Jerritt Canyon Mine Expansion
Draft Environmental Impact Statement

United States Department of Agriculture
Humboldt National Forest
Elko County, Nevada

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Photo Description: West side of Independence Range as seen from Highway 226 (Fall 1992).

JERRITT CANYON MINE EXPANSION PROJECT
Elko County, Nevada

Draft Environmental Impact Statement

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Humboldt National Forest

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Abstract:
This Draft Environmental Impact Statement (DEIS) is written in response to a proposed Plan of Operations submitted by Independence Mining Company Inc. (IMC) to expand its existing gold mining operations at the Jerritt Canyon Mine on the Humboldt National Forest in Elko County, Nevada. The proposal includes construction of four open pit mines and associated waste rock dumps, soil stockpiles, ore stockpiles, haul roads and support facilities. The proposal would disturb approximately 3,000 acres of land of which about 400 acres have been disturbed by previous and on-going mining activities. Seven alternatives, including the No Action alternative and the proposed Project, are presented and analyzed for their effects on environmental resources in this DEIS. The alternatives have been developed in response to environmental resource issues and concerns identified through the public scoping process and interagency meetings.

The U.S. Forest Service's preferred alternative is Alternative C.

Comment Deadline:
Comments on this Draft EIS must be received by January 18, 1994.

Reviewers should provide the Forest Service with their comments during the review period of the draft environmental impact statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decision making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewers' position and contentions. *Vermont Yankee Nuclear Power Corp. v NRDC*, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. *City of Angoon v. Hodel* (9th Circuit, 1986) and *Wisconsin Heritages, Inc. v. Harris*, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Summary

Introduction

Independence Mining Company Inc. (IMC) has submitted a proposed Plan of Operations (POO) to the U.S. Department of Agriculture-Forest Service (USFS) to expand its existing gold mining operation at the Jerritt Canyon Mine in Elko County, Nevada. The proposed project would consist of four mine pits, associated waste rock dumps, haul roads, ore stockpiles, mine facilities, soil stockpiles, and drainage and sediment control structures. The proposed mining operation would be situated on private lands and National Forest System lands administered by the Mountain City Ranger District of the Humboldt National Forest. IMC has the statutory right, under the 1872 Mining Law as amended, to enter National Forest System lands for the purpose of conducting mineral exploration and mining activities, subject to the USFS approval of the POO and meeting the provisions of the National Environmental Policy Act (NEPA).

The USFS has determined that implementation of the POO would be a major federal action requiring preparation of an Environmental Impact Statement (EIS). The Draft EIS (DEIS) describes components of reasonable alternatives to and environmental consequences of implementing the Project.

This summary briefly reviews the content of the DEIS as follows:

Chapter 1: Purpose of and Need for Action. This chapter describes the need for the proposed project and the decisions to be made. The project background, the environmental analysis process, public participation, the major issues and concerns raised during public and agency scoping, and the federal, state, and local permits required for the Project are also discussed.

Chapter 2: Alternatives Including the Proposed Action. This chapter describes the process by which alternatives were developed, describes IMC's proposed action and the other alternatives considered. It identifies existing operations, the management, mitigation and monitoring measures and compares alternatives on the basis of their environmental effects.

Chapter 3: Affected Environment. This chapter describes the physical and biological environmental resources and socioeconomic conditions that would be affected by the action alternatives.

Chapter 4: Environmental Consequences. This chapter analyzes and describes the potential environmental consequences of all alternatives.

1.0 Purpose of and Need for Action

Implementation of the mining activities described in the POO submitted by IMC is necessary for the continued and uninterrupted supply of gold bearing ore in an economically feasible manner to IMC's milling operations. The proposed Saval, Steer, New Deep and Burns Basin mining expansion areas would replace gold ore reserves that have been exhausted over the past twelve years at the existing Jerritt Canyon mining operations. This expansion would enable IMC to maintain current operations. Without implementation of the proposed project, IMC anticipates production and employment at IMC's mining and mineral processing operations would begin to decline in 1994 and totally cease sometime during 1996, based on current mine economics.

Implementation of the project would require a decision by the USFS and acquisition of applicable permits and authorizations from other agencies. The Humboldt National Forest Supervisor's decision to be made is to either approve the mine expansion activities as proposed by IMC or to approve an alternative course of action. A final POO would be developed to conform to the Forest Supervisor's selected action alternative. In addition to the Supervisor's decision and approval of the final POO, implementation of the project would require authorizing actions from other federal, state or local agencies including the US Army Corps of Engineers (Corps), US Department of Interior-Bureau of Land Management (BLM), the Nevada Divisions of Environmental Protection (NDEP), Water Resources, Health, and Historic Preservation, and the Elko County Department of Public Works.

The existing and proposed mining operations are located within the Independence Mountain Range approximately 50 miles northwest of Elko, Nevada. Mining operations began at the Jerritt Canyon Project after completion of the 1980 Jerritt Canyon Gold Mine and Mill FEIS and approval of the POO by the USFS and BLM. The proposed Saval and Steer mine areas were identified in the 1980 FEIS as areas with future mining potential. The New Deep mine area is essentially the extension of the West Generator pit, which was completed in 1993. The Burns Basin mine development began in 1988 and continues at present. The proposed project would provide for continued mine operations through 2005. The Project is expected to result in the creation of between 150 and 200 new job opportunities at IMC during mining.

During the scoping process, federal and state agencies, private individuals and organizations, and IMC identified issues and concerns regarding the proposed project and the alternatives to the proposed project. Public meetings were conducted in Elko, Reno, Mountain City and Tuscarora to assist in identifying public issues and agency concerns related to the project. Public and agency scoping identified the issues and concerns as listed in Table 1.2. These issues were narrowed to four focus issues to guide the development of alternatives: 1) water quality - potential for acid rock drainage, 2) waste rock dump design for stability, 3) reclamation potential - revegetation, and 4) mine economics - economic viability.

2.0 Alternatives Including the Proposed Action

The formulation of alternatives was a multiple-step process guided by the focus issues and post-mining land use objectives. Post-mining land use objectives established for the mine expansion by the USFS include providing for livestock grazing, wildlife habitat, recreational opportunities, public access, visual quality consistent with established classifications, and a stable post-mining watershed. Several alternatives were eliminated from detailed study because they did not respond to the focus issues, had significant environmental disadvantages, or were technically or economically infeasible. The Forest Supervisor approved the development of detailed analysis of seven alternatives, including the No Action alternative.

Alternative A - No Action

Under the No Action Alternative, the USFS would not authorize the proposed action or any action alternative. Currently approved operations would continue until completion. The No Action Alternative is required by NEPA and serves as a baseline for evaluation of the action alternatives.

Existing mining and milling operations are divided into two separate geographic components, one for mining and one for processing. Mining occurs on approximately 3,137 acres of private and USFS-administered land in the Independence Mountains, primarily on the west side of the range. Gold ore is currently mined from five pits utilizing conventional open pit mining methods. Waste is hauled to various disposal sites, including waste rock dumps and partial pit backfill areas. Ore is hauled to the processing facilities, located on approximately 1,400 acres of BLM-managed land on the eastern flanks of the Independence Mountains.

Existing operations at the Jerritt Canyon Project are estimated to continue at current levels until 1994, at which point operations would begin to decline and completely shut down sometime before or during 1996. Employment, estimated at 600 persons in 1993, would decline accordingly.

Alternative B: Proposed Action

The Proposed action for the Jerritt Canyon Mine Expansion is the development, operation and reclamation of the Saval, Steer, and New Deep mine areas and expansion of the existing Burns Basin mine area. Proposed operations are expected to result in production of gold from 20 million tons of ore. Ore would be processed at the existing mill and the milling waste would be deposited in the existing and approved tailings ponds. This alternative would result in about 2,966 acres of disturbance, which includes about 407 acres of existing disturbance.

Conventional open pit mining methods would be the primary means of developing the pits. Total area associated with pit development would be about 1,330 acres of which 308 acres have been previously disturbed. Underground mining methods may be utilized within the pits during or after open pit mining to increase ore recovery. Active dewatering of the pits is not anticipated because the Saval, Steer and Burns Basin pits are located above the regional groundwater table and estimated pit inflow rates for New Deep are low. If active dewatering were necessary, the water would be utilized in mine operations or discharged to the surface or re-injected underground.

Approximately 1,084 million tons of waste rock would be deposited in waste rock dumps or in partial pit backfill areas. The majority of the waste rock dumps would be built as complete or partial valley-fills with angle of repose slopes in portions of the Jerritt Creek, Saval Canyon, Steer Canyon, and Burns Basin drainages. Approximately 1,308 acres of disturbance are associated with construction of the waste rock dumps. Under-dump drainage systems would convey surface water through the base of the dumps. The under-dump drainage system would consist of large rocks placed by gravity sorting of materials during dumping.

The haul road network required to develop the proposed Project would disturb about 184 acres. No changes to alignment or dimensions are anticipated for the haul roads outside of the Project area. Haul roads would range in width and would be constructed using a combination of cut and fill methods. The haul roads would be constructed and maintained to ensure adequate drainage and minimize damage to soil, water and other resources. Mine roads would be closed and reclaimed after mining unless authorized by the USFS to be left open.

Growth medium would be salvaged from portions of the pit area and stockpiled at various locations or redistributed directly. Approximately 119 acres would be covered by growth medium stockpiles. Low grade ore stockpiles would disturb an estimated 12 acres. New mine facilities would be constructed to support the New Deep mining operations. Sediment control structures would be constructed to trap sediment and control runoff, and are expected to disturb approximately 11 acres. Sediment ponds and traps would be removed after mining unless they are retained as post-mining water sources.

Alternative C

Alternative C was developed in response to concerns about waste rock dump stability, revegetation potential, visual quality, integrity of stream inflow and outflow under dumps, water diversion in Burns Creek, and partial pit backfilling. This alternative would result in about 3,099 acres of disturbance, of which approximately 437 acres have been previously disturbed.

Stability would be enhanced by adding terraces to waste rock dumps in specific locations and constructing and reclaiming some waste rock dump faces to ratios of 3H:1V (three feet horizontal to one foot vertical) and 2H:1V compared to the steeper angle of repose slopes proposed in Alternative B. The upstream side of the South Deep dump would be constructed as a single level approximately 130 feet high to promote gravity sorting of waste rock and reduce potential for material compaction above the stream inflow point. Potential partial pit backfill locations are in the West Generator, Saval, and Burns Basin pits.

Alternative D

Alternative D was developed in response to the dump stability and reclamation potential focus issues. Under this alternative, all dump slope faces would be constructed and reclaimed to 3H:1V slopes, with the exception of three angle of repose dump slopes immediately southeast of the New Deep pit. This alternative would result in about 3,142 acres of disturbance, including 398 acres of previously disturbed area. Developing 3H:1V slopes would require constructing the dumps in multiple levels with angle of repose slopes, which would require additional haul roads to access the lower portion of the dumps. During reclamation, the angle of repose slopes would be reshaped to overall dump slopes of 3H:1V. The South Deep dump would be expanded farther downstream and in a different configuration from Alternative B, which would result in an undisturbed area southwest of the New Deep pit and new disturbance in a drainage to the west of Saval and Steer canyons.

Alternative E

Alternative E was developed to address the concerns about dump stability, reclamation potential and water quality as it relates to the under-dump drainage system. This alternative would result in about 2,952 acres of disturbance, of which approximately 395 acres have been previously disturbed. Alternative E is identical to Alternative D, except the upstream and downstream faces of the waste rock dumps would be developed at angle of repose to facilitate water flow into and out of the dump. The upstream side of the South Deep dump would be constructed as a single level approximately 130 feet high similar to Alternative C to promote water flow through the dump.

Alternative F

This alternative was developed to address the potential to mine the New Deep deposit by underground mining methods. Surface disturbance for the Saval, Steer, and Burns Basin operations would be similar to that displayed in Alternative C, except that the dumps south of the Saval and Steer pits would have angle of repose slopes. Alternative F would result in about 2,041 acres of disturbance, which includes approximately 264 acres that have been previously disturbed. Surface disturbance associated with the underground mining of the New Deep pit would include up to three portals, five ventilation shafts, haul roads, facilities, and two small waste rock dumps. Some surface subsidence may occur as a result of underground mining.

Alternative G

This alternative was developed to display the combined effects of developing the New Deep orebody with both underground mining and surface mining techniques. Development of the Saval and Steer mine area and expansion of the Burns Basin pit would be the same as in Alternative B. Alternative G would result in the disturbance of about 3,013 acres including approximately 408 acres of previously disturbed areas. Throughout the analysis, Alternative G impacts are assumed to be the total of the combined surface disturbances of

Alternatives B and F, although it is unlikely that actual surface disturbance would be the total of both alternatives.

Management, Mitigation and Monitoring

Management constraints are the laws, regulatory requirements, Humboldt National Forest Land and Resource Management Plan (LRMP) standards, and guidelines which are in place that ensure that resource development takes place in an environmentally sound manner. Federal, state, and local government agencies administer the laws, regulatory programs, and guidelines for the protection of the environment. Permits and approvals are required for the implementation of the proposed project or any of the action alternatives. These permits are the means by which the appropriate regulatory agencies implement the laws, regulations and guidelines for which they are responsible. The proposed Project and the action alternatives have been designed and developed within the management constraints of these permits and approvals.

Mitigation measures and monitoring programs are a part of each action alternative. Mitigation measures are designed to offset or reduce adverse environmental impacts that cannot be avoided. Monitoring programs are designed to ensure that environmental safeguards are executed according to plan, necessary adjustments are made to achieve desired effects, and anticipated results are reviewed.

Comparison of Alternatives

This section of the DEIS briefly summarizes and compares the environmental effects of the seven alternatives and includes a matrix chart of environmental effects by issues identified through public and agency scoping.

Effects to the physical, biological and socioeconomic environments would be incurred among all alternatives. One of the purposes of this DEIS is to display the differences in environmental effects among the alternatives. A summary of the effects of the alternatives in relation to identified issues is presented in Chapter 2. Additional discussion of the effects associated with the alternatives are included in Chapter 4. Qualitative analysis is provided where differences are not easily defined by quantitative measurement.

The fundamental differences among the alternatives are the use of 3H:1V waste rock dump slopes and underground mining of the New Deep ore body. Alternatives that include final reclamation to 3H:1V waste rock dump slopes were proposed with the intent of providing greater slope stability and greater revegetation potential. Underground mining of New Deep was proposed in two of the alternatives because it is a reasonably foreseeable future activity that warranted consideration and analysis. As indicated in Chapter 2 and discussed in the analysis in Chapter 4, use of underground mining methods in Alternative F would provide environmental benefits in relation to the other alternatives because there would be less disturbance associated with New Deep mining operations. However, costs of underground mining are greater, and results in less than full utilization of the mineral resource.

Environmental benefits of 3H:1V slopes are less easily quantified. The potential for revegetation is greater on 3H:1V slopes than on angle of repose slopes, and mass stability is greater. Additional benefits may be realized by other resources such as wildlife and vegetation. However, there is greater surface disturbance associated with construction and reclamation of waste rock dumps to 3H:1V slopes and costs are higher. All slopes under any alternative would meet minimum safety requirements.

Preferred Alternative

The USFS's preferred alternative is Alternative C.

3.0 Affected Environment

This section provides a summary of the physical, biological, social and economic environments that would affect or may be affected by implementation of any of the alternatives for the Jerritt Canyon Mine Expansion. Existing conditions provide a baseline for the analysis of potential impacts that are examined in Chapter 4. The Project area (shown on Map 1.2) has been extensively studied since initiation of baseline surveys for the Jerritt Canyon Project Gold Mine and Mill EIS in 1978. This information base was updated by field studies, literature surveys and personal interviews conducted by an interdisciplinary group of resource specialists. Detailed information was collected within the Project area and additional updated information was collected in the general study area (shown on Map 1.2), a 44,000 acre area surrounding the Project area.

The condition of many of the existing resources are described in the DEIS according to criteria outlined in the *Independence Range Cumulative Effects Analysis (CEA) Draft Technical Guide*. The CEA model was developed by the USFS, NDOW, and several mining companies to provide a standardized approach for analyzing direct and cumulative impacts in the Independence Mountain Range. The CEA Draft Technical Guide describes the procedures, analytical models, and data bases to be used in evaluating the cumulative effects of mining proposals in combination with the effects of past and foreseeable future development. The CEA model defines the geographic area of analysis, or analysis "province," for a variety of resources. The CEA model also identifies the criteria used to measure impacts for each resource and identifies "thresholds of concern" (TOCs) to determine the significance of impacts. In the DEIS, existing resources are described in relation to TOCs and other CEA criteria in order to provide a basis of comparison for the potential impacts described in Chapter 4.

4.0 Environmental Consequences

This chapter analyzes and describes the potential environmental consequences of the action alternatives relative to the No Action alternative, and provides the basis for comparison of the alternatives presented in Chapter 2. The discussion is focused on significant issues and concerns raised during scoping regarding the environmental resources and conditions.

Location and Topography

Changes in the steep, mountainous topography of the Independence Mountains would occur under all alternatives. Permanent or long-term changes are primarily associated with mine pits, waste rock dumps and haul roads. For all action alternatives, the Saval and Steer pits could be as much as 711 acres in size and 820 feet deep, and the Burns Basin expansion could be up to 94 acres in size and 340 feet deep. The New Deep pit would be up to 527 acres in size and 1,180 feet deep under all alternatives except F. Waste rock dumps under any alternative would result in a greater area of relatively flat terrain than exists under natural topographic conditions. The area of disturbance for waste rock dumps ranges from 730 acres under Alternative F to 1,414 acres under Alternative D.

Mineral Resources

Effects to the mineral resource from all action alternatives except Alternative F would result in the excavation and relocation of approximately 1,084 million tons of waste rock and 20 million tons of ore. Under Alternative F, some of the mineral resources in the New Deep area would remain in the ground after mining as low grade ore that cannot be economically recovered. The configuration of the Alternative D waste rock dumps would make it difficult or impossible to access identified mineral resources west of the New Deep pit in the future.

Geochemistry

Waste rock dumps in the Saval, Steer and Burns Basin mine areas have low potential to generate acid. Potential for acid rock drainage is low to moderate in the New Deep area based on the initial static testing. Additional testing, including kinetic testing, is being conducted on waste rock samples to determine the potential for waste rock to generate acid. Results of static and kinetic testing would be used to develop a waste rock evaluation program that would guide additional sampling, handling and placement of materials that are determined to be acid-forming. Surface water monitoring would continue at the existing stations that are located downgradient of the proposed waste rock dumps and monitoring results and a discussion of trends in water chemistry would continue to be submitted to the USFS each year.

Geotechnical Considerations

The waste rock dumps under all action alternatives would be designed and constructed with safety factors acceptable to the USFS. Potential effects of seismic events, foundation hazards, waste rock characteristics, and final slope steepness are the major geotechnical considerations affecting dump stability. Waste rock dumps with slopes of 3H:1V would typically have higher factors of safety than those with angle of repose slopes.

Soils

A loss of soil productivity would occur under all of the action alternatives. Soil productivity losses would be the greatest for Alternative G and the least for Alternative D.

An adequate amount of soil exists within accessible portions of the pits for use as growth medium under each of the action alternatives. Growth medium would be redistributed to a depth of approximately eight inches on relatively flat dump tops, partial pit backfill surfaces, 3H:1V slopes, facility sites and the tops of low grade ore stockpiles abandoned at mine closure. Reclamation areas where growth medium is not redistributed represent a loss of soil productivity.

The reclamation potential focus issue is closely related to soils, since the application of growth medium to disturbed areas enhances revegetation success. The steepness of the final dump slopes is also directly related to revegetation capabilities and was called reclamation potential for the purposes of this analysis. Alternative G would have the lowest and Alternative D would have the highest reclamation potential.

Climatology and Air Quality

Effects to the baseline air quality would be limited primarily to particulates from mining, crushing and construction activities under all action alternatives. Previous air monitoring at the Jerritt Canyon project indicates that there would be negligible impacts to air quality from particulate emissions. The mitigation measures to be implemented would ensure that emissions would be within acceptable limits as determined by NDEP.

Surface Water Resources

Water quantity is expected to decrease as a result of the proposed mining operations, but the timing of water flow would be regulated to a certain degree by the waste rock dumps. Under the action alternatives, implementation would likely result in decreased water flow in Jerritt Creek and Burns Creek compared to pre-mining conditions because precipitation and runoff would be captured by the pits. Most of the precipitation and runoff intercepted by the pits would recharge the local groundwater system.

The action alternatives may result in a short-term increase in sediment yield as a result of surface disturbance during pit development, haul road and waste rock dump construction. This would be mitigated by construction of sediment control structures. With the exception of Alternative A, all the alternatives would result in less sediment yield after final reclamation than the pre-mining condition, based on computer modeling. This is primarily due to the development of pits which serve as sediment traps.

All of the action alternatives would result in new and/or additional changes to stream channel characteristics in Jerritt Creek and Burns Creek as waste rock dumps are created. Underdump drainage systems that would form in the drainage bottoms would convey surface water through the lower part of the dumps. The underdump drainage system in the South Deep dump, the largest dump created, would be capable of passing the 100-year, 24-hour precipitation event and the predicted sediment load in Jerritt Creek without clogging.

Groundwater Resources

The final elevation of the proposed New Deep pit bottom would be approximately 140 feet below the estimated regional groundwater elevation. Preliminary estimates of potential groundwater inflow rates range from 100 to 300 gallons per minute, and active dewatering of the pit would not be required. If water collects in the pit during mining it would either evaporate, infiltrate into the fractured rock in the bottom of the pit or be collected and used in the mining operations. If dewatering was required, the water would be used by the mining operations, discharged to the surface, or re-injected into the groundwater system. After mining, groundwater may flow into the New Deep pit and may reach a maximum depth of 140 feet with a surface area as large as 19 acres. Under Alternatives F and G, sustained groundwater inflows into the New Deep underground workings are estimated to be 100 to 150 gpm and would be directed to sumps. Active dewatering of the underground workings is not anticipated. Water would collect in the workings after mining but would not flow out of the portals to surface waters.

As many as five springs and two seeps would be covered by waste rock dump construction or be affected by pit excavation. A short term reduction in spring flow could potentially occur at Niagara Spring. If a reduction of flow occurs that impairs the use of Niagara Spring and is attributable to mining, appropriate mitigation measures would be implemented. No reduction in flow from Van Norman Spring is expected to occur as a result of mining the New Deep pit.

Wetlands

Wetlands would be affected under all of the action alternatives. The mine components were designed and planned to avoid and minimize disturbance to wetlands to the extent practicable. The area of impacted wetlands would range from 2.89 acres under Alternative F to 3.82 acres under Alternative D. A mitigation and monitoring plan for impacted wetlands would be developed in coordination with resource agencies and a final plan would be approved by the Army Corps of Engineers (Corps). Off-site wetlands mitigation has been proposed by IMC for any action alternative selected.

Aquatic Resources and Fisheries

Surface water impacts that would directly affect aquatic and fisheries resources include decreases in water quantity, timing of flow, and effects to water quality due to changes in sediment yields and the potential for acid generation. After reclamation and revegetation, reduced sediment yields and longer duration of flows may occur.

Vegetation

No threatened, endangered, or sensitive plant species have been identified in the Project area and no effects to such plant species are anticipated as a result of any action alternative.

During the life of the Project, there would be a modification in plant species composition, age classes, heights and canopy densities within disturbed areas. Once reclamation activities are completed and vegetation becomes re-established, new community types consisting of a mixture of native and introduced grasses, forbs and shrubs would be created. Over time, first generation plantings of aspen and shrubs would mature and reproduce. Plant species from adjacent undisturbed areas would also colonize disturbed areas, resulting in diversity similar to that of undisturbed areas. Alternative F would have the least impact (1,777 acres) to existing vegetation resources and Alternative D would have the greatest impact (2,744 acres) to existing vegetation resources.

Most of the aspen communities that would be disturbed under any action alternative are located in the Saval and Steer mine areas and all action alternatives have very similar disturbances in this area. Therefore, the amount of aspen disturbed does not vary substantively between action alternatives, and ranges from 614 acres under Alternative F to 640 acres under Alternative C.

Wildlife

A direct short-term loss of wildlife habitat would occur upon implementation of any of the action alternatives. Direct disturbance to wildlife habitat from the action alternatives ranges from a low of 1,777 acres under Alternative F to 2,744 acres under Alternative D. Indirect impacts to wildlife in the form of temporary displacement would also result from project implementation. In the long-term, successful revegetation would result in habitat diversity similar to adjacent undisturbed areas.

Threatened, Endangered, Candidate and Sensitive Species. Bald eagles may occasionally migrate through the Project annually. Peregrine falcons rarely pass through the area. Impacts to these two endangered species would be negligible. There would be no additional impact to the only threatened species in the vicinity, the Lahontan cutthroat trout. Decreased flows and short term increases in sedimentation could have some adverse impacts for potential red band trout habitat in Burns Creek, a candidate species. No other candidate species are anticipated to be significantly effected. There may be a long term loss of potential habitat for the flammulated owl, a USFS-designated sensitive species.

Management Indicator Species. Three historic goshawk nests would be removed by proposed disturbance under all action alternatives. Proposed operations would exceed TOCs for mule deer winter range, and summer range and fawning habitat in the Jerritt Canyon watershed but not in the Burns Creek watershed. All action alternatives would exceed TOCs for sage grouse brooding habitat.

Land Use

Under all action alternatives, land use within the Project area would shift to predominately mining during the operations phase of the Project. Post-mining land uses for all alternatives would generally reflect pre-mining uses, although changes in topography would prohibit an exact duplication of pre-mining conditions.

Livestock Grazing

All action alternatives would affect some forage areas in the Schmitt Creek and Jerritt Canyon cattle and horse grazing allotments. There would be a fifty percent reduction in Animal Unit Months (AUMs) in the Jerritt Canyon allotment during the life of the mine, but there would be no loss of AUMs in Schmitt Creek. Long term cumulative effects would not exceed TOCs for the Jerritt Creek or Schmitt Creek allotments. IMC would maintain about 23 miles of allotment boundary and pasture fences surrounding the existing mining operations.

Recreation

Effects to recreational opportunities would occur under all of the action alternatives. The existing closure areas would be expanded to the west along Jerritt Creek about 1.5 miles for public safety purposes. Hunting access would be restricted in this area, but would remain open outside of the closure area. There would be no direct impacts to recreational fishing.

Public Access

Relocating the road closures along the Jerritt Creek Road (#875) and Arana Road to the west would result in additional areas that are totally closed for public safety reasons. The majority of the expansion area is not readily accessible under existing conditions due to the limited number of access routes and the steepness of the terrain. The existing closure area is about 7,347 acres in size.

After mining and reclamation, the closure area would be re-opened with some access restrictions for safety. Some of the mine roads would be left open once the final closure operations are completed.

Socioeconomics

Under Alternative A, the existing mining operations would begin to decline in 1994 and cease sometime before or during 1996. Socioeconomic impacts would include resultant losses in the community in terms of jobs, revenues and real estate values.

The rapid growth rates of the 1980s have subsided with annual increases in Elko County population projected at 3.8 percent in 1993-94, then slowing to less than two percent per year through 1998. Elko County population would probably increase as a result of implementation of the proposed action. It is estimated that 43 percent of the 155 (under Alterative F) to 270 (under Alternative G) new employees required for the project would be hired locally. An additional 109 to 190 jobs would be created in support and service businesses. Sustained employment at the Jerritt Canyon Mine along with new job opportunities would contribute to community stability.

Local government financial resources are especially sensitive to the volume of local economic activity and continued revenues from sales and use taxes, property taxes and net proceeds of mine taxes. Adverse effects to local government financial resources would be greatest under Alternative D and least under Alternative B. Many capital improvement projects which have been undertaken to expand local infrastructure, such as the ten-year pay-as-you go school building program, are dependent on continued payment of these taxes. Existing crowded conditions in some public schools in Elko may continue until new facilities are constructed.

The rental housing market would probably continue to be tight, particularly in Elko over the next several years, regardless of the proposed expansion. Existing and new single-family dwellings and mobile homes are expected to meet most of the anticipated additional housing needs associated with this project. Real estate values would likely continue to reflect local supply and demand.

