grass	black greasewood			spring fenced with trough below	much cooler water than nearby springs	black-tailed jackrabbit, ground squirrel, coyote, killdeer, horned lark, western meadowlark

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/48-11,24	hillside seep with pond		saltgrass	black greasewood			excavated pond (dry) below seep, fenced, dilapidated 60 ft. trough	old mine excavations nearby	black-tailed jackrabbit, horned lark, black-throated sparrow
29/48-11,433	alkali flat pothole	burrows	bulrushes, saltgrass	rubber rabbitbrush, black greasewood			small island in middle of pothole		pocket gopher, black-tailed jackrabbit, antelope, coyote, killdeer, cinnamon teal, mallard, mourning dove, horned lark, western meadowlark

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/48-11,434	alkali flat pothole	burrows	bulrushes, saltgrass	rubber rabbitbrush, black greasewood			small island in middle of pothole		pocket gopher, black-tailed jackrabbit, antelope, coyote, killdeer, cinnamon teal, blue-winged teal, gadwall, mallard, bufflehead, mourning dove, horned lark
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Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-12,411	4-spring complex at canyon mouth	burrows	sedge, forbs, grass	coyote willow, rose, big sagebrush/mtn. brush	yellow willow	yellow willow	recent excavation activity and trough	much horse sign	pocket gopher, cottontail rabbit, mule deer, coyote, chukar, mourning dove, horned lark, meadowlark, Brewer's sparrow, rufous-sided towhee, robin, mountain bluebird

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-12,423	hillside spring next to flowing creek		grass/forbs	rose, big sagebrush	yellow willow	yellow willow	spring flow augmented by water from springs above (not in study area)		cottontail rabbit, mule deer, coyote, mourning dove, meadowlark, Brewer's sparrow, sage thrasher, white-crowned sparrow, rufous-sided towhee, robin, mountain bluebird

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-16,43	hillside spring at top of alluvial fan	burrows dens	grass/sedge	rose, rubber rabbitbrush	service-berry	service-berry	steep cutbank (10 ft. high) above spring	old mine prospect above; rock outcrops within 300yds. above; within large recent wildfire	pocket gopher, ground squirrel, antelope, coyote, badger, mourning dove, horned lark, meadowlark, Brewer's sparrow, bank swallow, magpie, raven
29/50-20,23	diverted spring at top of alluvial fan		almost barren (scattered forbs)	big sagebrush	yellow willow	yellow willow (>20 ft)	spring area is dried up by recent piping to trough below	hydro-logically altered	ground squirrel, coyote, mourning dove, horned lark, raven

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-20,24	intermittent hillside drainage/ spring complex	burrows	grass/forbs	coyote willow, rose, rubber rabbitbrush	yellow willow, sapling aspen	yellow willow thicket, sapling aspen	at least 4 springs in this complex	slopes above are scarred from recent wildfire	ground squirrel, cottontail rabbit, mule deer, coyote, chukar, mourning dove, meadowlark, yellow warbler, Brewer's sparrow, sage thrasher, white-crowned sparrow, rufous-sided towhee, robin, mountain bluebird, raven, magpie, golden eagle

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-21,33	intermittent hillside drainage/spring complex	burrows	grass/forbs	rose, currant, big sagebrush/mtn. brush	yellow willow, aspen, chokecherry	yellow willow, aspen (up to 40 ft.), chokecherry	springs flowing from several locations	in same drainage above 29/50-20,23 and 29/50-20,24	ground squirrel, cottontail rabbit, mule deer, coyote, northern flicker, house wren mourning dove, yellow warbler, white-crowned sparrow, rufous-sided towhee, American goldfinch, lazuli bunting, robin, magpie, golden eagle

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-29,31	hillside spring next to flowing creek	burrows dens	forbs/grass	rose, elderberry, big sagebrush				large rock outcrops up drainage within 1/2 mi.; historical artifacts near spring	pocket gopher, ground squirrel, cottontail rabbit, mule deer, coyote, killdeer, chukar, mourning dove, meadowlark, Brewer's sparrow, dark-eyed junco, white-crowned sparrow, rufous-sided towhee, robin, magpie, golden eagle