Visual Resources

Changes to the visual resource would occur as changes to topography and vegetative cover. Implementation of any action alternative would not result in any change to the visual quality objectives (VQOs) established by the USFS for the area. Under Alternative A, there would be no new impacts to visual resources other than those already approved for existing operations. Changes to visual quality would be similar for all action alternatives except F. Portions of the disturbance would be seen from the Independence Valley, but due to the viewing distances, differences among the alternatives would not be substantial. Once public access is reopened, more of the disturbance would be visible from within the Project area and those alternatives with a greater disturbance would result in a greater area of impact to the pre-mining visual resource.

Cultural Resources

Under Alternative A, any impacts to cultural resources would be those that have already been identified and approved for existing operations. In order to avoid damage to unidentified sites, IMC contributes funds for the Humboldt National Forest to inventory and evaluate areas before they are developed. There are no sites identified as significant or unevaluated that would fall within the proposed disturbance or within a 300 foot buffer around the proposed disturbance. Initial consultations with descendants of the Tosawihi, the native people who historically used the area, indicate there would be no direct or indirect impacts on Native American traditional sacred areas under any action alternative.

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Photo Description: View of west side of the Independence Mountains from Highway 226 (Fall 1992).

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List of Abbreviations

ABA . . . . Acid-Base Accounting
AC . . . . Additional Costs
AP . . . . Acidification Potential
AUM . . . . Animal Unit Months
BLM . . . . United States Bureau of Land Management
CEA . . . . Cumulative Effect Analysis
CFS . . . . Cubic Feet Per Second
Corps . . . . United States Army Corps of Engineers
DEIS . . . . Draft Environmental Impact Statement
EA . . . . Environmental Assessment
EIS . . . . Environmental Impact Statement
EPA . . . . United States Environmental Protection Agency
FEIS . . . . Final Environmental Impact Statement
FOS . . . . Factor of Safety
FPS . . . . Feet Per Second
GIS . . . . Geographical Information System
GPM . . . . Gallons Per Minute
IDT . . . . Inter-disciplinary Team
IMC . . . . Independence Mining Company Inc.
IME . . . . IME Wetlands Consultants
LRMP . . . . Land and Resource Management Plan
MCE . . . . Maximum Credible Earthquake
MSA . . . . Mine Services and Administration Site (IMC)
MWMP . . . . Meteoric Water Mobility Procedure
NDEP . . . . Nevada Division of Environmental Protection
NDOM . . . . Nevada Division of Minerals
NDOW . . . . Nevada Division of Wildlife
NENDA . . . . North East Nevada Development Authority
NEPA . . . . National Environmental Policy Act
NNNPS . . . . Northern Nevada Native Plant Society
NSPS . . . . New Source Performance Standards
NP . . . . Neutralization Potential
PFA . . . . Post Fledgling Area (for goshawks)
POO . . . . Plan of Operations
QA/QC . . . . Quality Assurance/Quality Control
ROD . . . . Record of Decision
SCS . . . . United States Soil Conservation Service
SPCCP . . . . Spill Prevention Control and Countermeasure Plan
TDS . . . . Total dissolved solids

TOC	Threshold of Concern
TSS	Total suspended solids
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VQO	Visual Quality Objective

Chapter 1

Purpose of and Need for Action

Photo Description: Overall view of existing operations in Jerritt Canyon (Summer 1993).

CHAPTER 1

PURPOSE OF AND NEED FOR ACTION

1.0 PURPOSE OF AND NEED FOR ACTION

1.1 Introduction

In January 1993, Independence Mining Company Inc. (IMC) submitted to the US Department of Agriculture-Forest Service (USFS), Humboldt National Forest a proposed Plan of Operations (POO) to expand its existing gold mining operation at the Jerritt Canyon Mine in Elko County, Nevada (Map 1.1 and Map 1.2). The proposed mining operation area (Project area) is situated on private lands and on public lands administered by the Mountain City Ranger District of the Humboldt National Forest (Map 1.3). The project would involve disturbance of approximately 2,966 acres of land including four mine pits, associated waste rock dumps, a haul road system, ore stockpiles, mine facilities, soil stockpiles and drainage and sediment control structures. Other activities may include development and condemnation drilling within and next to the mine areas and underground mining to maximize gold ore recovery.

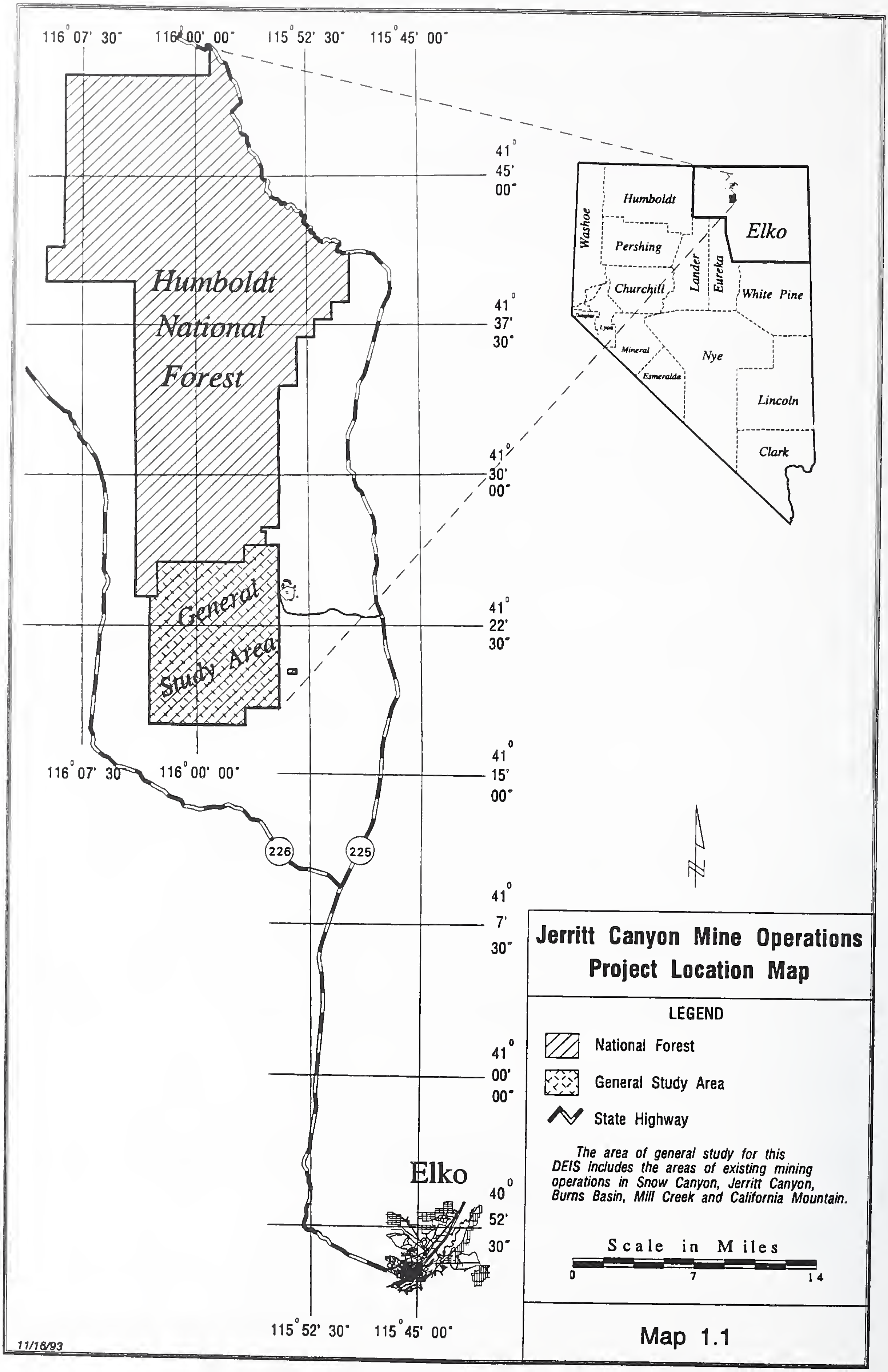
The Humboldt National Forest is the lead agency responsible for the preparation of the Environmental Impact Statement (EIS). The Forest Supervisor is the responsible official for the project and is directly responsible for conducting the environmental analysis, preparing the EIS, and making and implementing a decision on the proposed action.

1.2 Purpose and Need

Implementation of the mining activities described in the POO submitted by IMC is necessary for the continued and uninterrupted supply of gold bearing ore in an economically feasible manner to their milling operations. The proposed Saval, Steer, New Deep, and Burns Basin mining expansion areas would replace gold ore reserves that have been exhausted over the past twelve years at the existing Jerritt Canyon mining operations. This expansion would enable IMC to maintain current operations. Without implementation of the proposed project, IMC anticipates production and employment at IMC's mining and mineral processing operations would begin to decline in 1994 and cease sometime during 1996, based on current mine economics.

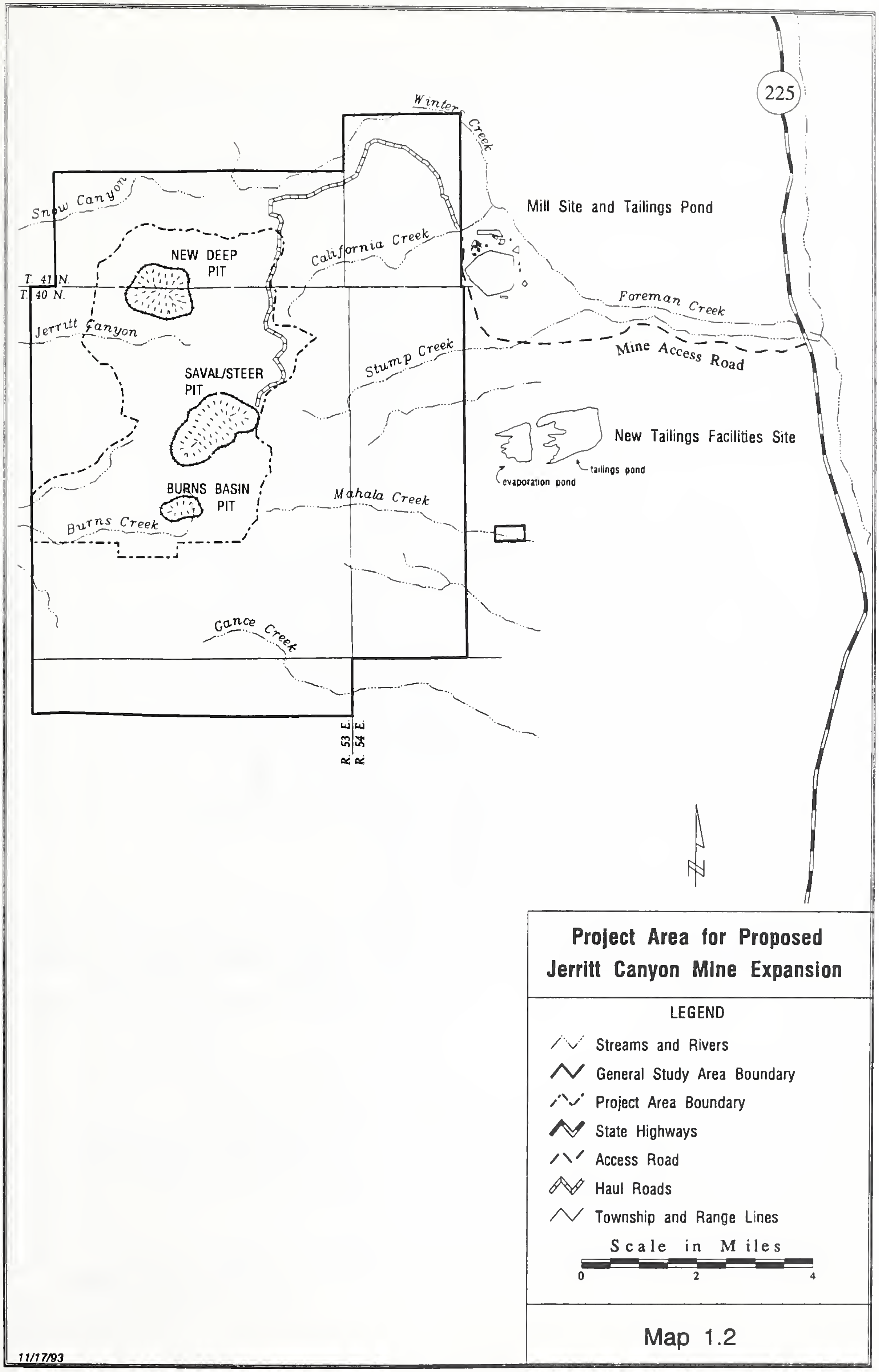
1.3 Decision to be Made

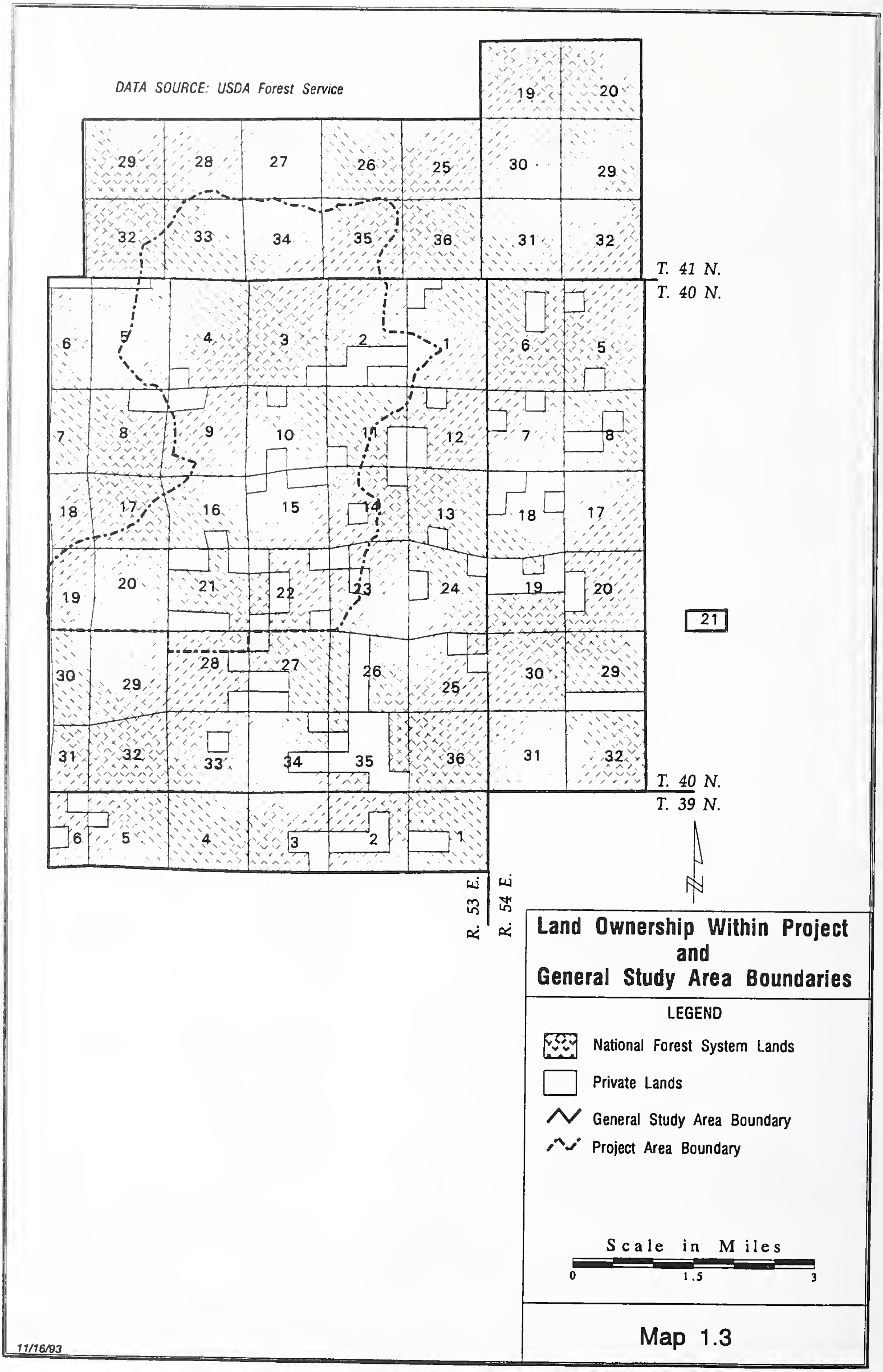
The Humboldt National Forest Supervisor's decision to be made is to either approve the mine expansion activities as proposed by IMC (proposed action) or to approve an alternative course of action giving consideration to:



Jerritt Canyon Mine Operations Project Location Map

Map 1.1


225
Winters Creek
Mill Site and Tailings Pond
Snow Canyon
NEW DEEP PIT
California Creek
T. 41 N.
T. 40 N.
Jerritt Canyon
Foreman Creek
Mine Access Road
Stump Creek
SAVAL/STEER PIT
New Tailings Facilities Site
tailings pond
evaporation pond
BURNS BASIN PIT
Mahala Creek
Burns Creek
Gance Creek
R. 53 E.
R. 54 E.
Project Area for Proposed
Jerritt Canyon Mine Expansion
LEGEND
Streams and Rivers
General Study Area Boundary
Project Area Boundary
State Highways
Access Road
Haul Roads
Township and Range Lines
Scale in Miles
0
2
4
Map 1.2
11/17/93


DATA SOURCE: USDA Forest Service
T. 41 N.
T. 40 N.
T. 40 N.
T. 39 N.
R. 53 E.
R. 54 E.
Land Ownership Within Project and General Study Area Boundaries
LEGEND
National Forest System Lands
Private Lands
General Study Area Boundary
Project Area Boundary
Scale in Miles
0
1.5
3
Map 1.3
11/16/93

a) IMC's right under the 1872 Mining Law as amended, other applicable federal laws, and applicable USFS regulations,

b) USFS responsibility under the National Environmental Policy Act (NEPA) of 1969 as amended, to minimize possible adverse effects on the quality of human environment (40 CFR 1500.2(f)), and with consideration for social and economic impacts (40 CFR 1508.14) and

c) Resource management direction provided by the Humboldt National Forest Land and Resource Management Plan (USDA, USFS 1986b).

The legal authority to require and modify locatable mineral operations on National Forest Lands is based on the 1897 Organic Act and is described in regulations found in 36 CFR Part 228. These mining regulations emphasize Forest Service authority to require a POO for locatable mineral proposals to minimize adverse environmental impacts on National Forest System surface resources (36 CFR 228.1).

Because the proposed mining expansion may significantly affect the quality of the physical human environment, NEPA and its implementing regulations require that an EIS be prepared. The USFS is required by NEPA to make decisions that are based on an understanding of the environmental consequences of an action. This DEIS provides a discussion of the significant direct, indirect, and cumulative effects of the proposed action and the alternatives. Interested and affected agencies, state and local governments, organizations and individuals must be involved in the planning, analysis and decision-making process. Therefore, public comment on this DEIS will be considered in the preparation of the Final EIS (FEIS). The information in the FEIS will be the basis for the Forest Supervisor's decision to approve the proposed action or an alternative examined in the FEIS. A final POO would be developed to conform to the Forest Supervisor's selected action alternative. Once the final POO has been approved by the Forest Supervisor, with an appropriate appeal period, project implementation can begin.

In addition to the EIS decision and approval of the final POO, the implementation of the project would require authorizing actions from other federal, state or local agencies with jurisdiction over the project. Authorizing actions include environmental permits, licenses and approvals. Table 1.1 summarizes the principal authorizing actions that may potentially be required for the proposed action.

1.4 Project Background

The existing and proposed mining operations are located within the Independence Mountain Range approximately 50 miles northwest of Elko, Nevada (Map 1.1). Mining operations began at the Jerritt Canyon Project after completion of the 1980 Jerritt Canyon Gold Mine and Mill FEIS and approval of the POO by the USFS and Bureau of Land Management (BLM). The proposed Saval and Steer mine areas were identified in the 1980 FEIS as areas with future mining potential. The New Deep mine area is essentially the extension of the existing West Generator pit, which was started in 1986 and completed in

Table 1.1
Summary of Permits & Approvals Potentially Required for the Jerritt Canyon Mine Expansion

Agency/Permit	Facet of Project
FEDERAL	
U.S. FOREST SERVICE	
Approval of Plan of Operations	Detailed operating plans to implement the USFS Record of Decision on the EIS
U.S. ARMY CORPS OF ENGINEERS	
Section 404 Permit	Any filling or dredging of wetlands and waters of the U.S.
BUREAU OF LAND MANAGEMENT	
Approval of Plan to Expand Tailings Facility	The new tailings facility has been approved up to a 10 million ton capacity. Mine expansion would require 20 million tons of additional capacity.
STATE	
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION	
Air Quality Permit	Fugitive dust associated with surface disturbance and stationary source emissions.
Authorization to Discharge	Discharge of water to surface water (i.e. pit dewatering)
General Discharge Permit - Storm Water	Discharge of stormwater runoff
Underground Injection Control Permit	Subsurface disposal of water from dewatering operation
Water Pollution Control Permit	Discharge and seepage potential of mine and waste rock dumps, ore processing and tailings deposition
Reclamation Permit for Mining Operations	Surface disturbing components of the project
Solid Waste Disposal	Disposal of solid, non-toxic wastes
NEVADA DIVISION OF WATER RESOURCES	
Water Appropriation Permit	Use of surface and ground water
Dam Safety Permit	Any dam over 10 feet in height or impounding more than 10 acre-feet of water
NEVADA DIVISION OF HEALTH	
Sewage Disposal System Permit	Sewage disposal systems associated with mine facilities
Public Water System Permit	Drinking water
NEVADA DIVISION OF HISTORIC PRESERVATION	
Review/Oversight	Cultural resources clearances
STATE MINE INSPECTOR	
Notification	Opening or closing of mines
LOCAL	
ELKO COUNTY DEPARTMENT OF PUBLIC WORKS	
Building Permit	Surface facilities

Note: List is not all inclusive

1993. An Environmental Assessment (EA) was completed for the Burns Basin mine area in 1986, with development starting in 1988 and continuing through today.

The Jerritt Canyon operations are divided into two separate geographic components, one for mining and one for processing. Mining occurs on private and National Forest System lands in the Independence Mountains, primarily on the western flanks. The mining operations are located on approximately 3,000 acres of land in Townships 40 and 41 North, Ranges 53 and 54 East. The mill processing facilities are located on approximately 1,400 acres of BLM-managed land in Townships 40 and 41 North, Range 54 East, on the eastern flanks of the Independence Mountains. The mining and milling operations are connected by a haul road (Map 1.2).

The Jerritt Canyon Gold Mine and Mill FEIS and POO provided the basis for mining operations conducted over the past thirteen years in the Project area. During that time, amendments and modifications to the original POO were made with USFS approval based on supplemental EAs. By incorporating these and other documents by reference, this DEIS will eliminate repetitive discussion of issues and conditions already disclosed. A list of those items incorporated by reference is included in the references section of this document. Documents incorporated by reference are available for review at the Humboldt National Forest District Office in Mountain City, Nevada.

This DEIS is tiered to the Humboldt National Forest LRMP. The DEIS will follow guidance provided in the LRMP for the management and use of the Humboldt National Forest, including locatable mineral exploration and development activities. Management direction and consistency with the LRMP has been considered as part of all project alternatives.

1.5 Environmental Analysis Process

Technical Participation

Several government agencies have been invited to participate in the project. The BLM is a cooperating agency because the mill site is located on lands they manage. In addition, U.S. Army Corps of Engineers (Corps), the Nevada Division of Minerals (NDOM), Nevada Division of Wildlife (NDOW) and Elko County Commission are also cooperating agencies. The U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (EPA) and Nevada Division of Environmental Protection (NDEP) are participating as technical advisors and reviewers in areas of their technical expertise and/or regulatory authority. Other agencies involved in the review of the proposed operations for permits or other approvals are listed in Table 1.1.

An Interdisciplinary Team (IDT) of technical specialists from the USFS and BLM was established to integrate the environmental analysis from a variety of disciplines including physical, biological, economic and social sciences. The IDT is responsible for identifying the issues related to the proposed action, developing alternatives to be analyzed, and guiding and participating in the collection, evaluation and presentation of data leading to the FEIS.

GeoResearch, Inc., is the third-party consultant responsible for preparing the EIS under the direction of the USFS. This group consists of resource specialists approved by the USFS. They are responsible for collecting and analyzing resource data, estimating effects, evaluating alternatives, recommending preliminary mitigation measures and writing the EIS under the supervision and review of the USFS. IMC is responsible for funding the third-party consultant and had substantial involvement in providing technical information.

EIS Process

The EIS process prescribed by NEPA consists of scoping, alternative development, analysis, documentation, and implementation of the decision, including any monitoring that may be required.

The purpose of scoping is to determine the scope of issues to be addressed and to identify the significant issues related to the proposed action. Public, federal, state and local government agency participation is a key component of scoping.

A series of analysis procedures is used to assess the nature and significance of the physical, biological, social and economic effects of the proposed action and its reasonable alternatives. Alternatives must provide different responses to important issues identified in the scoping process. The direct, indirect and cumulative effects of each alternative, including an alternative of no action, must be considered and evaluated.

The results of the scoping and analyses are documented in the DEIS. Mandatory documentation for preparation of an EIS includes a Notice of Intent to prepare an EIS, and notices of availability for the DEIS, FEIS, and Record of Decision (ROD) signed by the decision maker.

The ROD may be implemented no sooner than 30 days following the date on which EPA publishes the Notice of Availability of the FEIS in the Federal Register (40 CFR 1506.10). Monitoring programs would be described in the FEIS or ROD which ensure that environmental safeguards are executed according to plan, anticipated results are achieved and/or changes are made in the POO to ensure they are achieved.

1.6 Public Participation

Public involvement is an important part of scoping and the environmental analysis process. It ensures that the general public actively participates in the decision-making process and communicates their concerns so that these concerns are addressed in the EIS. In addition, involvement by local governments helps them anticipate the impacts and benefits which could occur from the project and make necessary plans and changes in public policy.

To encourage public participation, the USFS utilized a variety of techniques including information mailed to 270 interested parties, public meetings and open houses. An updated mailing list of citizens, government agencies and interest groups was prepared for mailing Project EIS information.

The USFS began the scoping process by publishing a Notice of Intent to prepare an EIS which appeared in the Federal Register, Vol. 58, No. 37, on February 26, 1993, and again on March 5, 1993. A letter and scoping statement were mailed to individuals, groups, and other entities. These documents presented the tentative issues and preliminary alternatives, and requested participation in the scoping process. A formal public meeting was held in Elko on March 8, 1993, and informal open houses were held in Reno, Mountain City and Tuscarora, Nevada on March 15, 17, and 18, 1993, respectively. Approximately one hundred individuals attended the public meeting in Elko, and approximately fifty persons attended the informal open houses. Written comments concerning the proposed activity and the associated issues were requested by April 10, 1993. Thirty-seven written comments were received from the general public.

1.7 Issues and Concerns

Federal and state agencies, private individuals and organizations, and IMC have raised a number of issues and concerns regarding the proposed Project and its alternatives throughout the course of the NEPA process. These include potential adverse environmental effects, technical and engineering feasibility considerations, and positive opportunities which could develop as a result of the proposed Project. The issues help establish the scope of the environmental analysis and keep it focused on the resources of most importance to the public and agencies.

Comments received throughout the scoping process have been recorded and the issues and concerns were summarized and organized under general resource topic headings as displayed in Table 1.2. As part of the process of summarizing issues, some issues were consolidated into broader issue statements. The issues in Table 1.2 are the significant issues that are analyzed in this DEIS. Also shown at the end of Table 1.2 are key issues that were developed by the IDT to focus alternative development. These "focus" issues overlap with the other issues in Table 1.2. A more detailed discussion of focus issues and other methodology used to develop alternatives is included in Chapter 2.

Table 1.2
Issues Identified in Scoping
(Key to Tracking Issues in the DEIS)

Issue	EIS Document Section
Wildlife	
1. Potential effects on mule deer habitat.	Wildlife - Chapter 4
2. Potential effects on goshawk habitat.	Wildlife - Chapter 4
3. Potential effects on sage grouse brooding habitat.	Wildlife - Chapter 4
4. Potential effects on any threatened, endangered or sensitive animal species.	Wildlife - Chapter 4
5. Potential effects on golden eagles.	Wildlife - Chapter 4
6. Potential effects on upland game birds, furbearers and trout.	Wildlife - Chapter 4
Wetlands	
1. Potential loss of wetlands and mitigation for no net loss.	Wetlands - Chapter 4
Vegetation	
1. Potential effects on vegetative biodiversity.	Vegetation - Chapter 4
2. Potential effects on any threatened, endangered or sensitive plant species.	Vegetation - Chapter 4
3. Potential for aspen fragmentation.	Vegetation - Chapter 4 Wildlife/Cavity Nesters - Chapter 4
Livestock Grazing	
1. Potential effects on the current carrying capacity of the affected allotments.	Land Use - Livestock Grazing - Chapter 4
Water Quality and Quantity	
1. Potential for water impoundment.	Surface Water and Groundwater - Chapter 4
2. Potential for acid rock drainage.	Geology - Chapter 4 Surface Water - Chapter 4 Groundwater - Chapter 4
3. Potential loss of water flow to the surface at Niagara Spring and Van Norman Spring.	Groundwater - Chapter 4
4. Potential for sedimentation of surface water from erosion of roads, pits, and dumps.	Surface Water - Chapter 4
5. Potential effects on discharge and timing of discharge and potential snow deposition.	Surface Water and Groundwater - Chapter 4
6. Potential effects on the quality of surface water and groundwater.	Surface Water and Groundwater - Chapter 4

Table 1.2, Continued
Issues Identified in Scoping
(Key to Tracking Issues in the DEIS)

Issue	EIS Document Section
Recreation	
1. Potential effects on hunting and fishing. 2. Potential effects on visual resources.	Wildlife and Recreation - Chapter 4 Public Access - Chapter 4 Visual Resources - Chapter 4
Cultural Resources	
1. Potential effects on cultural resources.	Cultural Resources - Chapter 4
Socioeconomics	
1. Potential effects on employment.	Socioeconomics - Chapter 4
2. Potential effects on Elko County.	Socioeconomics - Chapter 4
3. Potential effects to tax structure and revenues to the County.	Socioeconomics - Chapter 4
4. Community stability - length of operations.	Socioeconomics - Chapter 4
Reclamation	
1. Potential disturbance area over the life of the Project.	Chapter 2
2. Reclamation and revegetation methods.	Vegetation - Chapter 4, Soils - Chapter 4
3. Stability of reclaimed and revegetated sites.	Geology - Chapter 4
4. Post mining land uses.	Land Use - Chapter 4, Soils - Chapter 4
Mine Economics	
1. Potential effects of the various alternatives on the ability of the mine operator to continue operations.	Chapter 2, Socioeconomics - Chapter 4
2. Costs and benefits of alternatives considered.	Chapter 2
3. Cost of mitigation.	Chapter 2
Air Quality	
1. Fugitive dust abatement.	Air Quality - Chapter 4
Focus Issues	
1. Water Quality - Acid Rock Drainage Potential.	Geochemistry, Surface Water, Groundwater - Chapters 3 & 4
2. Waste Rock Dump Design for Stability.	Geotechnical - Chapters 3 & 4
3. Reclamation Potential - Revegetation.	Soils, Vegetation - Chapter 4
4. Mine Economics - Economic Viability.	Chapter 2, Socioeconomics - Chapter 4

Chapter 2

Alternatives Including the Proposed Action

Photo Description: Pit operations in Burns Basin (Summer 1993).

CHAPTER 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 Introduction

This chapter describes the no action, proposed action, and five other alternatives. Alternatives were developed to respond to the various issues raised during scoping and to meet the purpose and need described in Chapter 1. This chapter also summarizes the environmental consequences of the alternatives, which are described in more detail in Chapter 4.

Detailed discussions of the following topics are presented in Chapter 2:

Section 2.2 Formulation of Alternatives

Section 2.3 Existing Operations

Section 2.4 Alternatives Considered for Detailed Study

Section 2.5 Alternatives Eliminated From Detailed Study

Section 2.6 Management, Mitigation and Monitoring

Section 2.7 Comparison of Alternatives

Section 2.8 Preferred Alternative

2.2 Formulation of Alternatives

The formulation of alternatives was a multiple-step process guided by significant issues and post-mining land use objectives. Meetings involving an interdisciplinary team from the USFS, BLM, NDOW, NDOM, Elko County Commission, Corps, and IMC were conducted to develop and finalize alternatives. Issues identified through public and agency scoping were narrowed to four focus issues to guide the development of alternatives. The Forest Supervisor approved the development of detailed analysis of the seven alternatives examined in this DEIS based on their ability to respond to the issues and to meet specified post-mine land use objectives.

The range of alternatives was developed to respond to identified issues. Written comments received through public and agency scoping were analyzed for content by the USFS. Issues were summarized and reviewed by an IDT, comprised of various USFS and other agency specialists. The team reviewed the issues and separated them into two types: those that would be focus issues for the development of alternatives and those that would be tracked through the document for analysis of impacts. A summary of issues and a key to track issues is provided in Chapter 1. Focus issues for developing the range of alternatives were identified as follows:

- Water Quality - Acid Rock Drainage (ARD) Potential
- Waste Rock Dump Design for Stability
- Reclamation Potential - Revegetation
- Mine Economics - Economic Viability

Post-mining land use objectives developed by the USFS were also used to guide alternative development. These site-specific objectives are based on management direction and standards and guidelines presented in the LRMP. The objectives were used to guide development and evaluate effects of the proposed Project and the alternatives. Post-mine land use would approximate overall conditions in the Project area prior to mining but would not recreate pre-mining conditions due to changes in topography. Not all of the objectives can be met concurrently on every piece of ground in the Project area. Some objectives are mutually exclusive, but overall the post-mining land use would be a composite of uses that meets the objectives presented below.

1. Forage/Livestock Use. The objective is to provide forage for seasonal livestock grazing on suitable reclaimed acres. Suitability is determined by plant communities, vegetative productivity, topography, access and distance to water.

2. Wildlife. The objective is to provide for a diverse vegetative cover that would retain the soil resource and afford wildlife habitat by utilizing a seed mix that contains native species.

3. Recreation. The objective is to provide for the traditional outdoor recreation activities.

4. Access. The objective is to re-establish the pre-mining public access within the Project area.

5. Visuals. The objective is to provide a natural landscape based on the maximum modification VQO for the area.

6. Minerals. The objective is to provide for responsible exploration and development of mineral resources.

7. Watershed. The reclaimed area would still function as a watershed. The goal is to provide a stable post-mining watershed which can best be accomplished by implementing the following objectives:

   Best management practices would be used to meet baseline conditions and/or applicable state and federal water quality standards during and after mining activities.

   Appropriate reclamation and revegetation measures and storm water routing and runoff measures would be implemented to minimize sediment loading.

As part of the process of alternative development, several preliminary alternatives were considered and later modified or eliminated from further consideration. The IDT developed an initial set of issues and four preliminary alternatives prior to starting the public scoping process. The intent was to give the public a starting point in their analysis and assessment of this Project. Those issues and alternatives were included in the "Initial Scoping Document for the Jerritt Canyon Mine Expansion" mailed in March 1993. As a result of scoping, the original four preliminary alternatives were modified or deleted. One alternative was dropped but was replaced by two alternatives that addressed additional resource concerns not previously identified. During the IDT meetings, two other alternatives were developed to address the potential for underground mining. Other preliminary alternatives were reviewed and eliminated from detailed study because they did not meet baseline criteria for slope stability or economic feasibility. Section 2.5 of this chapter provides more information on alternatives eliminated from further consideration.

2.3 Existing Operations

To assist the reader in understanding the Jerritt Canyon Mine Expansion, a discussion of the existing operations is presented below and explains the various major components of the mining and ore processing operations. These operations are carried out under POO's approved by the USFS and BLM.

Gold Ore Processing

Ore processing produces gold bullion and tailings (by-products that remain after ore is recovered) which are disposed of in a tailings facility. Ore processing and tailings facilities are authorized by BLM and NDEP as closed circuits which do not result in any surface water discharge of process solutions.

Ore excavated from the Jerritt Canyon mine is hauled to the existing mill and processed to recover gold (See Map 1.2). Ore processing consists of several consecutive steps to extract the gold. Processing at the Jerritt Canyon mill consists of crushing, chlorination, roasting, grinding and gold recovery. In general, the process is a typical gold recovery system that uses dilute cyanide to free gold from ore and carbon to recover the gold. The majority of the ore is processed in the mill, using chlorination or roasting techniques, but a small amount of the ore is processed by heap leaching. Current milling operations are conducted pursuant to the April 1980 ROD for the "Jerritt Canyon Project Final Environmental Impact Statement" and subsequent amendments to the original POO.

Tailings facilities include an impoundment area (tailings pond), evaporation pond, surge pond and a tailings pipeline to move tailings from the mill to the impoundment. The tailings consist of approximately 30 to 35 percent finely ground rock and between 65 to 70 percent liquid. Tailings from existing operations are currently piped to the original tailings facility until a new tailings facility is completed. The new tailings facility was approved by the BLM on June 29, 1993, after completion of an EA, which is incorporated by reference in this DEIS. The EA analyzed the disturbance necessary to achieve the proposed ultimate capacity of 30 million tons in the new tailings impoundment. The Decision Record for the EA approved the proposed action, indicated that there would be no significant impacts, and required monitoring wells downstream of the new tailings facilities to assure maintenance of zero discharge. The Decision Record only approved the facilities for the 10 million ton capacity required by existing mining operations.

Pits

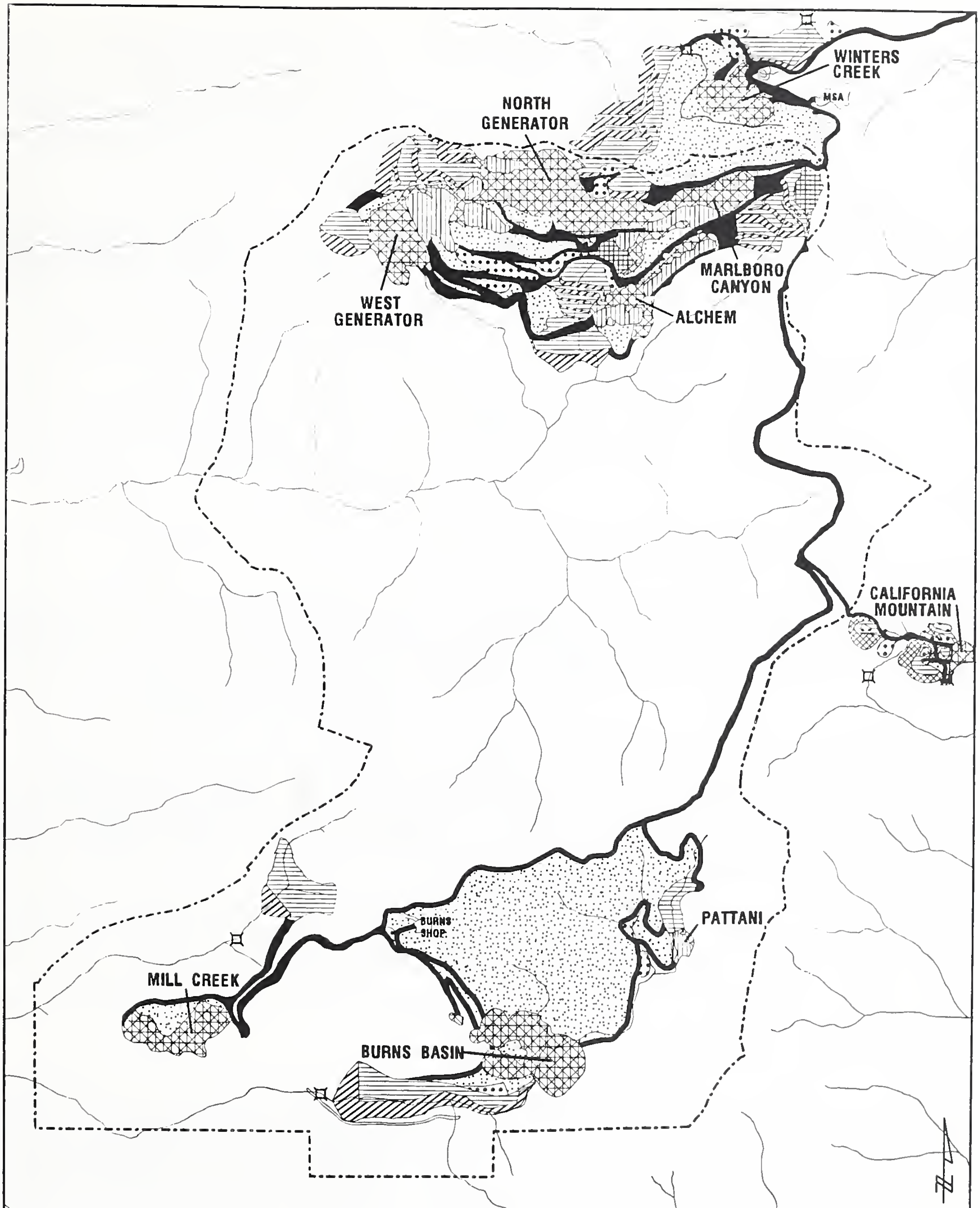
Although eight mine pits have been established since mining was initiated in the Jerritt Canyon area, existing operations consist of five pits: Alchem, Mill Creek, Burns Basin, Winters Creek and California Mountain (See Map 2.1). All other pit operations have ceased. Pit operations have disturbed approximately 720 acres of which 139 acres have been partially backfilled. Dewatering has not been necessary in any past or existing pit operations.

Pit operations are conducted 24 hours a day on a year-round basis. Ore and waste rock are drilled and blasted in benches to facilitate loading and hauling. Due to the steep pre-mining topography, a pit totally surrounded by highwalls and benches is rarely created. Benches typically range from 20 to 40 feet in height and up to several hundred feet in width. Horizontal drilling and blasting, typically referred to as slabbing, is also authorized in select portions of the pits to increase ore recovery. Underground mining tests have been conducted in the West Generator and North Generator pits to maximize ore recovery and evaluate economic and technical feasibility of underground mining.

Blasted ore and waste rock are loaded into end-dump haul trucks using hydraulic shovels or front-end loaders. The material is then transported in haul trucks with capacities ranging from 85 to 190 tons. Ore is transported either to stockpiles or directly to the mill for processing. Waste rock is transported to waste rock disposal areas or used to construct haul roads.

Waste Rock Disposal Areas

Waste rock dumps are located at various disposal sites throughout the project area as shown on Map 2.1. Approximately 708 acres of waste rock disposal areas have been approved for the operations to date. Waste rock dumps are developed using cross-valley, head-of-valley or side-hill methods. Waste rock is placed in levels or lifts varying in height



No Action - Alternative A
Jerritt Canyon Expansion Project

Map 2.1

LEGEND

- Pits
- Haul Roads
- Ore Stockpiles
- Pit Backfills
- Dumps - Relatively Flat
- Dumps - 3H:1V Slopes
- Dumps - Angle of Repose Slopes
- Facilities
- Growth Medium Stockpiles
- Undisturbed Areas
- Project Area Boundary
- Streams (USGS)
- Major Sediment Ponds/Traps

SCW : 11/13/93

Scale in Miles

0 1/8 1/4 1/2 1

from 40 feet to 600 feet. Rock catchment trenches, berms or a combination of the two have been installed along portions of some dump toes to contain rock rolling down the dump faces during operations. The tops of waste rock dumps are typically flat, undulating surfaces with an approximate two percent slope away from the dump face. This reduces the potential for surface runoff to accumulate and flow over the dump slopes.

Waste rock is end-dumped at the natural angle of repose. End-dumping at the angle of repose provides for gravity segregation of waste material by size, with the larger boulders rolling farthest downslope. During the final stages of dump construction, coarse and durable rock is used to armor the angle of repose slopes to enhance stability and decrease erosion potential.

The north and east facing slopes of the Winters Creek waste rock dump will be built with slopes of 2.5 horizontal to 1 vertical (2.5H:1V) instead of angle of repose (1.3H:1V). Final reclamation of the California Mountain dumps will involve pushing the slopes to 3H:1V.

Ore Stockpiles/Crushing and Screening

Sub-grade ore is temporarily stockpiled until such time as it can be processed economically. To facilitate rehandling, stockpiles are typically located on flat, disturbed areas such as waste rock dump surfaces. Ore stockpiles on previously undisturbed areas occupy approximately 31 acres. Ore stockpile locations are shown on Map 2.1.

A portable crushing and screening system was initiated in 1993 in the vicinity of the Marlboro Canyon pit. Subsequent sites will be located on previously disturbed areas and will be identified in the Annual Work Plan submitted each year to the USFS. These operations are conducted in accordance with the NDEP, Bureau of Air Quality regulations and applicable air quality permits issued to IMC.

Crushing and screening results in mill feed and reject material, which are placed in stockpiles using conveyors and stackers. Reject material is stockpiled for future use as road base and road sanding material or is placed in waste rock disposal areas.

Growth Medium Stockpiles

Growth medium, defined as material which is suitable for plant growth, is salvaged from the pits or is removed from accessible areas of waste rock dump sites that have slopes less than 30 percent. Direct redistribution is given preference over stockpiling whenever operationally feasible. Growth medium that cannot be directly redistributed is temporarily stockpiled, as shown on Map 2.1. Growth medium stockpiles occupy an estimated 87 acres.

Roads

There are three types of roads within the mine operations area: access roads, haul roads, and exploration roads. Access roads are used by heavy equipment to develop pits and dumps and install sediment control structures. Most of these roads are eventually eliminated by mining or covered by waste rock dumps.

Approximately 597 acres of haul roads provide access to mine pits, waste rock dumps, ore stockpiles, mill operations, and other facilities as shown on Map 2.1. Haul roads range from 50 to 250 feet in width depending on the type and frequency of traffic and road alignment. The largest road widths are typically at sharp curves and intersections. Roads are bermed and maintained to ensure safe and efficient hauling operations, to reduce particulate dust emissions, and to control drainage.

Exploration roads occur throughout the Project area. The running surface of these one-lane roads is generally 12 to 16 feet wide. Disturbance associated with these roads and exploration drill pads covers approximately 954 acres.

Facilities

There are two existing facilities in the mining operations area as shown on Map 2.1. The Mine Services and Administration (MSA) complex, located on National Forest System lands near Winters Creek, includes: a maintenance shop; tire shop; offices; warehouse; storage buildings; change house; explosives storage area; ready lines; fuel, oil, propane and water tanks; and the associated underground and above-ground utilities. The Burns Basin mine facilities are located on private land and are similar to the MSA complex.

Drainage and Sediment Control Structures

Drainage and sediment control structures consist of a variety of structures that divert water and retain sediment. Sedimentation ponds, sediment traps, sumps, checkdams, silt fences, riprap, erosion control fabric, and vegetative sediment filters are some of the methods used to control sediment. The purpose is to reduce and retain sediment within the areas of disturbance or close to its source. Water control ditches are used to divert runoff around pits, waste rock dumps areas, and haul roads. The largest existing diversion ditch routes water around the Burns Basin waste rock dump area.

Water Supply

Water supply for existing mine operations comes from two sources: 1) water wells at the mill site, and 2) the Burns Basin water supply well, located adjacent to the Pattani haul road. Water from the wells at the mill site is piped to a lined pond near the Winters Creek Mine area and the MSA area. Water from the Burns Basin well is currently stored in 10,000 and 20,000 gallon tanks.

Hazardous Materials: Fuel and Explosive Storage and Handling

IMC's mining operations do not use or produce any materials classified as hazardous other than petroleum products, antifreeze, or explosive products. Petroleum products and antifreeze are stored in approved locations, containers, and structures at the MSA complex and Burns Basin shop. Current operations utilize approximately 450,000 gallons per month of diesel fuel. IMC adheres to a Spill Prevention Control and Countermeasure Plan (SPCC) for the Jerritt Canyon Project which includes the Burns Basin operations. The existing storage areas are located and constructed so as to contain any accidental spills. Petroleum storage tanks have a containment basin large enough to hold the contents of the tank in case of a spill. Explosives are stored, transported, and used in compliance with regulations established by state and federal regulatory agencies.

Reclamation

Reclamation activities for existing operations are detailed in the POOs approved for each mining area. Reclamation generally consists of armoring angle of repose waste rock dump slopes with coarse and durable rocks; partially or fully recontouring roads; placing waste rock into mined out areas of pits as partial backfill; providing drainage controls; removing structures no longer needed after completion of operations; revegetating by applying growth medium and reseeding various designated areas; and providing public safety measures, such as safety berms. Approximately 194 acres of disturbance designated for final reclamation have been reseeded.

2.4 Alternatives Considered for Detailed Study

This section describes alternatives to the Proposed Action including the No Action Alternative. Consideration of the No Action Alternative is required by NEPA. Five other alternatives were developed to respond to various issues as described in the section titled "Formulation of Alternatives." The alternatives are labeled from A to G throughout this DEIS.

To simplify and to eliminate repetitive discussions, these alternatives are described in terms of their differences from the proposed action, Alternative B. Table 2.1 summarizes disturbance by each alternative. Table 2.2 displays areas to be reclaimed and revegetated.

All alternatives would be consistent with the LRMP, with the exception of Alternative A, which would conflict with IMC's right to mine under the General Mining Law of 1872. All action alternatives would be within the legal jurisdiction of the USFS.

Alternative A - No Action

Under the No Action Alternative displayed on Map 2.1, the USFS would not authorize the proposed action or any action alternative. Current operations, already approved as described above under "Existing Operations," would continue. However, the General Mining Law of 1872 gives IMC certain rights to conduct mining operations on public lands. The No Action Alternative is required by NEPA and serves as a baseline for evaluation of the action alternatives.

Table 2.1
Summary
Disturbance by Alternative (in Acres)

Disturbance Type	Alternative						
	A (existing)	B[1]	C	D	E	F	G
Pit	581	1,332	1,332[2]	1,332	1,332	803	1,332
Partial Pit Backfill	139	0	50	13	13	0	0
Dumps Total	708	1,308	1,388	1,413	1,298	730	1,323
Angle-of-Repose	31	276	223	22	78	178	278
2:1 Slopes	0	0	26	0	26	0	0
3:1 Slopes	27	0	73	503	277	0	0
Flat	447	1,032	1,065	889	916	552	1,045
Haul Roads	597	184	189	249	173	275	216
Ore Stockpiles	31	12	12	12	12	13	12
Sediment Ponds/Traps	4	11	10	10	11	10	11
Growth Media	87	119	118	113	113	52	119
Other	36	0	0	0	0	158	0
Total Disturbance Acres	**3,137[3]**	**2,966**	**3,099**	**3,142**	**2,952**	**2,041**	**3,013**
Area of Overlap with Existing Disturbance	N/A	(407)	(437)	(398)	(395)	(264)	(408)
Net Additional Disturbance	N/A	2,559	2,662	2,744	2,557	1,777	2,605
Total Net Cumulative Disturbance	**3,137[3]**	**5,696**	**5,799**	**5,881**	**5,694**	**4,914**	**5,742**

Source: GIS Computer-generated Statistics 1993.

Note: [1] Alternatives B through G show new disturbance.
[2] Includes 77 acres of partial backfill into EIS pits.
[3] Includes 954 acres of exploration and USFS roads.

Existing operations at the Jerritt Canyon Project are estimated to continue at current levels until 1994, at which point mining operations would begin to decline and cease sometime before or during 1996. Employment, estimated at 600 persons in 1993, would decline accordingly.

Alternative B - Proposed Action

The proposed action for the Jerritt Canyon Mine Expansion is the development, operation and reclamation of the Saval, Steer, and New Deep mine areas and expansion of

Table 2.2
Proposed Disturbance and Reclamation by Alternative (Acres)

	Alternative						
	A	B	C	D	E	F	G
Disturbance Area[1]							
Existing	2,183	407	437	398	264	264	408
Proposed Additional	N/A	2,559	2,662	2,744	2,557	1,777	2,605
TOTAL DISTURBANCE[2] **(Existing and Proposed)**	**2,183**	**2,966**	**3,099**	**3,142**	**2,952**	**2,041**	**3,013**
Reclamation Area							
Acres to be Revegetated	1,102	1,289	1,447	1,691	1,447	957	1,322
Other Reclamation[3]	500	345	302	118	172	281	359
TOTAL RECLAMATION	**1,602**	**1,634**	**1,767**	**1,809**	**1,619**	**1,238**	**1,681**
Pit Area[4]	581	1,322	1,332	1,322	1,322	803	1,332
TOTAL AREA (RECLAMATION + PITS)[5]	**2,183**	**2,966**	**3,099**	**3,142**	**2,952**	**2,041**	**3,013**

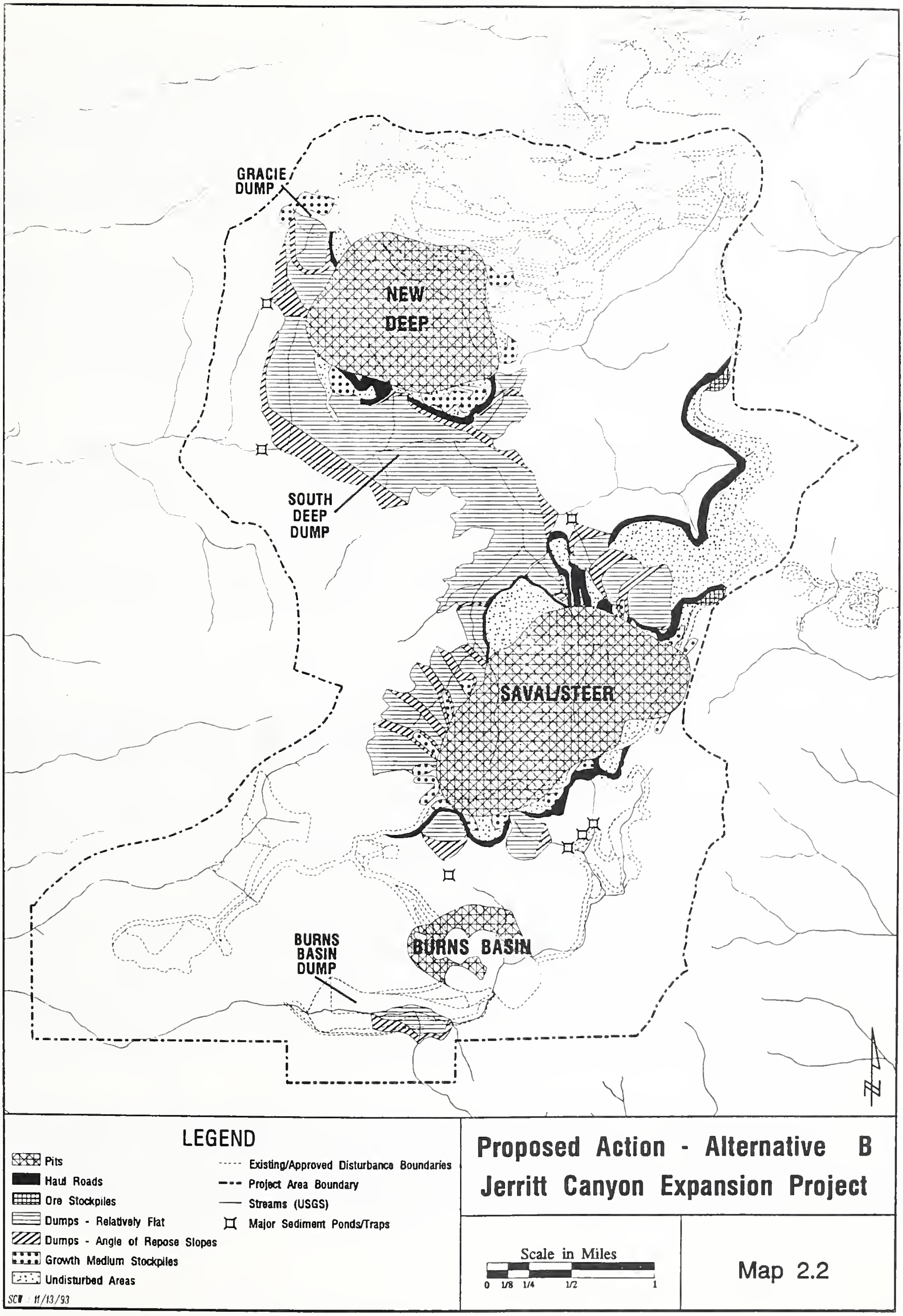
Source: USFS GIS data base, June 24, 1993.