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-29,34	spring at base of hill		sedge/grass	big sagebrush/mtn. brush			long stringer meadow below spring	dilapidated spring box, pipe, and trough; large rock outcrops within 1/4 mi. uphill	ground squirrel, cottontail rabbit, mule deer, coyote, killdeer, chukar, mourning dove, meadowlark, Brewer's sparrow, robin, magpie
29/50-31,311	hillside spring next to flowing creek	burrows	forbs	rose, big sagebrush	yellow willow	yellow willow		this spring is the initial flow into Duff Creek	ground squirrel, cottontail rabbit, mule deer, coyote, chukar, mourning dove, yellow warbler, meadowlark, robin

Table H-1. WILDLIFE OBSERVATIONS (Continued)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsur-face	Surface	Midstory	Tree Bole	Tree Canopy			
29/50-31,314	hillside spring		grass/forbs	rose, big sagebrush/mtn. brush			rock outcrops are adjacent to here		cottontail rabbit, mule deer, coyote, chukar, mourning dove, scrub jay, Brewer's sparrow, meadowlark, robin
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Table H-1. WILDLIFE OBSERVATIONS (Concluded)

SITE NO.	WATER REGIME	TERRESTRIAL HABITAT LAYERS					UNIQUE FEATURES	NOTES	WILDLIFE SPECIES OBSERVED OR EXPECTED
		Subsurface	Surface	Midstory	Tree Bole	Tree Canopy			
29/51-18,11	hillside spring complex adjacent to intermittent stream		grass/forbs	rose, big sagebrush	chokecherry, yellow willow	chokecherry, yellow willow	large rock outcrops very close to spring	creek has been recently filled with rock and water is being piped to troughs in the alkali flats below	bushy-tailed woodrat, cottontail rabbit, mule deer, coyote, chukar, mourning dove, Brewer's sparrow, meadowlark, rufous-sided towhee, white-crowned sparrow, robin, rock wren, ledge-nesting raptors

METHODS USED TO ESTIMATE NON-LOCAL WORKER DISTRIBUTION

The immigrating construction and operations worker could choose to live in one of several existing communities in the study area. The choice would depend on availability of housing, preferences for diverse and adequate public services, desire for ample shopping opportunities, commute distance between work and home, and a number of such factors.

Gravity models have been extensively used in social science research to predict patterns of human behavior especially to predict human settlement patterns. A gravity model predicts residential settlement based on relationship between positive aspects of more amenities (represented in the model by population size), and the negative aspects of longer commute distances. The larger the community in its population size, the more likely it is to offer diverse amenities. Therefore, other things being equal, more immigrating workers move into larger communities than into smaller ones. However, this simple relationship is distorted by the effect of commute distances. Smaller communities nearer to the workplace attract more workers than suggested by their size because immigrants are willing to trade some amenities to reduce their commute distance. The model is of the form:

$$P_i = \frac{\dfrac{Pop_i}{Distance_i^{\,b}}}{\displaystyle\sum_{n}^{i=o} \frac{Pop}{Distance^{\,b}}}$$

where P_i = percent of population expected to migrate into community i
Pop_i = Population of community i
$Distance_i$ = Distance of worksite from community i
b = Distance elasticity.

Studies conducted by the BLM of energy-related construction and operations workers in North Dakota, South Dakota, Wyoming, and Montana reveal that distance elasticities of 1.44

for construction workers and 1.47 for operation workers better reflect the effect of distance on settlement patterns.

Using these distance elasticities, 1990 population of the study area communities and road distances between project site and the communities, percentage of population expected to migrate into each community was estimated. Table I-1 reports the results. Percentages do not differ significantly with the small difference in distance elasticities used. The table also reports the current distribution of Cortez employees in the study area. Analysis in Section 4-9 is based on all three patterns.

TABLE I-1

POTENTIAL RESIDENTIAL SETTLEMENT PATTERNS

Community	GM1	GM2	Current Residence Pattern
Elko	55.35	55.80	42
Carlin	13.16	13.13	18
Battle Mountain	16.42	16.47	8
Crescent Valley	9.00	8.64	29
Beowawe	6.07	6.96	2
	100%	100	100

GM1 - based on distance elasticity of 1.47; used for operations workforce
GM2 - based on distance elasticity of 1.44; used for construction employees

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

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Shoshone-Eureka Resource Area
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P.O. Box 1420
Battle Mountain, NV 89820

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