Note:
1 Null inclusions and undisturbed areas not included.
2 Does not include exploration or USFS roads (954 acres).
3 Coarse and durable for stability
4 Portions of the pit bottoms would be revegetated, but these areas cannot be calculated until the pit is developed.
5 For each alternative, total acres reclaimed plus the pit area equals the total disturbance area.

the existing Burns Basin mine area as shown on Map 2.2. Saval and Steer are new mine areas that were originally identified in the 1980 Jerritt Canyon Final EIS as areas with future mining potential. The New Deep mine area is an extension of the West Generator pit, which was started in 1986 and completed in 1993. The proposed action includes the expansion of the Burns Basin mining operations. Mining in this pit began in 1988 and continues as an existing operation. Proposed mining operations are expected to result in production of gold from 20 million tons of ore.

The proposed project would provide for mine operations, including reclamation activities, through 2005. The Project is expected to result in the creation of between 150 and 200 positions at IMC's operations.

A two-phased approach was used by IMC to describe the disturbances associated with the proposed mining expansion. The preliminary POO submitted by IMC included acres of



Proposed Action - Alternative B
Jerritt Canyon Expansion Project

Map 2.2

disturbance which would result under Phase One for the current market value of gold. Included in Phase Two was additional disturbance that might occur in the reasonably foreseeable future if gold prices were to increase over current levels. This DEIS contains an analysis based on the larger amount of disturbance as shown on Map 2.2. As a result, the area actually disturbed by implementation of the Project may be less than the 2,966 acres displayed in the DEIS. By conducting the analysis using the larger area, additional environmental analysis may not be required for future related actions, unless the various activities were not covered in the EIS or exceed the acres analyzed.

Reclamation occurs both during mine operations and after mine closure. The Annual Work Plan that describes completed and projected reclamation activities would continue to be submitted to the USFS. Annual reclamation would be targeted for areas where further mining operations are not anticipated and for other areas identified for temporary reclamation and stabilization.

Reclamation operations for the mine areas are designed to reduce impacts attributable to mining and meet the post-mining land use goals for the area. This would be accomplished by leaving areas disturbed by mining in a stable condition to provide mass and surface stability and by establishing vegetation. A summary of the areas to be reclaimed and revegetated under all alternatives is displayed in Table 2.2. The following discussion of the various components of the proposed Project includes specific reclamation procedures for each component.

Processing Facilities

Ore mined from the pits would be processed at the existing mill and the milling waste would be deposited in the existing and approved tailings ponds. Ore production would not exceed the design capacity of the mill or tailings facilities, both of which have been previously analyzed under NEPA. Those analyses are incorporated into this DEIS by reference and include the 1980 FEIS, the 1991 EA on the Jerritt Canyon Project Tailings Dam Raises, and the 1993 EA for the new tailings pond. The existing tailings pond has enough capacity to accept tailings until about September 1995. There would be no difference in the type of tailings deposited, construction or operation of the facility or disturbance associated with the facility, from that analyzed in the EA for the new tailings pond. It is anticipated that the proposed action being analyzed in this EIS would result in an approximate additional 20 million tons of mill waste to the tailings impoundment. The EA for the new tailings pond included analysis of a 30 million ton capacity, which provides for 20 million tons of additional capacity over that needed for existing operations.

The BLM would review and approve any additional raises to the tailings impoundment that would be required as a result of the expanded mining operations examined in this DEIS. It is anticipated that four raises with an approximate capacity of five million tons for each raise would be required for the estimated 20 million tons of additional mill waste resulting from the proposed expanded mining operation.

Pits

The Project would operate on a 24-hour-a-day, year-round basis. Conventional open pit mining methods are presently expected to be the primary means of developing the pits. Total area associated with pit development would be about 1,332 acres. This includes 308 acres of previously disturbed areas. Anticipated pit shapes are displayed on Map 2.2. Final pit shapes would be determined by the results of development drilling around the pits as they are being developed and from results of blast hole ore sampling. Development drilling would be allowed inside the proposed disturbance areas considered in this DEIS. These drilling operations would be conducted in a manner consistent with existing exploration drilling requirements.

Pit development would be similar to the existing operations. Highwall and bench slopes would be dependent upon the geologic conditions encountered during mining, but are expected to range from approximately 30 to 50 degrees. Benches would typically range from 20 to 100 feet in height and up to several hundred feet in width. Based upon current drilling information and mine plans, the distance from the top of the highwall to the bottom of the pits is expected to be 820 feet for the Saval pit, 600 feet for the Steer pit, 1,180 feet for the New Deep pit, and 340 feet for the Burns Basin pit.

During the last year of mining, the New Deep pit would extend below the groundwater table that is estimated to occur at an elevation of approximately 6,100 feet in the vicinity of this mine area. The area of the pit below an elevation of 6,100 feet is about 19 acres in size and decreases with depth. Pit inflow rates below the water table are expected to be on the order of 100 to 300 gallons per minute (HCI 1993). The Saval, Steer, and Burns Basin pit bottoms would be above the water table and only minor inflows from perched groundwater and precipitation are anticipated. Water that collects in the pits during mining would be routed to sumps where it would evaporate or infiltrate the pit floor. If sufficient quantities of water are available, it would be stored in sumps, ponds, or tanks and used for dust suppression or in other facets of the mining operations. The availability of water in the New Deep pit would reduce the amount of fresh water that is currently pumped over six miles from wells on the east side of the Independence Mountains to a storage pond near the existing mine areas. Active dewatering of the pit area prior to mining using wells and pumps is currently not anticipated. If active dewatering were necessary, the water would be pumped to storage ponds or tanks and utilized for dust suppression, exploration drilling, and washing heavy equipment or other uses at the existing and proposed mine facilities. In the event there was excess water beyond that required for the mining operations, IMC would obtain the required permits for surface discharge or underground injection.

Horizontal drilling and blasting, referred to as slabbing, may also be utilized within select portions of the pits to maximize ore recovery. No increase in surface disturbance is expected to result from this ore recovery technique. Slabbing could eliminate all or portions of the benches developed during surface mining, but the overall highwall angles would still be in the range of 30 degrees to 50 degrees.

Underground mining methods may be utilized within the pits developed in the Project area during or after open pit mining to increase ore recovery. Room and pillar, sublevel stoping and cut/fill underground mining techniques would be the primary means of recovering ore. No new surface disturbance would occur, because the waste rock would be placed in approved dumps or in partial pit backfill areas.

Pit appearance would not normally be altered by reclamation efforts, unless partial backfilling with waste rock is determined to be operationally and economically feasible. Although pits can be exempted from reclamation by NDEP pursuant to its regulations, fine-textured waste rock or growth medium may be applied to portions of the pit bottoms, depending upon availability of these materials. The material would be distributed to depths ranging from eight inches to three feet. The objective of pit revegetation efforts would be to establish a protective ground cover or aspen seedlings in appropriate portions of the pit bottoms. Trees on adjacent sites are potential sources of aspen for pit bottom revegetation. Other woody plant species may also be utilized to develop wildlife habitat within the pits. A mixture of grasses, forbs, and shrubs would be seeded on accessible benches and slopes that are less than 30 percent.

Waste Rock Disposal Areas

Approximately 1.08 billion tons of waste rock would be deposited either in waste rock dumps or in partial pit backfill areas. Partial pit backfill of proposed and existing pits would be conducted where economically and operationally feasible.

Waste rock dumps would be developed as cross-valley, head-of-valley, or side-hill type dumps in single or multiple levels with angle of repose slopes. The majority of the dumps would be built as valley-fills. Proposed dumps would include expansion of the Gracie dump to the west of the West Generator pit and the Burns Basin dump. It is estimated that 1,308 acres of disturbance would result from the waste rock dumps proposed in Alternative B and displayed on Map 2.2. Waste rock from proposed operations could also be disposed of in other existing, approved waste rock dumps. Specific dump plans would be included in the final POO and approved by the USFS.

The proposed configuration of the Saval and Steer pits would allow the majority of the associated waste rock dumps to be developed in a series of lifts progressing up the natural drainages, as shown on Map 2.2. Two head-of-valley dumps are proposed in the Burns Basin watershed, south of the Saval and Steer pits.

The waste rock from the upper portions of the New Deep pit would be transported to the existing Gracie dump. Waste rock would also be transported out of the southeastern end of the pit and deposited in the South Deep dump. During the later stages of orebody development, the majority of the waste rock would be transported to the South Deep dump. The South Deep dump would be constructed in a series of lifts on the upstream side progressing in height to the main flat surface of the South Deep dump. Angle of repose slopes would occur on both the upstream and downstream sides of the South Deep cross-valley dump configuration.

The proposed waste rock dump for expansion of the Burns Basin pit would be an extension of the southern portion of the existing dump. Partial backfilling of the Burns Basin pit may also be conducted.

The principal waste rock dump stability objective would be to provide structurally competent slopes to withstand anticipated geologic and climatic conditions without failure that would threaten public safety and the environment. Low-strength materials, typically silts and clays, would be placed in non-critical areas within the dumps.

Waste rock dumps would cover areas where there are aspen, willow and brush. Removal of trees, brush, or slash from the waste rock dump areas would not be operationally feasible over most of the area due to the steep slopes. Aspen trees in accessible portions of the disturbance areas would be made available for firewood when this would not pose a safety hazard or interfere with mining operations. If slash removal is determined to be necessary, then the slash would either be burned in accordance with applicable USFS guidelines or piled in non-critical areas. An undetermined number of live aspen would be salvaged for transplanting in other areas. Aspen outside of the planned disturbance areas would be avoided.

Dumps were designed to limit disturbance of drainage bottoms, springs and wetlands. These areas could not be avoided at all locations due to topographic constraints, economics, and dump stability considerations. Accessible springs or seeps discovered during dump construction would be isolated by building drainage systems. The need for and design of drainage systems would be determined in consultation with and subject to approval by the USFS. The dumps would cover portions of stream channels and therefore require under-dump drainage systems. These would consist of large rocks placed by gravity sorting of materials during dumping. Materials that are predominantly fine textured would be dumped outside the main channels during the initial stages of building the under-dump drainage systems.

Rock catchment trenches, berms, or a combination of the two would be installed along portions of the dump toes to protect sediment control structures and undisturbed areas from waste rock that may roll down the dump faces during operations.

Plans for development of the waste rock dumps would be included in the final POO. Any remaining dump condemnation drilling would be allowed inside the disturbance areas considered in this DEIS. These drilling operations would be conducted in a manner consistent with existing operating requirements for exploration drilling.

Reclamation of all angle of repose dump slopes would be accomplished by armoring these areas with coarse and durable rock. Fine-textured waste rock and/or growth medium would be used to cover portions of the upper dump slopes. Sediment from the upper slopes would be captured on the flat surfaces of the lower dumps. These slopes would be seeded with species of grasses, forbs, and shrubs.

Compacted flat surfaces of waste rock dumps would be scarified either before or after growth medium application. Large depressions on the surface of the dumps would be regraded and/or filled to prevent water impoundment after reclamation. The undulating surface of the dumps would be sloped to direct runoff away from the from the main dump face and toward the contact with the natural topography. Flat dump surfaces would be seeded with a mixture of grasses, forbs, and shrubs. Aspen and other woody plant species would be planted in locations on the flat dump surfaces that are expected to encourage survival.

Ore Stockpiles/Crushing and Screening

Some ore from the proposed pits would be stockpiled at various locations as shown on Map 2.2. With the exception of approximately 12 acres adjacent to the Burns Basin haul road, there would be no new additional disturbance as the stockpiles would be located on previously disturbed areas.

Crushing and screening of ore may be conducted at various locations using the portable equipment described in the "Ore Stockpiles/Crushing and Screening" section for existing mine operations. No new surface disturbance would result from these operations since IMC plans to locate them on approved disturbance areas. These operations would be conducted in accordance with NDEP regulations and applicable air quality permits. Haul trucks or conveyors would be used to transport crushed ore to stockpiles. Reject material would be hauled to waste rock dumps or stockpiled for use as road surfacing or sanding materials.

The number, type, and size of ore stockpiles that would remain after operations are completed depends on mine economics and developments in mine processing technology. Any ore stockpiles that remain after mining ceases would be reclaimed in the same manner as described for waste rock dumps. Relatively flat surfaces of ore stockpiles would be sloped away from the main angle of repose slopes. Growth medium would be applied to these flat surfaces where fine textured materials do not make up the final surface.

Growth Medium Removal and Stockpiling

Growth medium would generally be recovered from those portions of the pits with slopes less than 30 percent. Recovery of growth medium during mining of the pit would occur on slopes steeper than 30 percent when operationally feasible.

Direct redistribution would be given preference over stockpiling of growth medium. Growth medium that could not be directly redistributed would be stockpiled. Mixing of waste rock materials with growth medium would be reduced by locating stockpiles away from centers of activity. Anticipated locations for the growth medium stockpiles are shown on Map 2.2. Growth medium stockpiles would cover about 119 acres, including stockpiles that are located on waste rock dumps.

Growth medium stockpiles would be stabilized by a variety of measures. The type of stabilization measure used would be dependent upon the anticipated life of the stockpiles. The growth medium stockpiles would initially be developed with angle of repose slopes. Erosion controls such as berms, hay bales, or silt fence may be installed alone or in combination to control erosion. Angle of repose slopes on stockpiles that are in place longer than two years would be reduced to 2H:1V. Active stockpiles would not be seeded unless an adequate amount of time would elapse for plants to become established. Long term stockpiles would be seeded with an appropriate seed mixture during the first planting season after stockpiling is completed.

Roads

Haul Roads

Construction of a haul road network within the Project area would be required to develop the Project. New haul roads are anticipated to disturb about 184 acres outside of areas that would eventually become pits or waste rock dumps. Designs and specifications for the roads would be reviewed and approved by the USFS as part of the final POO.

No changes to alignment or dimensions are anticipated for the haul road to the mill outside of the Project area shown on Map 1.2. Use of this road would be conducted in accordance with maintenance and operational guidelines approved by the USFS for existing operations.

Haul road re-alignment may be necessary during construction to accommodate unanticipated field, ground, or geologic conditions. The roads displayed on Map 2.2 are the anticipated road alignment corridors.

Final road locations would be determined within an adjustment zone corridor, as identified in the preliminary POO. Final road locations would be dependent upon on-site engineering factors including avoidance of wetlands and areas requiring major road cuts. Should changes to the haul road alignment or dimensions be necessary, the changes would first be field-reviewed with the USFS.

It is currently anticipated that two sections of the existing Burns Basin haul road would be mined out by the Saval and Steer pits. The sections of haul road mined out by the pits would be re-established to maintain access.

Haul roads would be constructed using a combination of various cut and fill methods. Construction would include drainage features such as ditches and/or culverts and safety berms on the outer edge. A berm or trench would be built along the toe of the haul road fill to help protect undisturbed areas from rolling rocks. Seeding of haul road cut and fill slopes and safety berms would be initiated after construction is completed.

The running surface of the haul roads would range from approximately 70 to 250 feet in width, depending on the type and frequency of traffic and road alignment. Straight sections of the haul road running surfaces would typically be between 70 and 100 feet wide. At curves, intersections, and switchbacks, the haul road running surface may range up to 250 feet in width. The running surface would generally have grades between zero and ten percent. Truck run-away ramps would be built as needed in accordance with MSHA regulations.

Access Roads

Development of pits and dumps would require construction of roads 20 to 80 feet wide for access. These roads would be needed for heavy equipment to conduct dump drain work, clear trees, remove and stockpile growth medium, and install sediment control structures. These roads would be eliminated by mining, covered by waste rock dumps or reclaimed.

Drainage Control

Haul roads would be constructed and maintained so as to assure adequate drainage and to minimize or where practicable, eliminate damage to soil, water and other resource values. Final haul road location and design, with accompanying plans, profiles and cross sections, would be included in the final POO, and field reviewed and approved by the USFS prior to construction.

The haul road drainage plan would include a means of conveying runoff under the haul road at stream channel crossings. Other drainage controls along the haul roads would be provided by culverts, french drains, rolling dips, cross drains or other effective measures. The drainage control structures would be designed to effectively convey surface runoff across fill slopes and onto natural surfaces. Drainage control features would be kept clear of debris so that drainage systems function efficiently.

Dust Control

Roads would be maintained to ensure safe and efficient travel. Dust suppressants would be applied to control fugitive emissions. The principal dust suppressants expected to be utilized are water, calcium chloride, and magnesium chloride. To further reduce dust emissions, speed limits have been set at 25 mph for haul trucks and 35 mph for service vehicles.

Reclamation

Except for road sections which may be authorized by the USFS to be left open for resource management or recreational use after mining is completed, mine roads would be closed and reclaimed.

Haul roads within the Saval, Steer and Jerritt Creek drainages would be partially recontoured. Compacted roadbeds would be ripped or scarified before or after recontouring operations are initiated. The principal source of growth medium for haul road reclamation would be the growth medium on road safety berms and fill slopes.

Full recontouring would be performed on the haul roads within the Burns Creek watershed that are outside the confines of the pits and waste rock dumps. The goal of full recontouring is to blend the road into the surrounding terrain with slopes in the same general range as the natural topography.

Following partial or full recontouring, haul roads would be seeded with a mixture of grasses, forbs, and shrubs. Woody plant species may be planted at various locations along recontoured roads.

Facilities

Existing facilities would be expanded by building new mine facilities to support the New Deep mining operations. The new mine facilities would consist of a shop; offices; warehouse; change house; fuel, oil and water tanks; ready line for heavy equipment; light poles, generator sets; air compressors and lines; pipelines; powerlines; explosives storage areas; storage buildings; septic system; and sumps. Powerlines and pipelines would be installed from the existing MSA complex to the mine area. (See Map 2.3 for facility locations).

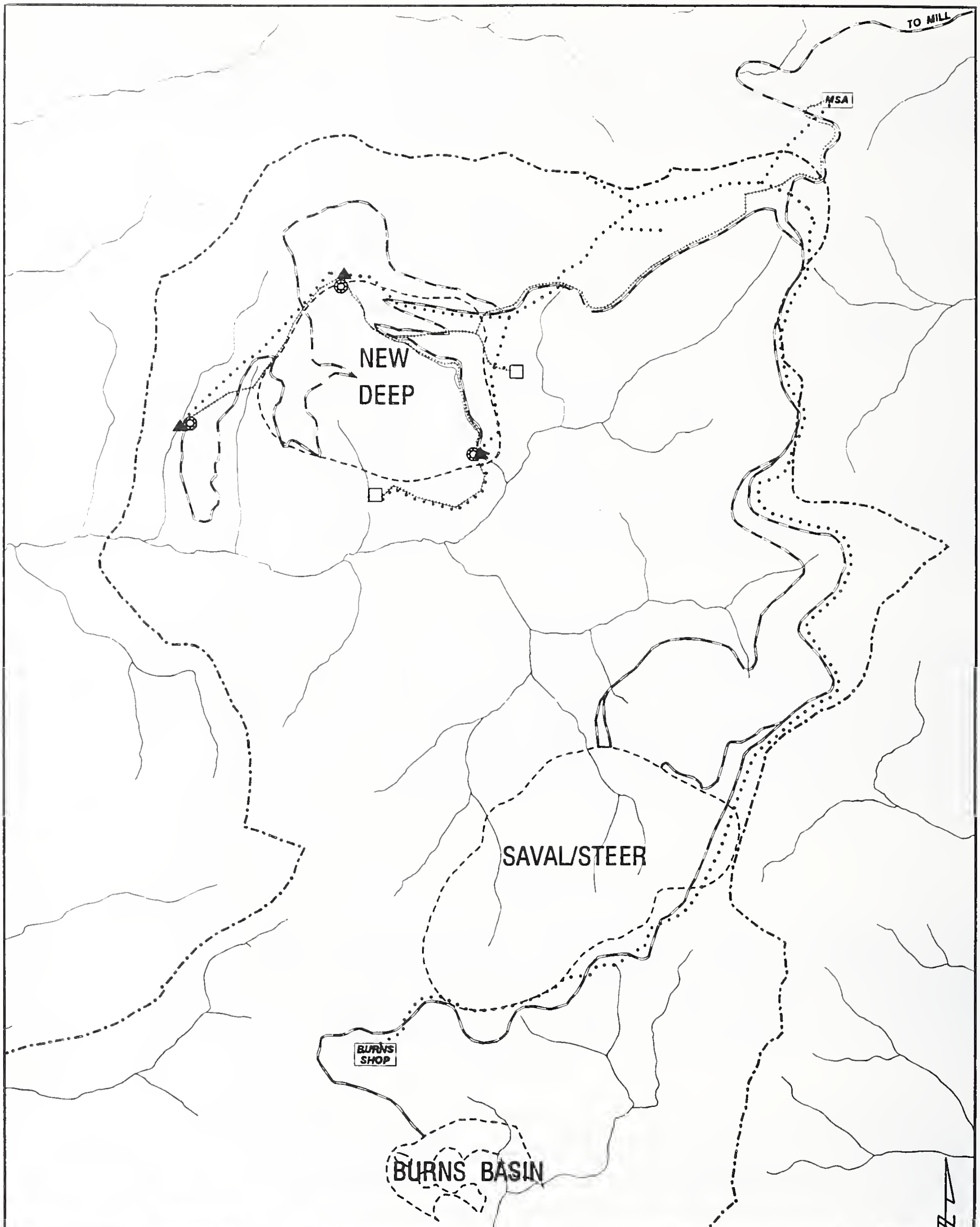
At the end of mine life, facilities located on National Forest System lands would be removed and the sites regraded to blend into surrounding terrain. Contaminated soils on National Forest System lands would be remediated in accordance with applicable state and federal requirements. Growth medium would be spread on relatively flat areas accessible to heavy equipment. Areas where facilities are removed would be recontoured so that runoff or other short term surface flows would infiltrate the soil and control sedimentation and erosion. The Burns Basin mine facilities, located on private land, may be retained for future use after mining has ceased.

Drainage and Sediment Control Structures

Anticipated locations for major sediment ponds and traps are shown on Map 2.2. The proposed sediment pond in Jerritt Canyon and six sediment traps are expected to result in approximately 11 acres of new disturbance. Final designs and specifications for sediment control structures would be incorporated into the final POO. Final locations of sediment ponds and traps would be field reviewed with USFS representatives prior to construction.

The sediment pond in Jerritt Canyon would be constructed to capture sediment originating from the South Deep dump slopes that face downstream. The design storage capacity would be maintained by continuous dewatering of the impoundment area. A spillway would be constructed to pass peak flows.

Sediment traps would be designed and constructed according to site-specific conditions. Diversion ditches may be constructed within the confines of the disturbance areas of the pits, dumps and/or haul roads to control runoff. Sediment control structures would be seeded with rapidly establishing plants.


TO MILL
MSA
NEW DEEP
SAVAL/STEER
BURNS SHOP
BURNS BASIN
LEGEND
Surface Mining Facilities (Alternatives B-E & G)
Underground Mining Facilities (Alternatives F & G)
Portal Areas (Alternatives F & G)
Powerline
Waterline
EIS Pit Boundaries
Primary Ore Haulage Routes
Streams (USGS)
Project Area Boundary
SCW : 11/13/93
Proposed Facility and Utility Locations
Scale in Miles
0 1/8 1/4 1/2 1
Map 2.3

After revegetation of disturbed areas, sediment control structures would be no longer needed. The sedimentation pond and sediment traps would be removed unless the USFS decides to retain them as post-mining water sources. Removal of these structures would consist of reestablishing the stream channels by excavating the fine sediment in the impoundment areas to stream level and contouring the material to blend with surrounding terrain. Disturbance created during removal of sediment control structures would be seeded with a mixture of grasses, forbs, and shrubs. Woody plant species would also be planted in these areas because the expected favorable moisture conditions would promote successful establishment.

Water Supply

IMC may develop new wells as a source of water for the mining operations and facilities. Specific locations for new water supply wells have not been identified. Should new water sources be necessary, IMC would obtain the required permits from the Nevada Division of Water Resources (NDWR) and USFS approval, if needed.

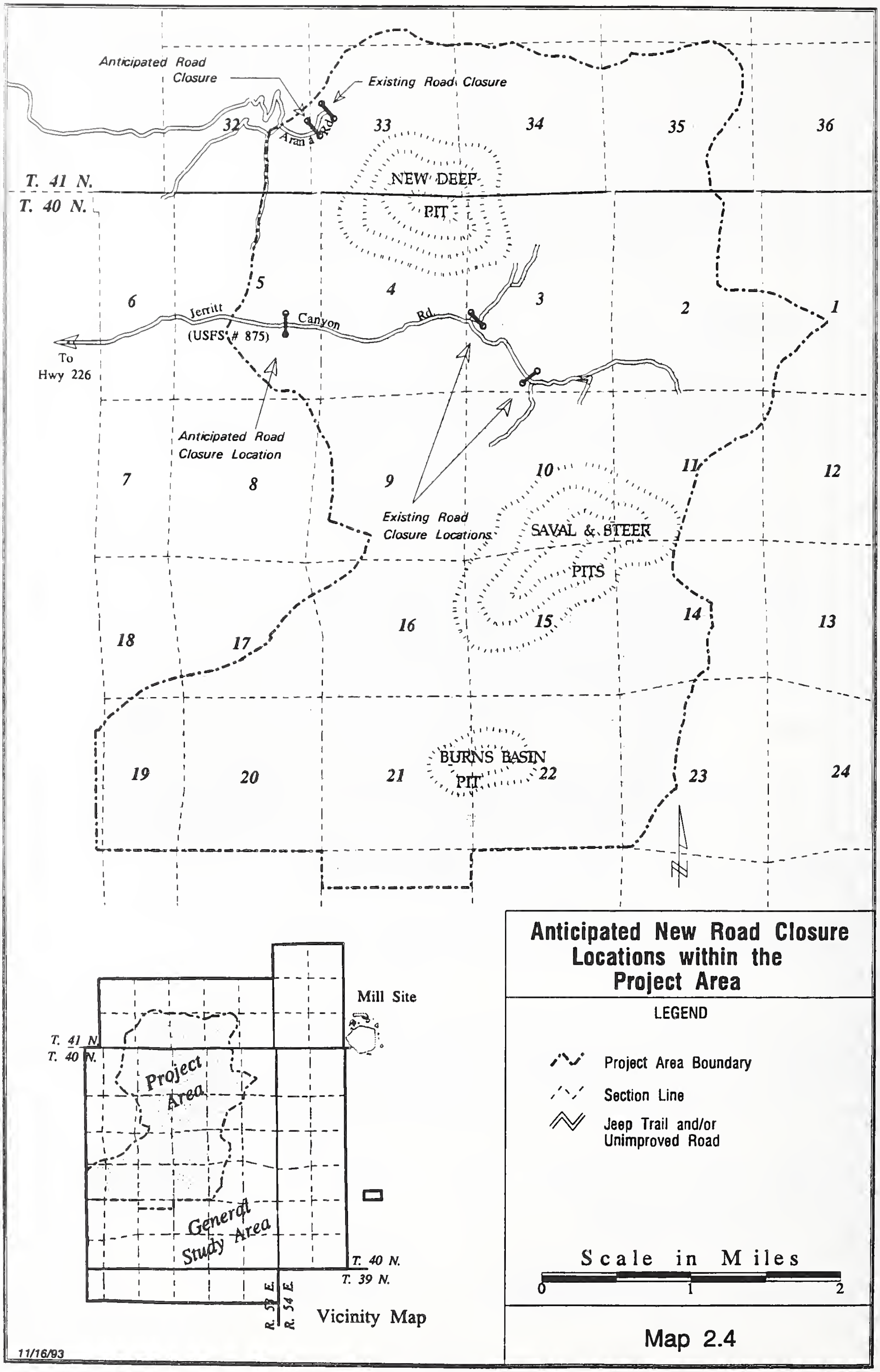
Hazardous Waste: Fuel and Explosive Storage and Handling

Petroleum products would be stored in appropriate locations, containers, and structures at the MSA complex, Burns Basin shop, and new mine facilities. Spill prevention would be conducted in accordance with the SPCCP for the Jerritt Canyon project. IMC would notify the USFS and other appropriate agencies of spills that meet the reportable quantity criteria specified by NDEP and EPA.

Health and Safety

IMC would continue to take precautionary measures for the health and safety of the public and IMC employees. Active mining operations areas would need to be closed for public safety reasons. The existing road closure on USFS Road 875 in Jerritt Canyon would be moved about 1.5 miles downstream from its current location in the western portion of Section 3, T40N, R53E to the middle of Section 5, T40N, R53E. The existing gate on Arana road would be moved less than one quarter mile to the west. The existing and proposed closure locations for these areas are shown on Map 2.4. No other new road closures are anticipated.

IMC would reduce the exposure of the public to mining related hazards after final mine closure by using one or more of the following methods: 1) restricting access with earthen berms or other effective barriers, 2) removing structures and equipment, 3) plugging drill holes, 4) leaving stable slopes, and 5) closing or sealing underground openings inside pits.



Anticipated New Road Closure Locations within the Project Area

LEGEND

- Project Area Boundary
- Section Line
- Jeep Trail and/or Unimproved Road

Scale in Miles

0 1 2

Map 2.4

Alternative C

Alternative C was developed in response to concerns about waste rock dump stability, reclamation potential, visual quality, integrity of stream inflow and outflow under dumps, water diversion in Burns Creek, and partial pit backfilling. Changes were made to the proposed action (Alternative B) as indicated on Map 2.5. Except as otherwise noted below, aspects of this alternative are the same as for Alternative B. A summary of the disturbance acres by disturbance type for Alternative C is displayed in Table 2.1.

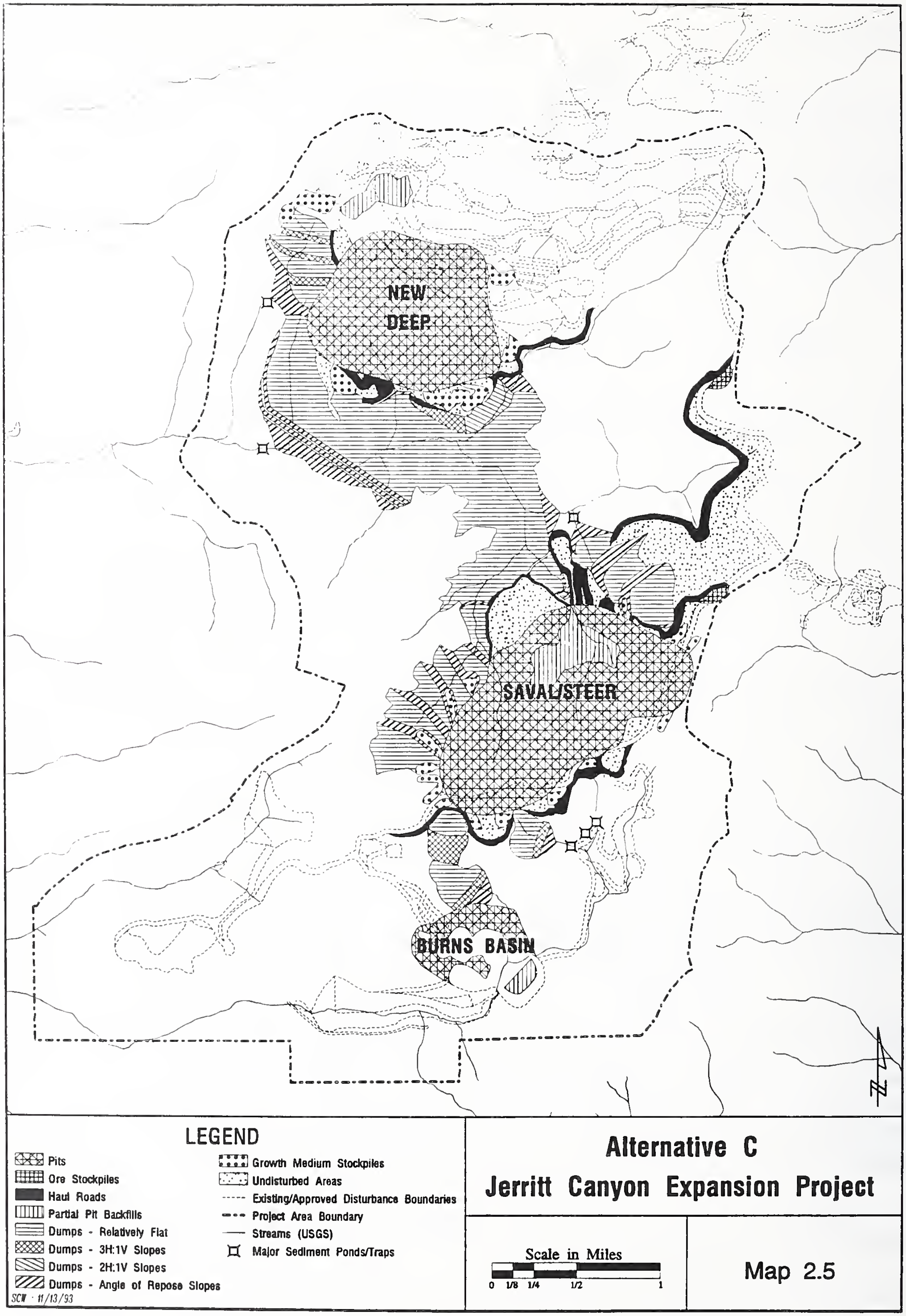
Stability would be enhanced through implementation of the following:

- Adding two terraces to the upper portion of the South Deep dump downstream slope;
- Developing a combination of 2H:1V and 3H:1V slopes on the south side of the ramp exiting the New Deep pit;
- Building the upstream portion of the South Deep dump as a single level;
- Reshaping upper slopes of the Gracie dump extension (to the west of the New Deep pit) to 3H:1V and adding two terraces;
- Adding 3H:1V slopes to the dumps south of the Saval and Steer pit area.

Stream inflow to and outflow from dumps were also considered in this alternative. Similar to the proposed action, dumps over stream channels would be constructed by end-dumping and an underdump drainage system would be created by gravity segregation of materials. The inlet and outlet of dump faces located in drainages would be left at angle of repose to promote functioning of the under-dump drainage systems. The dumps south of the Saval and Steer pits would be constructed with 3H:1V slopes along the upper portion of the dump and angle of repose slopes where the dump meets natural topography. The upstream side of the South Deep dump would be constructed as a single level with greater height to promote gravity sorting of waste rock and reduce the possibility of material compaction above the stream inflow point. The single level would be constructed to a height of approximately 130 feet, compared to 40 to 60 feet proposed under Alternative B.

Although potential partial backfilling is a feature common to all alternatives, this alternative displays conceptual partial pit backfill locations. Partial pit backfilling feasibility and locations depend on several factors which would be determined once pit development has begun. For this reason, partial backfilling in West Generator is the only known backfill location at this time since this pit has been mined out. Due to the uncertainties involved in planning for partial pit backfill, waste rock dumps generally are designed to provide sufficient capacity for all of the material from the pits.

The proposed Burns Basin dump expansion was relocated from the Burns Creek drainage to an area north of the pit and would be constructed as an extension of the south


NEW DEEP
SAVAL/STEER
BURNS BASIN
LEGEND
Pits
Ore Stockpiles
Haul Roads
Partial Pit Backfills
Dumps - Relatively Flat
Dumps - 3H:1V Slopes
Dumps - 2H:1V Slopes
Dumps - Angle of Repose Slopes
Growth Medium Stockpiles
Undisturbed Areas
Existing/Approved Disturbance Boundaries
Project Area Boundary
Streams (USGS)
Major Sediment Ponds/Traps
SCW · 11/13/93
Alternative C
Jerritt Canyon Expansion Project
Scale in Miles
0 1/8 1/4 1/2 1
Map 2.5

Steer dump proposed in Alternative B. The sediment trap proposed for this area under Alternative B would not be constructed.

In addition to the changes that respond to issues, a haul road was added that exits the New Deep pit and parallels Jerritt Creek to the existing Alchem pit.

Growth medium would be distributed on the 3H:1V dump slopes to a depth of approximately 8 inches. Otherwise, reclamation operations for the pits, dumps, ore stockpiles, haul roads, facilities, and sediment control structures would be the same as described for Alternative B.

Employment levels and duration of the Project for Alternative C are the same as for Alternative B.

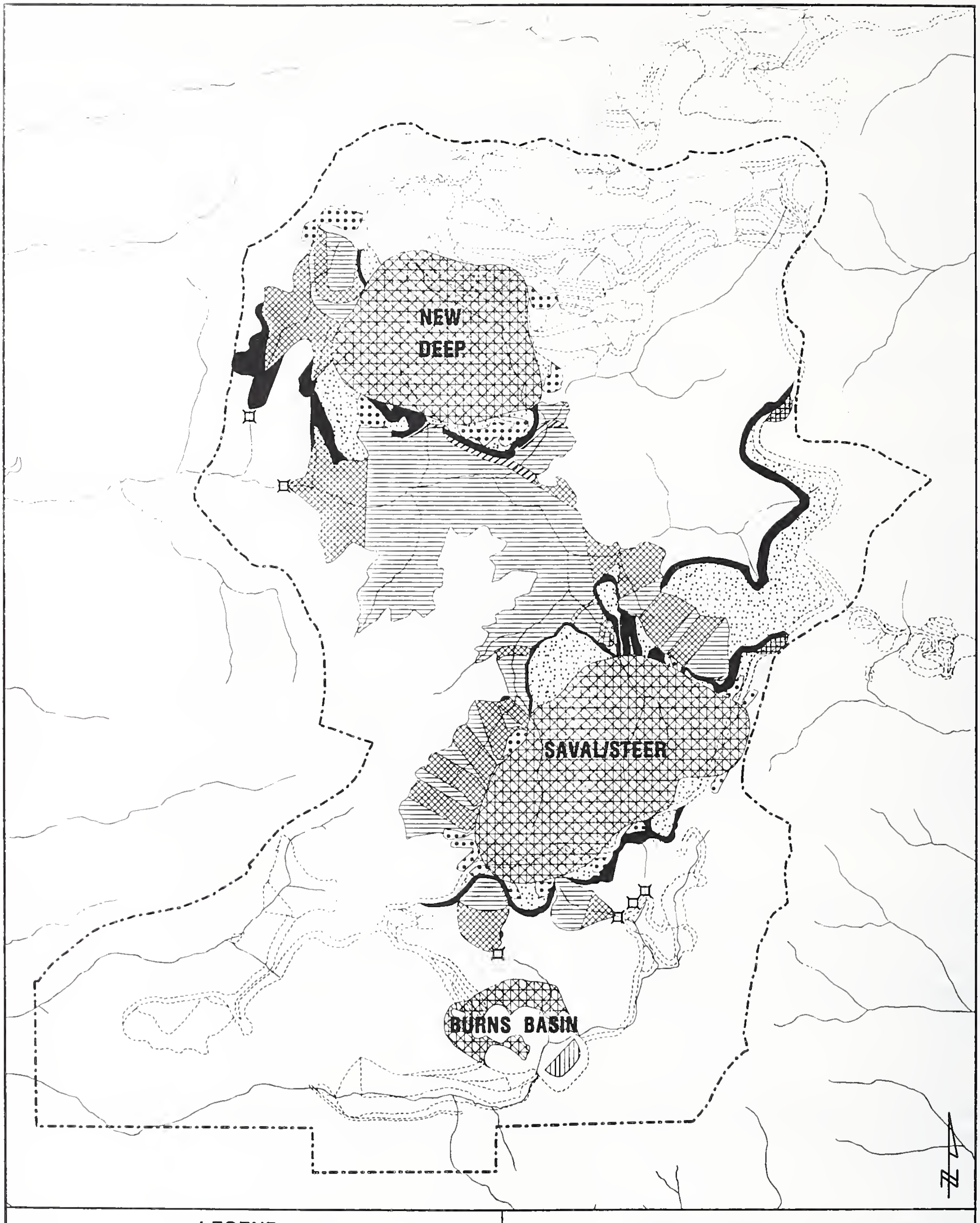
Alternative D

This alternative was developed in response to the waste rock dump stability and reclamation potential focus issues. Under this alternative, all dump slope faces would be graded to 3H:1V slopes, with the exception of the dumps immediately southeast of the New Deep pit which would remain as proposed in Alternative B. Waste rock excavated during the Burns Basin expansion would be partially backfilled in the Burns Basin pit. Developing 3H:1V slopes would require constructing the dumps in multiple levels, which in turn creates the need for more haul roads, as displayed on Map 2.6. It would be necessary to construct french drains from the base of the angle of repose slopes to the final base of the 3H:1V slopes. Extension of the french drains would be necessary to ensure proper functioning of the under-dump drainage system after the slopes are reduced to 3H:1V. A total of approximately 3,480 feet of french drains would be required. A summary of disturbance acres by disturbance type is displayed in Table 2.1.

As a result of creating 3H:1V slopes, the dump shapes would be altered and expanded from those in Alternative B. The most significant change is expansion of the South Deep dump downstream in Jerritt Canyon as shown on Map 2.6. An undisturbed area would occur southwest of the New Deep pit, which was proposed for a dump under Alternative B. The sediment trap proposed for the dumps to the north of the Saval and Steer pits is eliminated in this alternative.

The 3H:1V dump slopes would have approximately 8 inches of growth medium applied and be seeded with a mixture of grasses, forbs and shrubs. Reclamation of the pits, dumps, haul roads, facilities and sediment control structures would otherwise be the same as Alternative B.

Alternative D would result in mine operations and reclamation activities through 2006.


NEW DEEP
SAVAL/STEER
BURNS BASIN
LEGEND
Pits
Haul Roads
Ore Stockpiles
Partial Pit Backfills
Dumps - Relatively Flat
Dumps - 3H:1V Slopes
Dumps - Angle of Repose Slopes
Growth Medium Stockpiles
Undisturbed Areas
Existing/Approved Disturbance Boundaries
Project Area Boundary
Streams (USGS)
Major Sediment Ponds/Traps
Alternative D
Jerritt Canyon Expansion Project
Scale in Miles
0 1/8 1/4 1/2 1
Map 2.6
SCW : 11/13/93

Alternative E

This alternative was developed to address the concerns about waste rock dump stability, reclamation potential and water quality as it relates to the under-dump drainage system. Alternative E is essentially identical to Alternative D, except the upstream and downstream faces of the waste rock dumps would be developed at angle of repose to facilitate water flow into and out of the dump under drain. Alternative E is displayed on Map 2.7. In order to provide greater height for gravity sorting of waste rock and less compaction at stream inflow to the South Deep dump, the upstream design of this dump is the same as proposed in Alternative C. The upper portions of the downstream slope of the South Deep dump would be developed at 3H:1V, with the lower part at angle of repose.

The lower waste rock dump north of the Saval/Steer pit area would have the same angle of repose shape as in Alternative B and C. The dump to the southeast of the Saval and Steer pits would have the same slopes and shapes as Alternative B. The final downstream slope of the Gracie dump extension is proposed as angle of repose with a terrace. Other dump designs and Burns Basin partial pit backfill would be the same as for Alternative D. A summary of disturbance acreages is provided in Table 2.1.

Approximately eight inches of growth medium would be redistributed on the 3H:1V slopes and these areas revegetated. The other reclamation activities would be the same as Alternative B.

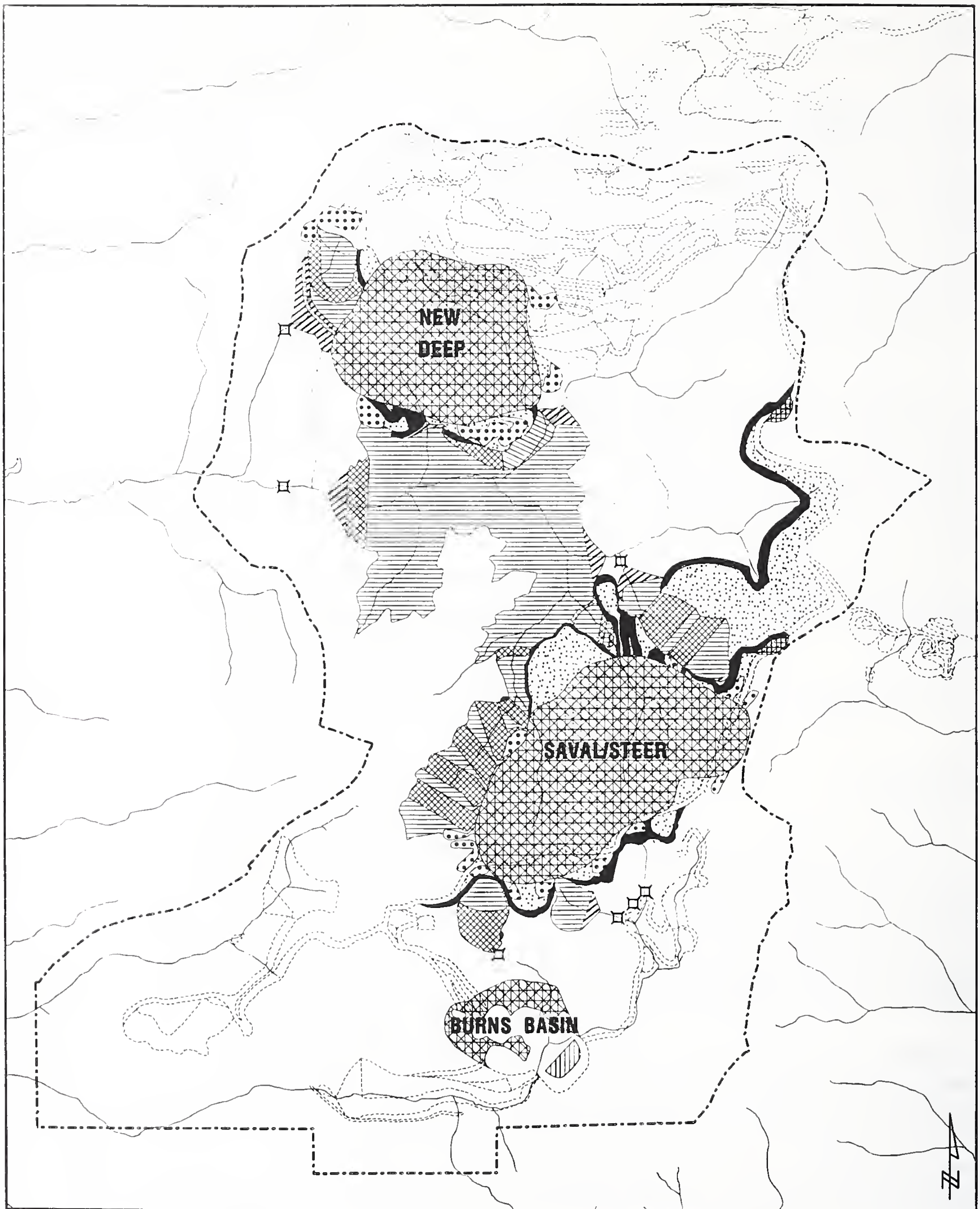
Alternative E would result in mine operations and reclamation activities through 2006.

Alternative F

This alternative was developed to respond to the potential for underground mining. IMC is currently evaluating the feasibility of developing the New Deep orebody using underground mining methods. This alternative, as displayed on Map 2.8, shows the disturbance associated with underground mining of the New Deep ore body and surface mining of the Saval, Steer, and Burns Basin pits. A summary of the disturbance acreages according to the type of disturbance is provided in Table 2.1.

Under this alternative, surface disturbance for the Saval, Steer and Burns Basin operations is the same as displayed in Alternative C with the following exceptions. The dumps to the south of the Saval and Steer pits would be designed with angle of repose slopes. The dump to the north of the Saval and Steer pits would be contained in the Saval and Steer drainage area and would stop short of the junction with Jerritt Creek. The sediment pond in Jerritt Creek would be moved upstream about one mile from the location shown for Alternative B.

Underground mining would require up to three portals as indicated on Map 2.8. Each of the portals would have dimensions ranging from about 13 to 20 feet wide by 15 to 20 high. As many as five ventilation shafts would extend from the surface to the workings.



LEGEND

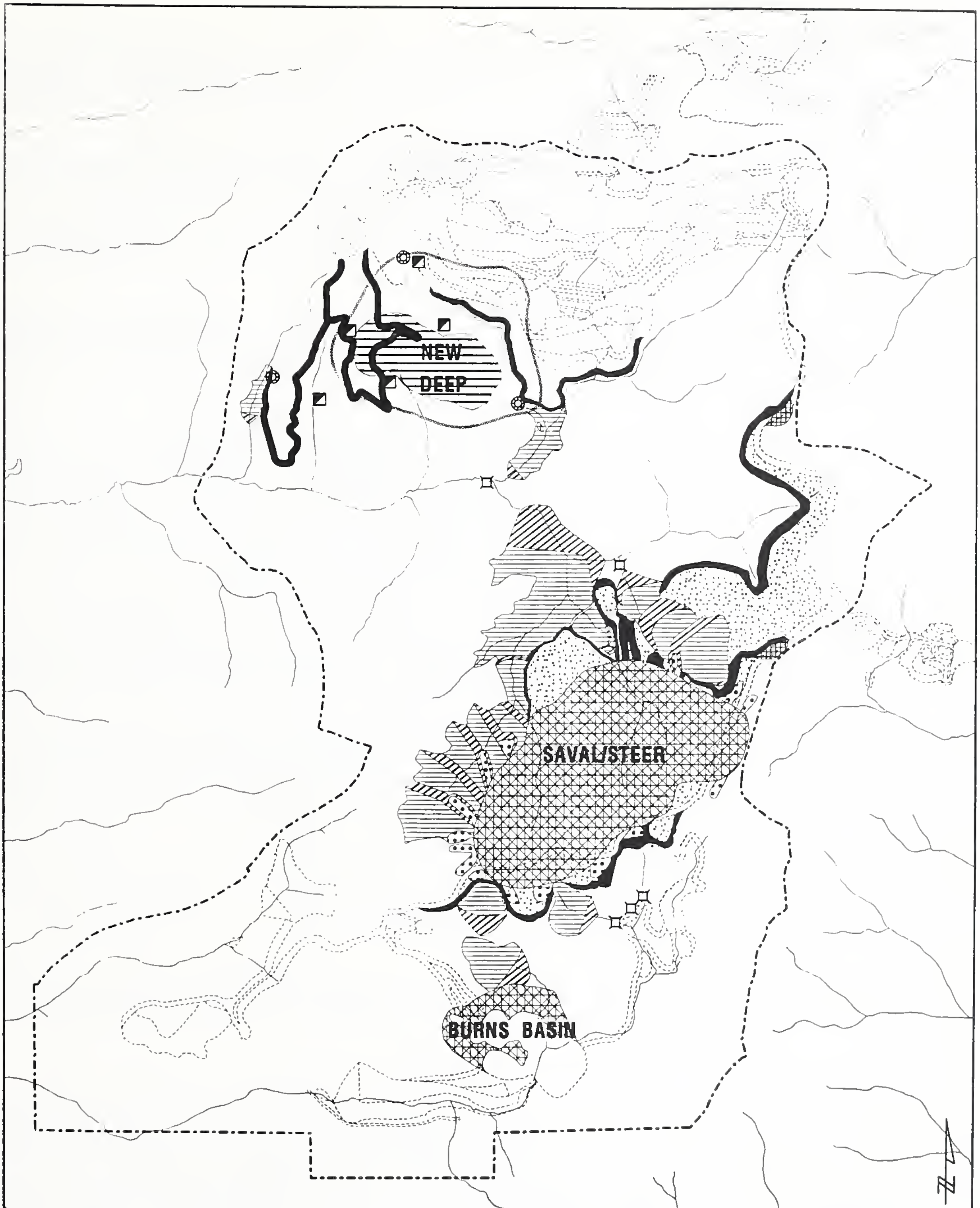
- Pits
- Ore Stockpiles
- Haul Roads
- Partial Pit Backfills
- Dumps - Relatively Flat
- Dumps - 3H:1V Slopes
- Dumps - 2H:1V Slopes
- Dumps - Angle of Repose Slopes
- Growth Medium Stockpiles
- Undisturbed Areas
- Existing/Approved Disturbance Boundaries
- Project Area Boundary
- Streams (USGS)
- Major Sediment Ponds/Traps

SCW 11/13/93

Alternative E
Jerritt Canyon Expansion Project

Scale in Miles
0 1/8 1/4 1/2 1

Map 2.7



LEGEND

- Pits
- Haul Roads
- Potential Subsidence Area
- Ore Stockpiles
- Dumps - Relatively Flat
- Dumps - Angle of Repose Slopes
- Growth Medium Stockpiles
- Undisturbed Areas
- Existing/Approved Didsturbance Boundaries
- Outer Limits of Potential Subsidence
- Project Area Boundary
- Streams (USGS)
- Major Sediment Ponds/Traps
- Portal Areas
- Ventilation Shaft Site Alternatives

SCW 11/13/93

Alternative F
Jerritt Canyon Expansion Project

Scale in Miles

0 1/8 1/4 1/2 1

Map 2.8

The shafts range from approximately 6 to 20 feet in diameter. One of these shafts would also serve as an emergency escapeway with a headframe and escape hoist at the surface.

Development of the underground workings would involve the use of cut and fill, sublevel stoping, or room and pillar mining methods, alone or in combination. Multiple levels would be required to access the orebody utilizing decline, incline and level drifts. Declines would be developed from the portal site to the orebody. Development of the underground workings in multiple levels would be required to access the orebody.

Surface subsidence may occur regardless of the underground mining method utilized, due to the overall size of the workings. The estimated maximum area of possible subsidence is shown on Map 2.8.

The volume of water that flows into the underground workings at New Deep is estimated to be on the order of 100 to 150 gallons per minute (gpm) on a sustained basis and not more than 250 gpm at any given time (HCI 1993). Inflows to the underground workings would be controlled using concrete, shotcrete, grout, or other standard methods. Water utilized or encountered during underground mining would be directed to sumps located inside the workings and near the portal sites. The availability of water at New Deep would reduce the amount of water that has to be pumped over six miles from wells on the east side of the Independence Mountains. Active dewatering prior to underground mining using wells and pumps is currently not anticipated. If active dewatering were necessary, the water would be pumped to storage ponds or tanks and utilized for dust suppression, exploration drilling, and washing heavy equipment or other uses at the existing and proposed mine facilities. In the event that there was excess water beyond that required for the mining operations, IMC would obtain the required permits for surface discharge or underground injection.

As described for Alternative B, underground mining from the pit walls or bottoms may be used to increase ore recovery during or after mining in the Saval, Steer and Burns Basin mine areas.

Facilities would be developed near the portal sites. Anticipated facilities would be similar to Alternative B and may possibly include conveyors from the portal to ore stockpiles.

Waste rock and ore would be removed through the portals. Ore would be transported from stockpiles near the portals to the mill on haul roads similar to those described for Alternative C. Waste rock would be transported to the waste rock dumps on haul roads shown on Map 2.8. These dumps would be developed by end-dumping and natural gravity segregation of materials, resulting in angle of repose slopes. Some waste rock may be used to backfill the stopes.

Bulkheading, blasting, or other effective methods would be used to permanently seal the portals after underground mining was completed. Earthen berms or steel grating would be utilized alone or in combination to prevent access to the ventilation shafts. Depending on the nature and extent of surface subsidence, appropriate access restrictions and reclamation measures would be implemented. Other reclamation activities would be the same as described for Alternative B.

Alternative F would result in mine operations and reclamation activates through 2004. Approximately 150 new positions would be created.

Alternative G

This alternative was developed to display the combined effects of using both underground mining and surface mining techniques for the New Deep orebody. The Saval and Steer pits along with the Burns Basin expansion would be the same as described under Alternative B. This alternative is displayed on Map 2.9 as a combination of Alternative B and Alternative F. Development of the western most portal site would result in additional disturbance as compared to Alternative B. It is unlikely that if both surface and underground mining were to occur that surface disturbance would be the total of both operations. However, throughout this analysis, Alternative G impacts are based on the total combined surface disturbances of Alternatives B and F.

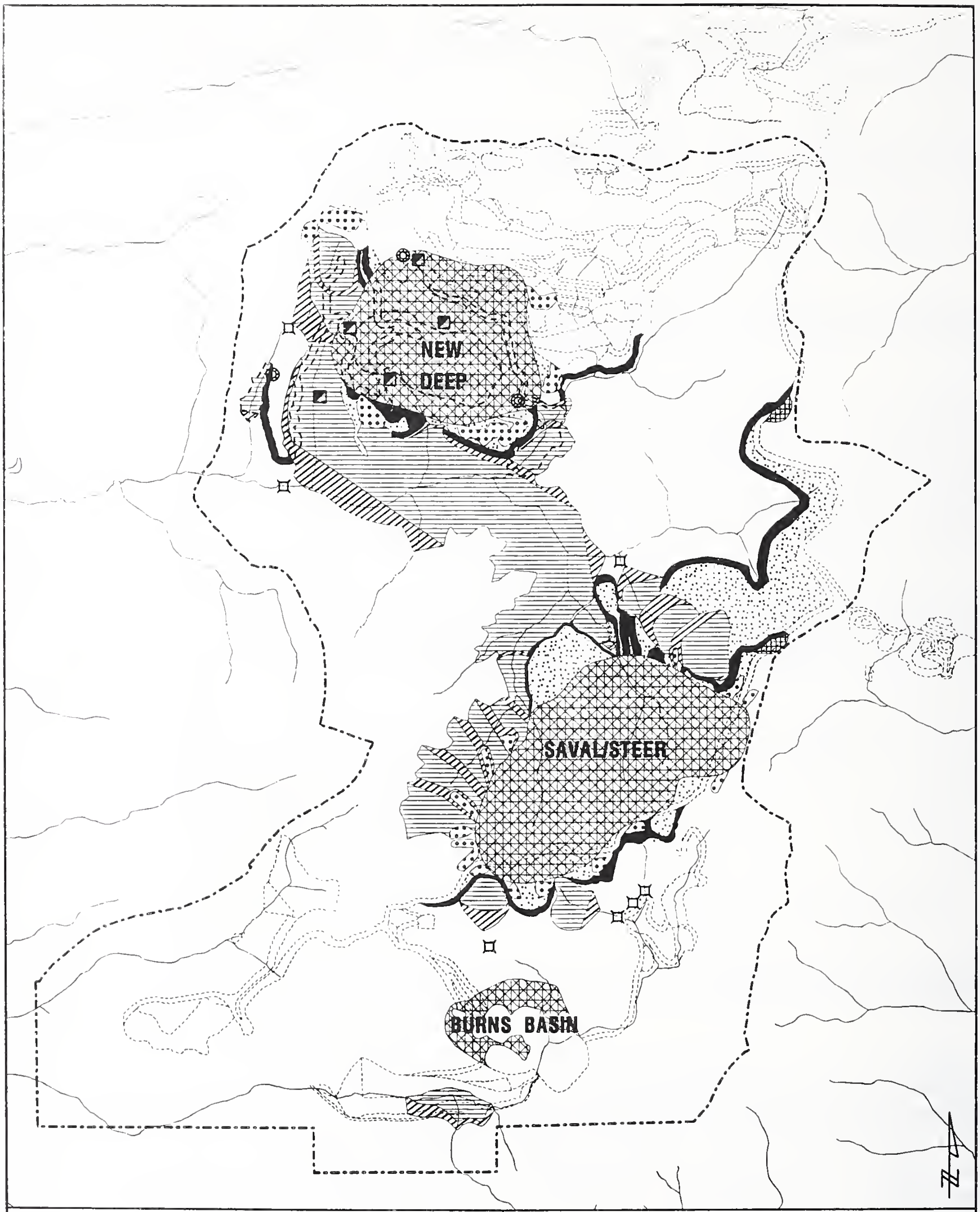
Underground mining methods may also be used in the Saval, Steer, New Deep and Burns Basin pits during or after surface mining to increase ore recovery. These sites are not known at this time. Use of such methods may require an amendment or modification to the POO and USFS approval before implementation.

Under this alternative it is assumed that surface mining operations would be the same as under Alternative B. The methods used to seal portals remaining after mining and restrict access to ventilation shafts and subsidence areas would be the same as described for Alternative F. Reclamation would be consistent with the methods described for Alternative B.

Alternative G would result in operations through 2005 as in Alternative B, but would create 200 to 300 new positions.

2.5 Alternatives Eliminated from Detailed Study

The IDT reviewed many alternatives that were eventually eliminated from further consideration because of environmental or operational constraints. These alternatives were based on the assumption that pit locations and configurations could not change, but that the waste rock dump and haul road locations and designs could change in response to various issues. Most of the alternatives focused on alternative waste rock dump locations with dump stability as the primary criterion for consideration. Other reasons to drop an alternative were:



Alternative G
Jerritt Canyon Expansion Project

Map 2.9

- Technical infeasibility;

- Did not respond to issues or had significant environmental disadvantages over the alternatives discussed in detail, especially if accompanied by increased technical risks or economic costs; and

- Economical infeasibility.

The following section provides a description of the alternatives that were eliminated from further consideration.

Initial Conceptual Design

In its initial conceptual design for the project developed in 1991, IMC estimated disturbance of approximately 4,900 acres for mine operations and associated waste rock dumps in the New Deep, Saval and Steer areas. This initial design had two major waste rock dump components, identified as the North Fork dump and the Saval/Steer/New Deep dump.

The North Fork dump included in the initial conceptual design was eliminated from further consideration for several reasons: (1) unfavorable haul distances and elevation changes; (2) limited capacity of the sidehill dump; (3) stability concerns; and, (4) the removal of one "island" of undisturbed habitat. This dump would have been 126 acres in size.

The Saval/Steer/New Deep dump was eliminated from further consideration because it would have (1) covered gold ore reserves and resources; (2) removed a larger area of deer winter range habitat; (3) filled additional wetlands and waters of the U.S.; (4) disturbed a greater amount of aspen stands; and, (5) disturbed an eagle nest. The dump would have covered approximately 3,360 acres in one interconnected dump footprint.

Burns Basin Waste Rock Dumps

Several sites were examined for locating waste rock removed from the Burns Basin pit. The following provides a description of other sites examined, but eliminated from further analysis.

Downstream Expansion of Existing Dump

Expansion of the existing dump downstream of the Burns Basin pit was considered but would result in environmental and operational problems. The dumping of additional waste rock to the downstream side of the dump would impact additional acres of aspen, waters of the U.S., and wetlands. Expanding the dump downstream could potentially result in disturbance of a raptor nest. It would also involve the relocation of the existing sediment pond and diversion ditch, and unfavorable haul distances.

Increase the Height of the Existing Dump

This alternative was eliminated because it did not meet stability criteria and because of negative environmental and operational considerations. Increasing the height of the existing dump would result in limited additional capacity, and would require additional dump sites as back-up. It could also result in visual quality impacts when viewed from the Independence Valley. The elevation differences between the existing dump and the pit would result in unfavorable haul costs.

Construction of Dumps from Burns Basin EA

Three dump sites that were originally considered in the Burns Basin EA were reconsidered and eliminated because of environmental, economic, and technical disadvantages. They were re-evaluated for their potential to contain waste rock from the expansion operations. Two of the alternative dump sites were eliminated from further considerations because they would disturb additional acres of waters of the U.S., wetlands, and aspen. The elevation change would result in unfavorable haul costs. The area partially covers a geologic resource area. The third dump site that was reconsidered would result in additional impacts to aspen and to waters of the U.S., including wetlands. An operational problem was that the pit itself would become a barrier to accessing the dump. A new haul road would need to be built across Burns Creek. The entire dump site would be located on a geologic resource area.

Expand the Existing Dump to Create Cross-Valley Fill

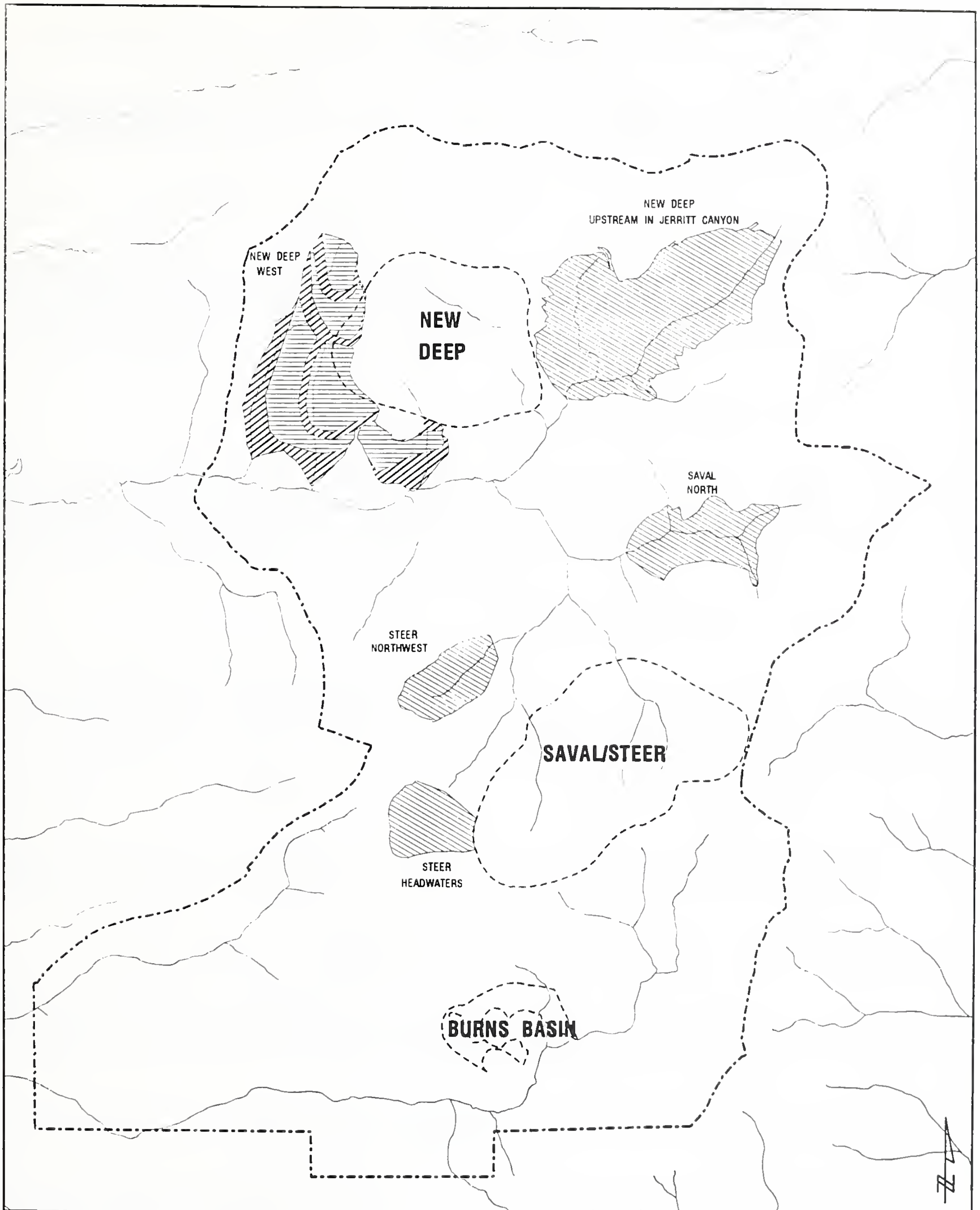
The possibility of providing greater stability by extending the dump across the drainage was examined but was eliminated because it is likely there would be insufficient material to extend the dump across the drainage. Extending the dump in this manner would also cover the existing diversion ditch located south of the Burns Basin dump. At least one and possibly two recently active goshawk nests would be covered. Additional waters of the U.S. including wetlands, would be impacted and more aspen would be disturbed.

Steer Canyon Waste Rock Dump Alternatives

Several sites were examined for locating waste rock from the Steer pit. The following provides a description of various sites examined, but eliminated from further analysis. Locations of select alternative dump sites eliminated from further study are shown on Map 2.10.

Haul Waste to Burns Pit and Backfill

This alternative was eliminated because the haulage distances would make the project uneconomical.



LEGEND

- Dumps - Angle of Repose Slopes
- Dumps - Relatively Flat
- Dumps - Slopes Undefined
- Proposed Pit Boundaries
- Project Area Boundary
- Streams (USGS)

SCW 11/13/93

Alternative Waste Rock Dump Sites Considered But Eliminated From Further Study

Scale in Miles

0 1/8 1/4 1/2 1

Map 2.10

Avoid Waters of the U.S. Including Wetlands

Creating sidehill dumps to avoid the Steer Canyon drainage resulted in slopes that did not meet dump stability criteria. The dumps would not have the capacity to contain the full volume of waste rock.

Develop Dump in Headwaters of Steer Canyon

In order to fully utilize the Steer Canyon drainage for waste rock disposal, the alternative of creating a head-of-valley dump was considered. This option would require an extensive haul road network and unfavorable haulage distance. In addition, there would be additional aspen removed.

Develop Dump Northwest of Steer Pit

This alternative was considered as a means of reducing the area of the waste rock dumps in Steer Canyon. It was eliminated because it required construction of additional roads, unfavorable haul distances and a causeway to be built across Steer Canyon to access the dump site.

Move Dumps from Steer Canyon

Completely eliminating all dumps in Steer Canyon and moving the waste rock to other locations was also considered. This alternative was infeasible due to the volume of waste rock and haul costs to other locations.

Saval Canyon Waste Rock Dumps

Several sites were examined for locating waste rock from the Saval pit. The following provides a description of various sites examined, but eliminated from further analysis.

Haulage to Pattani Pit for Partial Backfilling

This alternative was eliminated due to unfavorable haulage distances, elevation changes resulting in unfavorable haul costs, disturbance of previously reclaimed areas, and limited capacity for additional waste rock storage.

Avoidance of Waters of the U.S. Including Wetlands

Attempting to avoid waters of the U.S. and wetlands in Saval Canyon would result in dumps that could not meet stability criteria. The dumps would not have the capacity to hold the full volume of waste rock from the Saval pit.

Develop Dump North of Saval Pit

Fewer wetlands would be impacted under this alternative than under the proposal for dumps in Saval Canyon, but the distance required to haul the waste rock would be uneconomical. This alternative site is displayed on Map 2.10.

New Deep Waste Rock Dumps

Several sites were examined for locating waste rock from the New Deep pit. See Map 2.10 for locations of the alternatives eliminated from further study.

Develop Dumps West of the New Deep Pit

The alternative of creating dumps to the west of the New Deep pit was considered as a means of reducing or eliminating the South Deep dump, which would be located in Jerritt Creek. The alternative dump sites would create a combination of head-of-valley and sidehill type waste rock dumps in an unnamed drainage to Jerritt Creek. This alternative was eliminated because the sidehill dumps could not meet stability criteria. Additional capacity needs at this site would result in additional disturbance to the adjacent drainage to the west. Geologic resources would be covered and haul distances would be unfavorable.

Develop Dump Upstream in Jerritt Canyon

This alternative was proposed for waste dumps in the headwaters of Jerritt Creek. This alternative was eliminated due to unfavorable haul distances, elevation changes resulting in uneconomic haul costs and impacts to perennial portions of Jerritt Creek and wetlands areas.

Socioeconomic Alternatives

An alternative to promote community stability by freezing mine employment at current levels was examined. The 150 to 200 additional employees proposed in the Plan of Operations submitted by IMC would be necessary to strip the New Deep pit and to concurrently provide mill feed from Saval, Steer and Burns Basin until ore is produced from New Deep. It is estimated that it would take two to three years of stripping waste rock before ore is produced from New Deep. Without the proposed additional employees, mill feed would be reduced or curtailed at some point, resulting in layoffs of mill employees. Timing is a critical element in mine planning to ensure a consistent flow of ore through the process. Partially or fully shutting down the processing facility and laying off people is detrimental to any mining operation. Cash flow would be affected during this time frame and losses would be incurred by vendors, townspeople, and local government. Consequently, this alternative was eliminated from further consideration because it did not meet the purpose and need identified in Chapter 1.

Public Scoping Document Alternative C

As described in Section 2.2, this alternative was eliminated because its elements were incorporated into other alternatives. Therefore, environmental differences would be analyzed in the other alternatives.

2.6 Management, Mitigation and Monitoring

Management constraints, mitigation measures, and monitoring programs applicable to the proposed project and the project alternatives are discussed in this section.

Management Constraints

Management constraints are the laws, regulatory requirements, and LRMP standards and guidelines that are in place to ensure that resource development takes place in an environmentally sound manner. Federal, state, and local government agencies administer the laws, regulatory programs, and guidelines for the protection of the environment. The permits and approvals listed in Table 1.1 are required for the implementation of the proposed project or any of the action alternatives. These permits and approvals are the means by which the appropriate regulatory agencies implement the laws, regulations and guidelines for which they are responsible. The proposed Project and the action alternatives have been designed and developed within the management constraints of these permits and approvals. The final POO that would be submitted by IMC to the USFS following selection of an action alternative would describe in detail those aspects of project design and management practices that would protect environmental resources. The management constraints described in the POO submitted for the proposed project (IMC 1993) are generally applicable to all of the Project alternatives.

Mitigation Measures

Mitigation measures are applied to components of the proposed Project and the alternatives to help avoid, minimize or compensate for adverse environmental effects. The mitigation measures described in this section are applicable to the proposed Project and the action alternatives (Alternatives B through G). Existing activities form the no action alternative and were approved under various NEPA decisions. These activities have their own specific approved mitigation measures, most of which would also be implemented under the proposed action or an alternative to the proposed action. The proposed mitigation measures have been formulated by the issues, concerns, land use objectives and the management constraints of the Humboldt National Forest LRMP.

Monitoring Programs

Monitoring programs for the proposed action and the alternatives would be implemented to ensure that environmental safeguards are executed according to plan, necessary adjustments are made to achieve desired environmental effects and anticipated results are reviewed. Monitoring programs help ensure that decisions by the responsible officials are implemented, including mitigation measures and conditions in permits and approvals. The objective of the monitoring programs is to detect changes in environmental conditions and take corrective action in a timely manner. Results of monitoring programs are incorporated into the existing information base to more readily assess the effects of the mitigation measures. The results of relevant monitoring would be presented to the regulatory agencies on a regular basis.

Monitoring programs are currently in place for the existing mining operations, and are conducted by IMC in conjunction with the USFS, cooperating agencies, and the State of Nevada regulatory agencies. IMC would expand existing monitoring programs to include the proposed new mine areas. New monitoring programs, if required, would be designed and initiated in cooperation with the appropriate regulatory agency. Monitoring of baseline environmental conditions has also been conducted in the preparation of this DEIS. Some of the baseline studies would be continued as monitoring programs throughout the life of the Project and during and after reclamation.

Under all alternatives, a quality assurance/quality control (QA/QC) program would be implemented for the new mine areas by IMC in cooperation with the USFS. The QA/QC inspections would be designed to monitor compliance with the final approved POO.

Mitigation and Monitoring Measures Applicable to All Action Alternatives

The following mitigation measures and monitoring programs were proposed by IMC as part of the proposed action or were developed to respond to impacts identified during the EIS effects analysis process. They are organized by environmental resources and are discussed in the same order that resources are discussed in Chapters 3 and 4. Focus issues identified for the proposed project and the alternatives are discussed in more detail within the appropriate resource category.

Geology

Geochemistry

The potential for the waste rock dumps, pit walls, and ore stockpiles remaining after mining to release acidic waters or trace elements has been identified as a focus issue. The potential to generate acidic waters is currently being evaluated under a waste rock characterization program, including kinetic testing. Results of the static and kinetic testing program would be used to develop a waste rock evaluation program that would guide additional sampling, analysis, handling and placement of materials determined to be acid forming. This monitoring program would be incorporated into the final POO. Also, see Surface Water Monitoring section.

Geotechnical Considerations

Waste rock dump stability has been identified as a focus issue for the proposed project. Various engineering design and construction techniques are used to address the geotechnical and stability considerations, including pseudostatic (seismic) stability, mass stability, foundation stability, surface stability, long-term drainage control, and erosion control on waste rock dumps and other project components. Implementation of these techniques would provide for project components that are structurally competent under anticipated geologic and climatic conditions.

The waste rock dump designs may be modified from the configurations shown in Chapter 2 as site specific conditions or constraints dictate. This would allow for variations in the pit dimensions that may result in reductions to anticipated waste volumes, changes in the characteristics of the waste rock, or placement of waste rock in partial pit backfill areas. Waste rock dumps would meet stability requirements even if the dumps do not approximate the shape displayed in this DEIS. The final design would not exceed the approved waste rock dump footprints. Slopes that were approved at 2H:1V or 3H:1V would not be modified to steeper angles. Upon completion of a dump, no unbuttressed angle of repose slope would have its toe on a foundation that is steeper than 30 percent.

The waste rock dumps would be constructed by end dumping. The advancing face of the dumps would be at the angle of repose, estimated to be approximately 1.3H:1V. Waste rock dump design would include under-dump drainage systems to enhance physical stability and to encourage surface water flow through the dumps. Waste rock dump stability and hazard analyses have been performed to identify which design and construction techniques would be appropriate to achieve stable final configurations. Dumps with angle of repose slopes would meet factors of safety that are acceptable to the USFS. Under Alternatives C and D, the angle of repose waste rock dumps would be regraded to an overall slope of 3H:1V, which would further enhance stability.

Erosional stability of final 3H:1V dump slopes would be achieved by revegetation. Surface drainage and erosional stability of the 2H:1V and angle of repose dump slopes would be achieved by armoring with coarse and durable material.

The size and durability of material that would be placed in the under-dump drainage systems would be controlled during operations. This material would be large enough to remain in place while providing passage for a 100 year storm event through the waste rock dumps. A definition of coarseness and durability in measurable terms would be developed. These specifications would be based on standard engineering durability tests performed on representative samples of the various rock formations or subunits within formations. The geochemistry of material that would be placed in the underdump drain would also be evaluated under the waste rock evaluation program. Fine materials that would adversely affect dump stability and the underdrain would be placed in non-critical portions of the waste rock dump areas.

Springs and seeps identified within the drainage bottoms would be covered by the under-dump drainage system. Springs and seeps on hillsides outside of the drainage bottoms would be drained by foundation trenches that extend to the nearest drainage bottom or beyond the dump perimeter.

Other project components would also be designed to be stable and structurally competent. The pit would be mined using conventional open-pit methods that include drilling, blasting, loading and hauling from a series of benches. The walls of the pit would be left in a stable configuration with an overall slope of 30 to 50 degrees and 20 to 100 foot wide benches. Haul roads would be designed and constructed with drainage control structures such as ditches, culverts, and sediment control basins that would reduce erosion and enhance the stability of the roads.

Monitoring

Monitoring of geotechnical aspects during construction and operation would be accomplished primarily through implementation of the QA/QC program. The underdump drain material would be monitored during waste rock dumping. The size and durability of material placed in the drain would be evaluated visually and documented through photographs and other visual aids. These visual records would become part of the QA/QC inspection reports and would be submitted to the USFS. Monitoring of the coarse and durable material to be applied to the angle of repose dump surfaces and placement of fine materials in specified dump locations would take place under the QA/QC program. The condition of active haul roads and access roads would be monitored during weekly mine operations self-inspections, and appropriate corrective actions would be taken as necessary. This would be in addition to the normal USFS administration of the Project area.

Soils

The goal of the growth medium salvaging and stockpiling operations would be to remove sufficient quantities to cover the acreages specified in the reclamation plan. Growth medium is defined as the A, E, B, and C soil horizons or underlying materials that are suitable for plant growth. Soils would be salvaged during pit development from those portions of the proposed pits with slopes less than 30 percent with a sufficient thickness of soil to enable salvaging. Growth medium would be recovered from portions of the proposed pits with slopes greater than 30 percent where feasible. Direct redistribution would be used wherever possible to enhance soil productivity, expedite reclamation, and reduce double handling. Growth medium that cannot be redistributed would be stockpiled. These stockpile areas are located as close as possible to the removal and redistribution areas to minimize new disturbance to the extent possible. Stockpiled soils would be interim seeded and stabilized with silt fences or berms to retain the soil materials and control wind and water erosion. Preliminary estimates of available growth medium based on depth to bedrock and soil mapping in the Project area indicate that a sufficient quantity of soil is available to meet the projected needs.

Soil suitability for growth medium would be determined visually in the field during growth medium salvaging. This evaluation system would be based on soil characteristics such as color, texture, percent rock, soil depth, associated vegetation community type, and other easily recognized features. Nutrient characteristics of redistributed growth medium would be evaluated using standard soil tests. Fertilizer would be applied as necessary to enhance seeding success.

Protection of soil resources in the Project area would be accomplished through use of control measures such as silt fences, water bars, sediment traps, culverts, ditches and interim, concurrent, and final revegetation. Ongoing maintenance of these measures throughout construction and operation of the Project would protect soil resources.

Monitoring

Growth medium stockpile volumes are currently and would continue to be monitored on an annual basis. Locations and volumes of existing growth medium stockpiles and projections of future stockpiling would continue to be reported to the USFS in the Annual Work Plan submitted by IMC each year.

Air Quality

IMC would comply with applicable state and federal regulations pertaining to air quality. This would be accomplished through use of fugitive dust control measures as part of construction, mining and reclamation activities. These measures would include: 1) periodic watering of haul roads, construction roads, and unpaved access roads on a seasonal basis utilizing water trucks or other equally effective means; 2) chemical stabilization of unpaved roads through use of magnesium chloride or similar substances; 3) controlling emissions from stationary sources such as rock crushing and screening facilities; and 4) revegetation.

Monitoring

Fugitive dust emissions from haul roads and crushing activities would be monitored visually. Source testing would be conducted at the mine crushing and screening facilities if current production rates were to increase substantially. The source testing would be used to determine compliance with applicable air quality permits.

Surface Water Resources

Surface Water Quality

A variety of methods would be used to comply with state and federal water quality standards or to meet baseline conditions. The measures used would be designed to reduce introduction of sediment into surface waters and minimize the potential to introduce chemical contaminants into surface waters.

The objective of the sediment control measures would be to retain sediment within disturbed areas or to capture sediment as close to the source as possible. Sediment control measures would consist of practices such as: disturbing the smallest practicable area during mining through mine design and concurrent reclamation practices; stabilizing disturbed areas where possible to reduce the rate and volume of runoff; intercepting and treating runoff from disturbed areas to prevent sediment from leaving the site; and diversion of runoff around disturbed areas during mining where feasible. Runoff would be intercepted by use of straw dikes, riprap, check dams, mulches, vegetative sediment filters, silt fence, and erosion control fabric. These structures would also serve to decrease overland flow velocities, reduce runoff volumes and trap sediment. Sediment ponds, traps and/or sumps would be used alone or in series at appropriate locations to control sediment. Road crossings of waters of the U. S. would be designed, constructed, maintained and reclaimed to comply with the Corps Nationwide Permit 14 requirements through such measures as installing culverts, rock-armored crossings, or other effective measures. Final locations and design specifications of sediment control structures would be field-reviewed with the USFS prior to construction. Sediment control structures would be examined and maintained on a regular basis. Materials removed from sediment control structures would be disposed in a location approved by the USFS.

A waste rock evaluation program would be implemented during mining to determine whether selective handling and placement would be required. Implementation of these measures would mitigate potential effects to surface water quality if production of acid waters or release of trace elements were to occur. In order to minimize the potential for impacts to surface water quality from on-site spills involving petroleum products, a Spill Prevention Control and Countermeasure Plan (SPCCP) has been developed by IMC as part of the POO. The SPCCP outlines the procedures and equipment in place to prevent oil spills from entering navigable waters of the United States. A contingency plan is in place to ensure timely, efficient, coordinated and effective action to minimize environmental damage. The plan details a variety of cleanup and remediation strategies to be implemented in the event of an oil spill.

Surface Water Quantity

Mitigation of potential effects to surface water quantity would be accomplished by routing surface water through or around mine disturbance areas. Waste rock dumps placed in drainages would be constructed with an under-dump drainage system. This drain would be constructed and maintained so that surface water is conveyed through the dump.

Monitoring

Surface water quality and quantity are and would continue to be monitored at specific locations determined in cooperation with the USFS. Water quality would be monitored to determine compliance with applicable state and federal water standards or baseline conditions. The monitoring program would include existing sites on Burns Creek and Jerritt Creek. Event-based samples would be collected at selected stations using single-stage sediment samplers to provide data representative of water quality during storm events. The water monitoring program is currently being evaluated by the USFS and IMC, and sampling parameters, stations, and frequency of sampling may be modified.

Results from the surface water monitoring program are and would continue to be provided in the Annual Work Plan, which would be submitted to the USFS each year. Surface water quality trends identified by the monitoring program would be assessed, reported to the USFS in a timely manner, and acted upon to reduce the impacts to an accepted level.

Monitoring of sediment ponds and roads would also be conducted. Quality control and construction monitoring would be conducted by IMC and USFS personnel. IMC and the USFS would annually review the effectiveness of ongoing erosion and sediment control measures as part of the Annual Work Plan.

Groundwater Resources

Groundwater discharge from springs and seeps that would be covered by the waste rock dumps would be conveyed through the under-dump drainage systems. Flow from springs located on hillsides outside of the drainages would be conveyed to the dump perimeter or nearest drainage using trench drains.

The New Deep pit would extend below the estimated regional groundwater table and groundwater may enter the pit. The quantity of water that would enter the pit is unknown but, based on preliminary estimates, is expected to be on the order of 100 to 300 gpm (HCI 1993). During mining operations, water that collects in the pit would be routed to sumps, utilized at the mine facilities, used for dust suppression, or be discharged or injected into the ground with the required permits and authorization. After mining is completed, groundwater may flow into the New Deep pit and stabilize at or near the pre-mining static water level of approximately 6,100 feet.

The Saval, Steer and Burns Basin pits are not expected to intersect the regional groundwater surface. Groundwater from local perched aquifers may enter the pit and would be routed to sumps in the pits and utilized during mining if sufficient quantities are available.

Monitoring

Water that accumulates in the New Deep pit would be monitored during project implementation and after mining is completed. The pit water monitoring program would be developed and incorporated into the final POO. The Saval, Steer, and Burns Basin pits would be monitored after mining to determine if water would be impounded within the pits. If the pits impound water, the USFS, IMC and NDEP would evaluate the situation to determine if they should be allowed to retain water or if measures should be taken to provide drainage.

Water quality and quantity of Niagara and Van Norman Springs would also continue to be monitored on a regular basis. Groundwater flow rates for Niagara Spring and Van Norman Spring are highly variable. Monitoring for effects to flow would take into account baseline fluctuations. If monitoring of water flow of Van Norman or Niagara Springs detects a reduction of flow that impairs the use of these springs and if the reduction is attributable to mining, appropriate mitigation measures would be implemented. These mitigation measures would be developed in cooperation with the current holders of water rights to the springs.

Wetlands

Mitigation of impacts to wetlands includes avoiding, minimizing, rectifying, reducing or eliminating, and compensating, as defined in regulations at 40 CFR 1508.20. Development of alternatives and analysis of impacts in this DEIS have incorporated these aspects of mitigation for impacts to wetlands. Wetland areas and waters of the U. S. were avoided to the extent possible during design of the proposed project and the alternatives. Where wetlands would be affected by the Project, impacts would be minimized to the extent possible. A description of potential wetland mitigation, including avoidance and minimization, is included in Chapter 4.

A wetlands mitigation and monitoring plan is being developed by IMC in coordination with various resource agencies (IMC, 1993). The objective of the mitigation plan is to compensate for wetlands impacts in a manner consistent with mitigation guidelines and regulations. Under that plan, IMC would commit to the following measures, to the extent practicable: 1) avoid impacts to wetland habitat; 2) minimize wetland impacts that are unavoidable; 3) replace all wetland habitat that is disturbed with a mitigation ratio of at least 1:1 and as much as 2:1; and, 4) create new wetland habitat with similar functional values to those which were lost.

Monitoring

The QA/QC program to be implemented during project construction and operation would ensure that no additional wetlands are affected beyond those authorized for disturbance by the Corps. Monitoring would also occur under the wetlands mitigation plan that is designed to evaluate whether the created wetlands have been successfully established based on criteria specified in the plan. Monitoring efforts would determine the need for additional planting, seeding, weed control, or physical modification to ensure that success criteria are met. The created wetland sites would be monitored for five years or until the success criteria are met, whichever is greater.

Aquatic Resources and Fisheries

Aquatic habitat maintenance and protection for fisheries habitat would be accomplished through mitigation measures that protect surface water resources, described above. In particular, sediment would be controlled using a variety of sediment control techniques. Riparian habitat enhancement efforts would continue in Jerritt Creek.

Monitoring

Aspects of aquatic habitat would be monitored through the surface water quality and quantity monitoring program. Additional monitoring would include fish populations, macroinvertebrates, and stream characteristics for Burns Creek.

Vegetation

Effects to vegetation resources would be mitigated through implementation of interim, concurrent and final reclamation. IMC's POO describes reclamation measures for pits, waste rock dumps, roads, ore stockpiles, sediment control structures and facilities (IMC, 1993a). These are summarized briefly in the description of Alternative B in this chapter. The POO also describes revegetation goals and procedures that are briefly summarized below.

Areas designated for final revegetation would be seeded with a mixture of grasses, forbs and shrubs. Selection of plant species would primarily focus on controlling erosion, providing forage for wildlife and livestock, and developing portions of the post-mining reclamation areas as specific types of wildlife habitat. Seed mixes would be based on site-specific characteristics (soil type, vegetation community, precipitation, slope, aspect, etc.) with consideration of (1) adapted species (2) diversity of species (typically grasses, forbs, and shrubs), (3) species which enhance natural succession, (4) seed availability, (5) competition, and (6) speed of establishment. Areas where moisture accumulates and sites with a thick layer of growth medium would be given preference for supplemental revegetation with trees and/or shrubs.

Monitoring

Reclamation activities would be monitored throughout the operation and through the completion of final reclamation. Operational monitoring of interim reclamation includes qualitative visual assessment of vegetation growth and cover on disturbed areas, and assessing earthmoving strategies for achieving the long-term reclamation objectives. Reclamation monitoring would be conducted for at least three years to assess vegetative cover and woody plant density on disturbed areas. Revegetation success would be evaluated based on comparison with undisturbed reference areas or by other standard methods. Criteria for successful revegetation would be included in the final POO.

Wildlife

Mule Deer

Impacts to mule deer have been addressed and mitigation is provided for in a Memorandum of Understanding (MOU) between IMC, USFS and NDOW. This agreement identifies funds IMC has and will contribute to fund deer habitat management activities. This action mitigates for all past, present, and future impacts to mule deer habitat (up to 5,500 acres of long term impacts to mule deer habitat) in the Independence analysis area. In addition, IMC would continue to work with the USFS and NDOW to utilize reclamation practices and plant species in areas to be revegetated that would benefit and support mule deer on mined areas after reclamation.

Sage Grouse

Mitigation for effects to potential sage grouse brooding habitat would include off-site mitigation and habitat enhancement during reclamation. IMC, USFS, NDOW, and BLM would identify sites in which sage grouse brooding habitat can be improved or developed to mitigate the long term loss of potential brooding habitat caused by implementation of any action alternative in this DEIS. A system has been established and would be maintained by the USFS, NDOW, and IMC, to document the number of acres mitigated versus the number of acres disturbed. In addition to off-site sage grouse mitigation, IMC would include plant species recognized as having value to sage grouse in the seed mixtures that would be utilized on appropriate portions of the reclamation areas and in off-site mitigation.

Raptor Habitat

During mining or reclamation, portions of the pit walls would be altered by creating holes or cracks where natural voids and solution cavities are not exposed. This could result in additional raptor nesting or perching sites. The dimensions, locations, and number of holes would be determined in cooperation with the USFS and NDOW.

The proposed mining activities are expected to remove historic goshawk nests 074, 127, and 128 and impact the home range of three other nests. IMC is considering specific mitigation for the loss of the historic goshawk territory that includes nests 074, 127 and 128. Although these nests have not been occupied by goshawks recently, IMC is considering "hacking" nests in suitable unoccupied habitat. If this is considered desirable and feasible by the USFS and NDOW, researchers at a University specializing in raptors would be contacted for a research project. Potential hack sites, methods or other mitigation measures would be discussed with USFS and NDOW.

Disturbance of the home ranges for goshawk nests 027 and 136 would not exceed the TOC. Home range disturbance for goshawk nest 134 would exceed the short- and long-term TOC's. However, planting of aspen and other woody plant species on portions of the relatively flat dumps and along sections of the recontoured haul roads is proposed to develop suitable habitat for goshawks and other wildlife species. Rodent populations may increase within the waste rock dump sites after mining is completed, which would provide additional prey for goshawks.

A golden eagle nest would be covered by the New Deep dump as configured in Alternatives B and G. This nest is commonly known as the pinnacle nest. IMC would cooperatively attempt to remove, relocate, or "hack" this nest, if this is considered desirable and feasible by the USFS, NDOW and USFWS. IMC would be required to obtain a permit from the USFWS prior to removing this nest.

Boulder piles would be constructed at select locations on the dump surfaces to simulate rock outcrops. The boulder piles would create raptor perches and provide cover for small mammals.

Cavity Nester Habitat

Impacts to cavity nester habitat would be mitigated by various methods. Some aspen trees would be removed prior to dump and pit construction. These trees may be placed on-site as the dead and down component of aspen communities or windrowed as wildlife habitat. IMC would plant aspen in suitable areas both on-site and off-site. Artificial nesting boxes or snags would be placed on-site or off-site to replace some lost structures.

Aspen Habitat Fragmentation

Fragmentation of aspen habitat that would occur under the proposed action or the alternatives would be mitigated by planting aspen and other methods. Fencing of aspen stands outside the proposed disturbance areas and establishment of aspen tree pads would be coordinated with the USFS and NDOW.

Riparian Habitat

IMC has proposed to fund and carry out a habitat enhancement program within the Jerritt Creek watershed. The goal of this program is to enhance the ability of riparian vegetation to maintain streambeds and banks and regulate water flows and timing. This would be accomplished by the following methods: 1) continue concurrent and interim reclamation of exploration roads throughout the watershed; 2) plant a variety of adapted shrubs and trees within the riparian zone and sideslopes; 3) continue final and/or interim reclamation of mining areas; and 4) identify potential sites lower in the watershed for additional plantings and streambank stabilization. Off-site enhancement of existing riparian areas would occur through planting of species such as elderberry and chokecherry.

Other Wildlife Species

Other mammal habitat mitigation would include the creation of an undulating dump surface and placement of rock piles on the dump surface. Creating holes in portions of the pit walls may also result in additional bat roosting sites.

Monitoring

The wildlife mitigation measures to be implemented with the proposed project would be monitored as part of the QA/QC program. IMC would report the mitigation measures implemented during the previous year and projected to be performed for the coming year as part of the Annual Work Plan submitted to the USFS each year. Monitoring of riparian enhancement areas would be conducted to assess riparian vegetative trends in areas that have been planted. Riparian habitat photo points would be established and utilized annually to monitor trends over time. Monitoring results would be documented and summarized yearly in the Annual Work Plan.

Land Use and Mining

Land uses within the Project area would be changed to mining during the life of the proposed project or any of the action alternatives. Post-mining land uses designated by the USFS for the area would be established as a result of interim, concurrent and final reclamation within the area.

Monitoring

Reclamation activities would be monitored during implementation through the QA/QC program. Revegetation success would be determined by the methods described above under Vegetation.

Livestock Grazing

IMC proposes to work with the USFS and permittees to mitigate for changes affecting grazing allotments. Fences would continue to be constructed and maintained by IMC around the perimeter of the disturbance areas. Other grazing allotment fences would be constructed or relocated if required as a result of mining operations. IMC would construct new water developments designated by the USFS to mitigate loss or inability to use any water developments on affected open grazing allotments. Reclamation seed mixes would include plants that are used by livestock. Access would be provided to grazing permittees.

Monitoring

The livestock mitigation measures to be implemented with the proposed project would be monitored as part of the QA/QC program. IMC would report the mitigation measures implemented during the previous year and projected to be performed for the coming year as part of the Annual Work Plan submitted to the USFS each year.

Recreation and Public Access

During reclamation, USFS-designated roads would be reclaimed in a manner that would allow motorized access to and within the Project area. This measure would re-establish public access within the area closed during mining operations. IMC is considering the merits of establishing new public access routes elsewhere and would coordinate these efforts with the USFS. The establishment of new public access can be accomplished in many areas by improving existing exploration roads.

Monitoring

No monitoring of effects to public access or mitigation measures are proposed.

Socioeconomic Environment

No mitigation measures or monitoring programs for effects to the socioeconomic environment are proposed.

Visual Resources

All of the proposed disturbance areas are situated within an area that is classified with a Visual Quality Objective (VQO) of maximum modification. Under this category, human activities may dominate the characteristic landscape, with some limitations.

The waste rock dumps, haul roads and other mine components would be compatible with the surrounding terrain after reclamation. The flat portions of the waste rock dumps would have an undulating surface and piles of large boulders would be placed at scattered locations.

Monitoring

The visual resources mitigation measures to be implemented with the proposed project and the alternatives would be monitored as part of the QA/QC program

Cultural Resources

Cultural resource surveys have been completed for the Project area. However, if new sites are discovered during operations, activities would cease in these areas until the site was evaluated and the area cleared for continued operations. IMC would restrict heavy equipment under its control to the analyzed disturbance areas for the alternative selected for implementation by the USFS. This measure would mitigate against additional surface disturbance and potential disturbance to any unidentified cultural resources.

Monitoring

The cultural resources mitigation measures to be implemented with the proposed project and the alternatives would be monitored as part of the QA/QC program.

2.7 Comparison of Alternatives

Effects to the physical, biological and socioeconomic environments would be incurred under all alternatives. One of the purposes of this DEIS is to display the differences in environmental effects among the alternatives. A summary of the effects of the alternatives in relation to identified issues is presented in Table 2.3 at the end of this chapter. Additional discussion of the effects associated with the alternatives are included in Chapter 4. Differences between alternatives are displayed quantitatively in Table 2.3, where possible. Qualitative analysis is provided where differences are not easily defined by quantitative measurement.

The fundamental differences among the alternatives are the use of 3H:1V waste rock dump slopes and underground mining of the New Deep ore body. Alternatives that include final reclamation to 3H:1V waste rock dump slopes were proposed with the intent of providing greater slope stability and greater revegetation potential. Underground mining of New Deep was proposed in two of the alternatives because it is a reasonably foreseeable future activity that warranted consideration and analysis. As indicated in Table 2.3 and discussed in the analysis in Chapter 4, use of underground mining methods in Alternative F would provide environmental benefits in relation to the other alternatives because there would be less disturbance associated with New Deep mining operations. However, costs of underground mining are greater and it results in less than full utilization of the mineral resource.

Environmental benefits of 3H:1V slopes are less easily quantified. The potential for revegetation would be greater on 3H:1V slopes than on angle of repose slopes, and mass stability would be greater. Additional benefits may be realized by other resources such as wildlife and vegetation resources. However, there would be greater surface disturbance associated with construction and reclamation of waste rock dumps to 3H:1V slopes and construction costs would be higher. All slopes under any alternative would meet minimum safety requirements.

The following sections describe the differences in the effects of the various alternatives in relation to the four focus issues. A discussion of a cost and benefit analysis for the project follows these sections.

Water Quality - Acid Rock Drainage

Evaluation of the acid generation potential of waste rock to be mined in the Saval, Steer and Burns Basin mine areas indicates that the waste rock dumps for these mine areas have a low potential to generate acid. The composition of the waste rock to be mined and placed in the dumps does not vary appreciably among alternatives. There are no substantive differences among alternatives in terms of potential to generate acid in the Saval, Steer and Burns Basin mine areas.

Preliminary acid-base accounting analyses of waste rock to be generated by open-pit mining of the New Deep deposit indicate that these rocks have a low to moderate potential to form acid. Samples of these rocks are being evaluated using kinetic testing techniques. Under Alternatives B, C, D, E, and G the New Deep deposit would be mined by open pit methods, exposing more waste rock to oxidizing conditions than Alternative F.

Although Alternative F would have less waste rock, the volume of acid-generating and neutralizing waste rock is unknown. Therefore, the potential to create acidic waters is not known for this alternative, but would be determined during the waste rock evaluation program.

Waste Rock Dump Design for Stability

Waste rock dump designs under all action alternatives would have designed safety factors that are acceptable to the USFS. Waste rock dump slopes that are entirely 3H:1V from toe to crest under Alternatives D and E would have higher safety factors than dumps with angle of repose slopes.

Reclamation Potential - Revegetation

For the purposes of this analysis, reclamation potential is essentially equivalent to the acreage that would have growth medium applied and be seeded using proven reclamation techniques. Under this definition, alternatives with 3H:1V waste rock dump slopes (Alternatives C, D and E) have higher revegetation potential than those alternatives (B, F and G) with angle of repose slopes.

Mine Economics

Operational costs vary among Alternatives B, C, D, E, and G primarily in response to differences in the final configuration of the waste rock dumps and mining method. Under Alternatives C, D and E, waste rock dump slopes would be pushed to 3H:1V during reclamation. Increased costs that would result, compared to Alternative B, are $2.13 million for Alternative C, $35 million for Alternative D, and $17 million for Alternative E. Alternative F would cost approximately $410,000 more than Alternative B due to higher costs associated with underground mining. Alternative G would cost approximately $200,000 more than Alternative B due to increased costs associated with mining the New Deep orebody with both underground and open pit mining methods.

Costs and Benefits

The relative costs and benefits of the various alternatives was requested during the public scoping process. For purposes of complying with NEPA, weighing adverse and beneficial effects of the various alternatives need not be displayed in a monetary cost-benefit analysis. However, members of the public specifically requested an analysis of the tradeoffs between increased costs and environmental benefits. Such tradeoffs cannot always be quantified. The relationship between increased costs and the design of the alternatives to respond to various physical environmental and socioeconomic issues is summarized below.

Costs of the various alternatives are displayed in Table 2.3 under the Mine Economics section. Under Alternative A, additional operational costs would include the loss of investment in infrastructure, exploration, and the opportunity costs of leaving minable ore in the ground. Alternative B is the most economic alternative, giving consideration to the costs involved in the mitigation measures described in Section 2.6. Increased costs for Alternatives C, D, and E result primarily from the creation of 3H:1V slopes on waste rock dumps and from the additional costs of hauling waste rock farther from the New Deep pit in Alternatives D and E. In addition, the configuration of the waste rock dump in Alternative D would make it difficult or impossible to access identified mineral resources west of the New Deep pit in the future. Alternative F would cost more than Alternative B because of the increased costs of underground mining, and not as much ore would be recovered as under Alternative B. Alternative G would cost more than Alternative B because underground mining would be used first for concentrated ore bodies and open pit methods would be used later for the remaining and more dispersed ore reserves. Socioeconomic costs and benefits are also displayed in Table 2.3.

2.8 Preferred Alternative

The USFS's preferred alternative is Alternative C.

Table 2.3
Alternative Comparison and Impacts Summary
(by Issue)

Issue	Alternative A No Action	Alternative B Proposed Action	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
Focus Issue: Water Quality - ARD	Existing, approved operations would continue until completion. No ARD has been detected from existing operations.	Waste rock in the Saval, Steer & Burns Basin mine areas has low potential to generate acid. Potential for ARD in the New Deep mine area is low to moderate. Kinetic testing is being conducted to determine the potential for acid generation.	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B for the Saval, Steer & Burns Basin mine areas. There would be less waste rock than under Alternative B and the composition of the waste rock would also be different. Kinetic testing is being conducted to determine the acid-generating potential.	Similar to Alternatives B & F
Focus Issue: Waste Rock Dump Design for Stability	Existing, approved operations would continue until completed	Dumps would have designed safety factors acceptable to USFS.	Similar to Alternative B. Dumps with 3H:1V slopes would have higher factors of safety than Alternative B.	Similar to Alternative C	Similar to Alternative C	Similar to Alternative B	Similar to Alternative B
Focus Issue: Reclamation - Revegetation							
Disturbance Area	2,183 acres (existing, approved)	2,559 acres	2,662 acres	2,744 acres	2,557 acres	1,777 acres	2,605 acres
Revegetation Area	1,102 acres (existing, approved)	1,289 acres	1,447 acres	1,691 acres	1,447 acres	957 acres	1,322 acres
Reclamation & Revegetation methods	Existing, approved operations would continue until completed with reclamation plans as approved in previous documents.	The goal of revegetation efforts would be to re-establish a productive vegetative cover within two to five years. Seed mixtures would be approved by the USFS and would include a variety of grasses, forbs and shrubs. Species selection would be based on adaptability, diversity and potential for successional enhancement. Aspen seedlings would be planted on north-facing slopes or other appropriate locations.					
Post Mining Land Uses	Post-mining land use would approximate overall pre-mining conditions in the Project area, but would not recreate pre-mining conditions due to changes in topography. Post-mining land uses would be a composite of uses including forage for livestock use, wildlife habitat, recreation, public access, minerals exploration and development, and use as a functioning watershed.						
Focus Issue: Mine Economics (includes costs of mitigation)	Existing, approved operations are anticipated by IMC to decline in 1994 & totally cease by 1996.	In the range of alternatives, Alternative B is the most economical.	Alternative C would cost $2.13 million more than Alternative B.	Alternative D would cost $35 million more than Alternative B.	Alternative E would cost $17 million more than Alternative B.	Alternative F would cost $410,000 more than Alternative B, but would not recover as much ore.	Alternative G would cost $200,000 more than Alternative B.

Table 2.3, Continued
Alternative Comparison & Impacts Summary
(by Issue)

Issue	Alternative A No Action	Alternative B Proposed Action	Alternative C	Alternative F	Alternative E	Alternative F	Alternative G
Wildlife: Mule deer habitat	Existing, approved operations would continue until completed. Off-site mitigation would be conducted in accordance with the existing MOU among IMC, the USFS and NDOW and the Mule Deer Habitat Improvement Plan designed to implement the MOU.	Off-site mitigation would continue under the MOU and the Mule Deer Habitat Improvement Plan					
Mule Deer - Winter Range (acres of potential habitat affected)	1,833 acres (existing and approved)	2,627 acres	2,698 acres	2,854 acres	2,618 acres	1,790 acres	2,666 acres
Mule Deer - Summer Range (acres of potential habitat affected)	55 acres (existing and approved)	300 acres	301 acres	319 acres	305 acres	253 acres	300 acres
Wildlife: Goshawk Effects to Nests	Existing, approved operations would continue until completed.	Nest 074 would be removed by the Steer pit and nests 127 and 128 would be covered by the South Deep waste rock dump. No other nests would be directly affected, but new disturbance would occur in the home range of nests 027, 134 and 136	Same as Alternative B	Same as Alternative B	Same as Alternative B	Same as Alternative B	Same as Alternative B
Goshawks: Cumulative Short-term Effects (as percent of total "home range" area)	Alternative A effects are existing and approved.	The following information for Goshawk includes existing and proposed disturbances under each alternative for total cumulative disturbance.					
Nest 074	12.5%	42.1%	43.3%	45.3%	44.6%	39.7%	42.1%
Nest 127	13.1%	55.9%	56.9%	58.4%	55.7%	43.3%	56.4%
Nest 128	16.1%	57.7%	58.7%	60.7%	57.5%	44.6%	58.4%
Nest 027	7.0%	11.8%	12.1%	11.9%	11.8%	12.1%	11.8%
Nest 134	10.9%	19.4%	19.9%	19.5%	19.8%	19.8%	19.4%
Nest 136	11.0%	17.2%	17.7%	17.3%	17.2%	17.6%	17.2%
Wildlife: Sage Grouse Brooding Habitat (acres of potential habitat affected)	447 acres (existing and approved)	1,149 acres	1,196 acres	1,233 acres	1,051 acres	729 acres	1,178 acres
Wildlife: Threatened, Endangered or Sensitive Plan Species	Existing, approved operations would continue until completed and as approved under previous NEPA documentation.	Endangered species: Impacts to bald eagles and peregrine falcons would be negligible. Bald eagles may occasionally migrate through the Project annually; peregrine falcons rarely pass through the area. Threatened species: There would be no additional impact to Lahontan cut throat trout. Candidate Species: Decreased flows and short-term increases in sedimentation could have some adverse impacts for potential redband trout habitat in Burns Creek. Sensitive Species: Long term loss of potential flammulated owl habitat exists under all action alternatives.					

Table 2.3, Continued
Alternative Comparison & Impacts Summary
(by Issue)

Issue	Alternative A No Action	Alternative B Proposed Action	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
Wildlife: Golden Eagles							
Number of Golden Eagle Nests Directly Affected	Existing, approved operations would continue.	1 An unoccupied nest would be covered by a waste rock dump.	0	0	0	0	1
Other Golden Eagle Nests	Existing, approved operations would continue.	Proposed new disturbance would not disturb the two other nests within Jerritt Canyon. These nests, active during 1992 and 1993, are projected to continue to be occupied.	Same as Alternative B	Same as Alternative B	Same as Alternative B	Alternative F has the least likelihood of affecting golden eagle nests due to the greatly reduced surface disturbance in Jerritt Canyon.	Same as Alternative B
Wildlife: Upland Game Birds and Furbearers							
Loss of Habitat Associated with Projected Area of Disturbance (acres)	2,183 acres (existing, approved)	2,559 acres	2,662 acres	2,744 acres	2,557 acres	1,777 acres	2,605 acres
Wildlife: Trout	Decreased flows and short term increases in sedimentation could have some adverse impacts to potential trout habitat in Burns Creek.						
Wetlands: (acres of impacted wetlands)	3.57 acres (existing, approved)	3.40 acres	3.67 acres	3.82 acres	3.64 acres	2.89 acres	3.40 acres
Vegetation: Diversity	Existing, approved operations would continue.	During the life of the Project, there would be a modification in plant species, composition, age classes, heights and canopy densities within disturbed areas. Once reclamation activities are completed and vegetation becomes re-established, new community types consisting of a mixture of native and introduced grasses, forbs and shrubs would be created. Over time, first generation plantings of aspen and shrubs would mature and reproduce and invasion by plant species from adjacent undisturbed areas would occur resulting in diversity similar to that of undisturbed areas.					
Vegetation: Threatened, Endangered and Sensitive	No threatened, endangered, or sensitive plant species have been identified in the Project area and no effects to such plant species are anticipated as a result of the action alternatives.						
Vegetation: Aspen fragmentation Disturbance by type of aspen (in acres)							
Mature Aspen	559 acres	623 acres	648 acres	641 acres	627 acres	613 acres	623 acres
Snowbank Aspen	24 acres	14 acres	14 acres	15 acres	14 acres	14 acres	14 acres
Grazing	Existing, approved mining operations would continue until completed.	All action alternatives would affect some forage areas in the Schmitt Creek and Jerritt Canyon cattle and horse grazing allotments. There would be a fifty percent reduction in AUMs in the Jerritt Canyon allotment during the life of the mine, but there would be no loss of AUMs in Schmitt Creek.					

Table 2.3, Continued
Alternative Comparison & Impacts Summary
(by Issue)

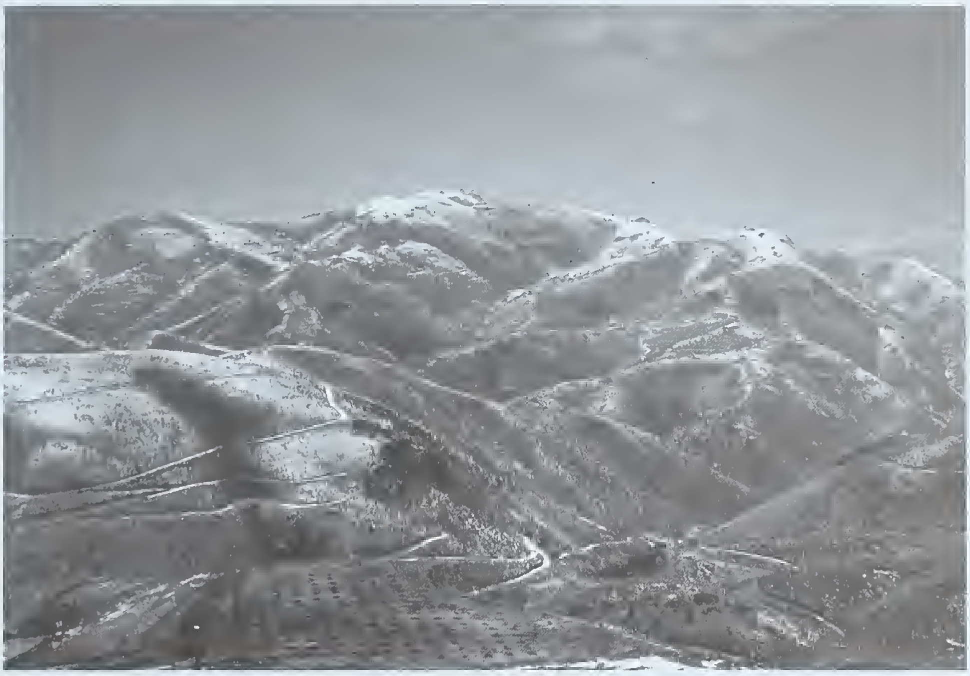
Issue	Alternative A No Action	Alternative B Proposed Action	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
Water Quality & Quantity: Potential for Water Impoundment	No water has been or is anticipated to be impounded by existing, approved operations	Impoundment of water in the Saval, Steer & Burns Basin pits is not expected. Water impoundment in the New Deep pit is possible. Pit inflow is anticipated between 100-300 gallons per minute. No active dewatering programs are currently anticipated, but water may be used for other mining activities (i.e. dust suppression) during operations. After mining, water impounded in the pit could be 140 feet deep with a 19 acre surface area.	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B for the Saval, Steer & Burns Basin pits. Water flow into underground workings at New Deep are estimated at 100-150 gallons per minute. Water would be directed to sumps. No active dewatering is currently anticipated. After mining, water would not flow out of underground workings to surface waters.	Similar to Alternative B
Water Quality: Potential Loss of Water Flow to the Surface at Niagara Spring & Van Norman Spring	Existing, approved operations would continue until completed.	No flow reductions are anticipated at Van Norman Springs. Flow reductions may be possible at Niagara Spring if there is a hydraulic connection to the New Deep pit area. Estimated inflows to New Deep pit are approximately three to eight percent of average flow at Niagara Spring.					
Water Quality & Quantity: Potential for Sedimentation: total post-mining annual sediment yield in excess (+) or below (-) pre-mining condition (in metric tons)							
Jerritt Creek (metric tons)	+400	-1,040	-1,040	-730	-1,000	-50	-1,040
Burns Creek (metric tons)	-260	-260	-200	-200	-200	-200	-260
(Note: Reductions in sediment yield in part reflect reductions in surface water runoff where runoff flows into pits.)							
Disturbance as percent of total watershed							
Jerritt Creek	17.5%	28.0%	28.9%	30.3%	28.0%	18.1%	28.6%
Burns Creek	12.5%	7.1%	7.8%	7.2%	7.0%	7.7%	7.1%

Table 2.3, Continued
Alternative Comparison & Impacts Summary
(by Issue)

Issue	Alternative A No Action	Alternative B Proposed Action	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
Post-mining changes to runoff in excess (+) or below (-) pre-mining conditions (in acre feet)							
Jerritt Creek (acre feet)	+220	-490	-490	-440	-560	-10	-490
Burns Creek (acre feet)	-520	-520	-520	-520	-520	-520	-520
Water Quality & Quantity: Quality of Surface & Ground Water	Existing, approved operations would continue until completion.	Impacts to water quality would primarily result from potential for acid rock drainages and sedimentation as described above.					
Recreation: Hunting & Fishing	Existing, areas closed for mine safety would remain closed until existing approved operations cease.	The area closed for public safety would be expanded to include proposed operation areas resulting in relocation of one gate on the Arana road and one on the Jerritt Creek road. Hunting opportunities outside of the closed area are not anticipated to change significantly from existing conditions. No mining operations are proposed for areas that support reproducing fish populations.					
Visual Resources	Existing, approved operations would continue to completion resulting in modifications to pre-mining land forms	Operations would result in major modifications to existing land forms but would be in conformance with the maximum modification VQO classification.	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B for the changes associated with the Saval, Steer & Burns Basin operations. Changes from underground mining in New Deep would be less than those of open pit & waste rock dumps in Alternative B.	Similar to Alternative B
Cultural: Impacts to Sites Eligible for the NRHP and/or to unevaluated sites.	0	0	0	0	0	0	0

Table 2.3, Continued
Alternative Comparison & Impacts Summary
(by Issue)

Issue	Alternative A No Action	Alternative B Proposed Action	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
Socioeconomics:							
Employment: (New Positions)	0	175	175	200	200	155	270
Effects on Elko County:							
Population	Potential decrease due to job losses. (up to 1,350 jobs)	Less than a two percent increase would result from people moving into Elko County due to expanded mining job and service sector job opportunities.					
Housing	Potential for reduced property values if displaced workers move out of Elko County.	An estimated 9 to 15 temporary units and 136 to 210 units could be required for in-migrating mine families and service sector families. The rental market would continue to be tight and new mobile and single-family homes would likely provide needed housing over time.					
Schools	An immediate loss of $3.7 million in revenues to the Elko County School District could result due to loss of students.	New students would likely be enrolled in public schools in Elko and Spring Creek beginning late 1994 and early 1995. The greatest impacts to schools would occur under Alternatives D, E and G.					
Potential effects to tax structure & revenues to the County	Potential for significant negative effects to the County's financial resources, due to loss of tax revenues. IMC is the largest property tax payer in the County.	The County's three most important sources of revenue are sales and use taxes, property taxes and net proceeds taxes. Revenues from sales and use taxes would be expected to increase under all action alternatives. However, because of reduced net proceeds in the 1992-1993 fiscal year, IMC has agreed to take a credit on future net proceeds tax payments in lieu of requesting an $800,000 refund from the county and state (net proceeds taxes are paid one year in advance). Compared to Alternative B, all action alternatives would result in added costs, resulting in reductions to net proceeds tax revenues as indicated below.					
		Potential Reduction in Net Proceeds Tax Revenues compared to Alternative B.					
		0 (Baseline)	($106,500)	($1,756,500)	($887,500)	($20,500)	($10,000)
Community Stability-Length of Operations: year of completion for mine operation & reclamation activities	1,996	2,005	2,005	2,006	2,006	2,004	2,005
Air Quality:							
Fugitive Dust	Existing, approved operations would continue until completion.	Particulate emissions would continue to result from mining operations but would not result in any substantial impacts to air quality with appropriate mitigation measures.	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B for Saval, Steer, & Burns Basin pits. Underground mining in New Deep would result in lower emissions than open pit mining in Alternative B.	Similar to Alternative B.



Chapter 3

Affected Environment

Photo Description: View of existing drill and blast operations looking south to the Saval and Steer Canyons (Fall 1992).

CHAPTER 3

AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the portions of the physical, biological, social and economic environments that would affect or may be affected by the implementation of any of the alternatives for the Jerritt Canyon Mine Expansion, referred to as the Project. This chapter presents the existing conditions as a baseline for the analysis of potential impacts that are examined in Chapter 4.

The Project area (shown on Map 1.2) has been the subject of numerous studies since 1979. The Jerritt Canyon Project was initiated after the completion of the Jerritt Canyon Project Gold Mine and Mill EIS in 1980. Data collected for this project and subsequent mining operations over the past thirteen years form a comprehensive data base that is incorporated by reference into this document. A list of documents that are incorporated by reference is included in the bibliography.

A substantial amount of additional information was gathered to update the existing information base for the Jerritt Canyon Mine Expansion EIS. Field studies, literature surveys and personal interviews were conducted by an interdisciplinary group of resource specialists including wildlife biologists, hydrologists, botanists, archaeologists, geologists, engineers and socioeconomists. Detailed information was collected within the Project area. Additional updated information was collected in the general study area, a 44,000 acre area surrounding the Project area (See Map 1.2).

Resource analysis areas vary by resource and are described in this chapter according to resource topics under the general categories of physical, biological, and socioeconomic environments, land use, visual and cultural resources. Many of the existing resources are described according to criteria outlined in the Independence Range Cumulative Effects Analysis (CEA) Technical Guide. The CEA model was developed by the USFS, NDOW, and three mining companies to provide a standardized approach for analyzing direct and cumulative impacts in the Independence Mountain Range. The CEA Technical Guide lays out the procedures, analytical models, and data base to be used in evaluating the cumulative effects of mining proposals in combination with the effects of past and foreseeable future development. The CEA model defines the geographic area of analysis, or analysis "province," for a variety of resources including wildlife species, visual quality, recreation, and cultural resources. The CEA model also identifies what will be used to measure impacts for each resource and identifies "thresholds of concern" (TOCs) to determine the significance of impacts. The TOCs, provinces, and other analytical procedures were developed by USFS and NDOW resource specialists in consultation with environmental staff from the mining companies. In this DEIS, existing resources are described in relation to TOCs and other CEA criteria in order to provide a basis of comparison for the potential impacts described in Chapter 4.

The CEA model utilizes a computerized Geographic Information System (GIS) data base to track and measure changes to each resource within a province. This data base consists of hundreds of computerized map "layers" that can be selectively integrated and statistically interpreted to provide quantitative analysis of existing conditions and potential impacts associated with each alternative. The quantitative analysis of existing conditions is included in this chapter. The quantitative analysis of impacts is detailed in Chapter 4 and is summarized in Table 2.3.

3.2 Physical Environment

Location and Topography

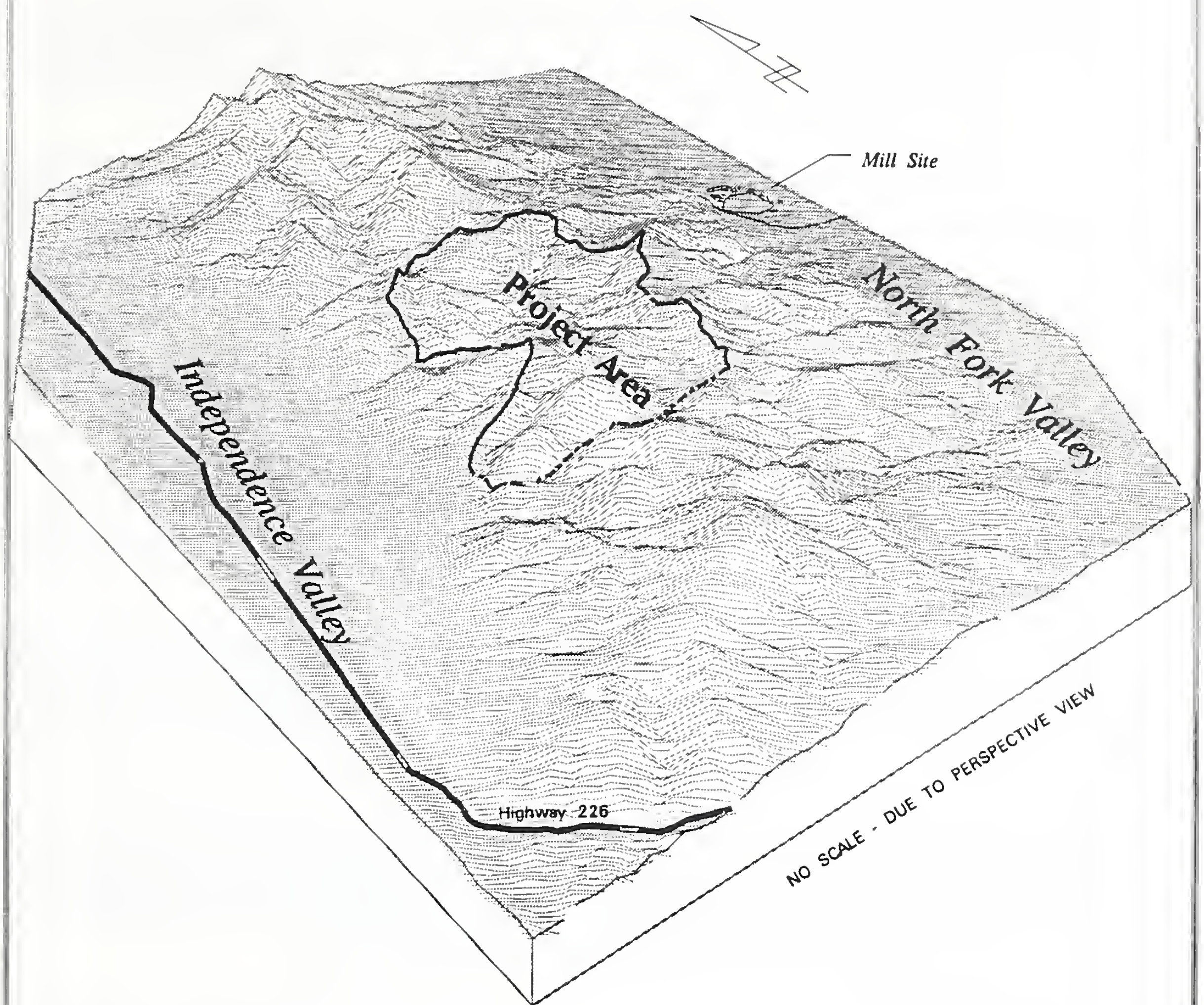
The analysis area for topography is the Project area. The Project area includes all or portions of Sections 28, 32, 33, 34 and 35, Township 41 North, Range 53 East and Sections 1, 2, 3, 4, 5, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 28, Township 40 North, Range 53 East Mount Diablo Meridian. The total Project area comprises 10,849 acres of which 1,272 acres are private inholdings within the Humboldt National Forest as shown on Map 1.2.

The Project area is located on the western slope of the Independence Mountain Range. The Independence Mountains are flanked by the Independence Valley to the west and the North Fork Valley to the east (Map 3.1). Topography ranges from moderate slopes to sheer cliffs in Burns Basin and Steer Canyon, with deeply dissected canyons, rolling ridges and shallow draws. Foothills and valleys along the west margins of the range slope down to the nearly flat Independence Valley basin. Elevations in the Project area range from 6,100 ft. to 8,500 ft. Existing topography within the Project area includes features that are the result of disturbance by mining activities, including haul roads, pits and waste rock dumps (See Map 2.1).

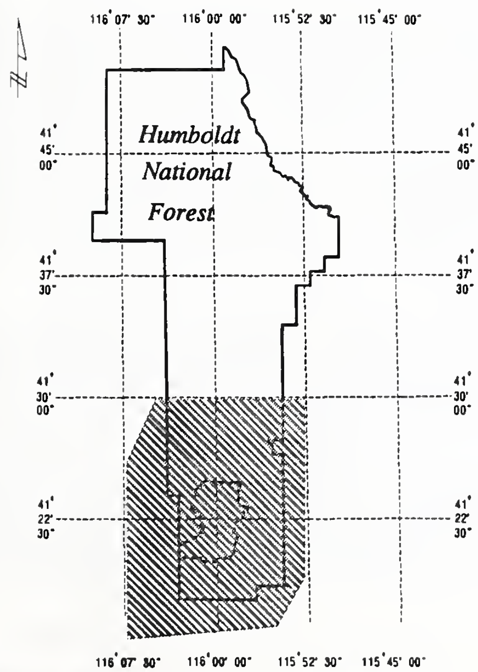
The drainages that dissect the mountain slopes in the Project area include Jerritt, Steer, Saval, Burns and Mill Creeks. Jerritt, Burns and Mill Creeks run generally to the west. Saval and Steer drain primarily north-facing slopes and are contributory drainages to Jerritt Creek.

Geology

The Independence Range was formed during Basin and Range faulting that created the steep, block-faulted mountain range and uplifted the terrain in the Jerritt Canyon area (Birak and Hawkins 1984). The rocks exposed by erosion in the Jerritt Canyon area consist of two distinct assemblages of sedimentary rocks that occur in the upper plate and lower plate of the Roberts Mountains Thrust. Movement on the Roberts Mountains Thrust



Vicinity Map



Three Dimensional View of Independence Mountain Range

The shaded area within the Humboldt National Forest Vicinity Map represents the extent of the area shown in the 3-D surface map (above).

Data source: USGS Digital Elevation Models

Map 3.1

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occurred when oceanic volcanic and sedimentary rocks of the Snow Canyon Formation were thrust eastward over basinal sedimentary rocks of the Roberts Mountains Formation and older sedimentary rocks (Coats 1987). The lower plate contains the host rock formations for the gold bearing ore deposits at the Jerritt Canyon Complex.

The Snow Canyon Formation is the dominant member of the upper plate and is comprised of carbonaceous siltstone and shale with lesser amounts of dolomitic siltstone, varicolored cherts, and altered mafic lavas (greenstones) and associated dikes. The Snow Canyon Formation is separated from the underlying rocks by the Roberts Mountains Thrust. The Roberts Mountains Formation is the upper member of the lower plate assemblage and consists of laminated calcareous siltstone that is typically carbonaceous and weakly pyritic. It has been divided into an upper silty limestone unit and a lower limy siltstone unit in the Jerritt Canyon mine area. The Hanson Creek Formation lies either in thrust contact or disconformably below the Roberts Mountains Formation. It has been subdivided into five distinct subunits in the Jerritt Canyon mine area that range from medium grained limestone with chert beds and nodules to thickly bedded or massive dolomitic and argillaceous limestones.

The upper and lower plates have both been cut by thin altered andesite dikes and sills that typically range in thickness from two to ten feet. Locally they are argillically altered and pyritic, particularly in areas where they are in proximity to or host low grade mineralization.

Younger faults in the Jerritt Canyon area have displaced all of these strata, exposing windows of lower plate rocks of the Roberts Mountains and Hanson Creek Formations throughout the Project area. The younger intrusive dikes typically are located in structures, which also served as fluid paths for mineralizing solutions.

Mineral Resources

The 1992 year-end gold reserves for the Jerritt Canyon Project were 3.66 million minable ounces, with 8.8 million ounces in geologic resources. Gold reserves consist of both oxidized ores and unoxidized carbonaceous ores (IMC 1992g). Continued exploration may result in the discovery of additional reserves or the conversion of some geologic resources to reserves. Other minerals found in the Project area and the Jerritt Canyon district include antimony, barite, silver, mercury and manganese. Barite is the only other mineral identified in the vicinity of the Project area by the U.S. Bureau of Mines as having a potential economic value (Schmauch 1992).

Gold mineralization in the Saval, Steer, New Deep and Burns Basin mine areas occurs at the intersection of high angle faults with structurally and lithologically permeable zones. The resulting ore bodies are typically tabular in form and concordant with bedding or located along high and low angle faults. The host rocks for mineralization vary throughout the district. The Saval and Steer ore bodies are hosted in unit 3 of the Hanson Creek Formation near its contact with unit 4 and in the Roberts Mountains Formation. In the New Deep area, mineralization occurs in all rock types adjacent to a major northwest striking fault (the "New Deep Fault"), but preferentially where this fault intersects northeast trending faults. In the Burns Basin area, ore is hosted in faults where they cut the Roberts Mountains Formation near the contact with Hanson Creek unit 1, in Hanson Creek unit 3, and in altered dikes.

The gold mineralization at Jerritt Canyon is disseminated in nature, and open pit mining methods are currently the most economic means of recovering this type of mineralization. Underground mining methods are feasible only when higher ore grades occur in localized zones that are deeply buried and not economically recoverable by open pit mining methods.

Geochemistry

The primary issue associated with the geochemistry of the rocks in the Jerritt Canyon mine area is the potential for waste rock, pit walls, and low grade ore stockpiles to generate acid drainage and affect water quality. Existing waste rock dumps are composed of the same lithologic formations that would be placed in the proposed dumps. The South Deep dump would be the largest dump constructed and would contain proportionally more of the Snow Canyon Formation than the existing or other proposed dumps. The estimated lithologic composition and tonnage of the waste rock dumps to be constructed for each mine area under the proposed action (Alternative B) and Alternatives C, D, E and G are shown in Table 3.1.

A total of 375 waste rock samples characteristic of the materials to be mined from the Saval, Steer, New Deep, and Burns Basin deposits were collected and analyzed. The number of samples collected for each mine area was determined based on the amount of waste rock material to be mined from each deposit.

Acid-Base Accounting

The acid-base accounting (ABA) procedure is a geochemical static test used as a screening technique for determining if waste rock has the potential to generate or consume acid. Static acid-base accounting methods utilized involved grinding the samples to a small size and determining the total amount of sulfur and the sulfur forms present (pyritic sulfur, sulfate sulfur, and non-extractable or residual sulfur) by acid and hot water extraction. The neutralization potential (NP), or the ability of the material to neutralize acid, was determined by acid titration. The acidification potential (AP), or the ability of the material to generate acid, was calculated using total sulfur values to provide a more conservative prediction of acid-forming potential as compared to using the pyritic sulfur values. This calculation assumes that all the sulfur present in the sample can be converted to sulfuric acid. Acid generation tests therefore do not measure acid generation, but rather they estimate the theoretical limit of acid generation, and thus are conservative in nature.

The potential for the waste rock in the New Deep, Saval, Steer, and Burns Basin mine areas to generate acid was evaluated using the ratio of NP to AP. Under this evaluation method, if the NP/AP ratio is less than one, the material is considered potentially

Table 3.1
Summary of Acid - Base Accounting Results for Saval, Steer, New Deep and Burns Basin
(All Acidification Potential Values Calculated with Total Sulfur)

MINE AREA	Percent of Rock Type In Dump[1]	Million Tons Of Waste	Total Number Of Samples	Range of NP/AP Values	Average NP/AP[2,3]	Number of Samples	
						NP/AP <1	NP/AP >1 and <3
NEW DEEP							
Snow Canyon	73.2	388.3	188	0.4 - 1475.2	27.3	0	37
Roberts Mountains	18.8	104.5	58	0.7 - 126.5	24.6	0	2
Hanson Creek I	0.5	2.6	6	4.1 - 113.6	55.3	0	0
Hanson Creek II	0.6	3.2	8	0.1 - 196.6	79.1	1	0
Hanson Creek III	0.6	3.2	8	7.0 - 51.2	36.3	0	0
Hanson Creek IV	1.6	8.4	11	0.8 - 245.8	71.2	1	1
Intrusives	3.3	17.4	13	0.0 - 45.9	13.7	1	0
TOTAL	**98.6**	**527.6**	**291**	**Total Weighted Average**	**28.1**		
SAVAL, STEER							
Snow Canyon	0.8	3.7	8	6.5 - 160.4	67.4	0	0
Roberts Mountains	55.6	257.5	22	1.5 - 1,452.8	165.3	0	1
Hanson Creek I	3.3	15.3	2	30.4 - 40.5	35.5	0	0
Hanson Creek II	2.4	11.1	4	2.7 - 1,155.5	363.3	0	1
Hanson Creek III	27.0	125.0	17	4.4 - 124.2	31.7	0	0
Hanson Creek IV	5.0	23.2	3	10.9 - 451.2	159.4	0	0
Eureka Quartzite	5.8	26.9	4	9.1 - 182.4	94.2	0	0
Intrusives	<1.0	0.5	4	1.1 - 2.3	1.7	0	4
Alluvium	<1.0	0.5	8	14.2 - 1,075.2	373.8	0	0
TOTAL	**101.9**	**463.6**	**72**	**Total Weighted Average**	**124.8**		
BURNS BASIN							
Snow Canyon	0.1	0.1	1	#	5.2	0	0
Roberts Mountains	28.3	26.5	2	15.9 - 139.7	77.8	0	0
Hanson Creek I	5.2	4.9	1	#	19.0	0	0
Hanson Creek II	3.5	3.3	1	#	42.6	0	0
Hanson Creek III	55.0	51.5	3	119.0 - 2,681.6	1,052.4	0	0
Hanson Creek IV	7.8	7.3	2	39.9 - 79.9	59.9	0	0
Intrusives	<0.1	0.1	2	9.3 - 64.3	8.0	0	0
TOTAL	**99.9**	**93.6**	**12**	**Total Weighted Average**	**630.0**		

Source: Westec September 24, 1993.

Note: [1] Calculated for dump volumes in Alternative B - the Proposed Action
[2] Neutralization Potential divided by Acidification Potential
[3] Reported in tons of $CaCO_3$/1,000 tons rock
\# Insufficient number of samples to report a range of values.

acid generating, if it is greater than 3, the material is considered non-acid generating, and if it is between 1:1 and 3:1, it falls into a "zone of uncertainty" (Broughton, Chambers and Robertson 1992). For the purposes of this study, samples with an NP/AP value less than 3 are referred to as potentially acid-generating. The NP/AP results from samples collected for the mine expansion are presented in Table 3.1.

If it is determined, based on the interpretation of static test results, that a sample has the potential to generate acid, kinetic testing (i.e. humidity cells or column leaching) is initiated on a representative number of waste rock samples. Kinetic testing provides an indication of whether acid would be generated and the rate of acid generation under simulated field conditions.

The NP/AP analysis results indicate that there is a low potential for acid generation and subsequent acid drainage from waste rock derived from the Saval and Steer pits and expansion of the Burns Basin pit. The low acid generation potential is indicated by the minimal number of samples with NP/AP ratios less than three and the high average NP/AP values. The NP/AP results from some samples of intrusive dikes in the Saval and Steer mine area and the Burns Basin mine area indicate that they would produce acid, but they comprise less than one percent of the waste rock that would be mined.

The average and weighted average NP/AP values for samples from the New Deep mine area suggest that there is a low potential for acid generation. Evaluating the acid generating potential of a waste material using only average or weighted average values may be misleading. Portions of the waste rock to be placed in a dump may potentially be acid-forming, although the averaged NP/AP analyses indicate that the waste rock as a whole would not generate acid.

Based on initial static acid-base accounting analysis data for the New Deep waste rock, there is low potential for acid to be generated by the Roberts Mountains and Hanson Creek Formations and a moderate potential for the Snow Canyon Formation and intrusive rocks to generate acid. Four of the 13 samples from intrusives in the New Deep mine area have NP/AP values less than one and may potentially produce acid. NP/AP values less than three were reported for 46 of the 188 samples analyzed from the Snow Canyon Formation and are classified as potentially acid producing. IMC has initiated an extensive kinetic testing program to evaluate the ability of these rock types to produce acid. A total of 27 samples are in the process of being analyzed in humidity cells, including 9 samples of intrusive dikes from all of the mine areas and 12 samples of the Snow Canyon Formation from the New Deep mine area. Two samples from the Roberts Mountains Formation and four from the Hanson Creek Formation are also being analyzed. The samples to be kinetically tested were chosen based on static test results. The results of the kinetic testing program are not available at present but will be discussed and evaluated in the FEIS. If the tests indicate that the rock types have the potential to produce acid, the FEIS will discuss control measures that are necessary to prevent acid drainage.

The acid-base accounting results were also interpreted using the method recommended by the NDEP (NDEP 1990). Under this method, materials are considered potentially acid-forming if the acidification potential (calculated only with total sulfur for this analysis) is less than 20 percent greater than the neutralization potential. Twenty-one samples out of the 291 analyzed in the New Deep area, none of the 12 samples analyzed in the Burns Basin area, and one sample from the 72 analyzed in the Saval and Steer area did not have 20 percent excess neutralization potential. A representative number of these samples are being analyzed by kinetic testing methods to determine if they would produce acid under simulated field conditions.

Trace Metal Mobilization

The potential for the waste rock to release trace elements was evaluated by the meteoric water mobility procedure (MWMP). This test was developed by the NDEP to determine if a material has the potential to release trace elements as a result of physical and chemical interaction with meteoric water (infiltrating rain water). It involves agitating a mixture of waste rock and synthetic meteoric water (pH 5.5 to 6.0) for twenty-four hours and analyzing the water to determine which constituents are dissolved from the waste rock.

At the present time, there are no state or federal regulatory standards or limits for meteoric water mobility extracts. The NDEP recommends comparing meteoric water mobility results to the primary and secondary drinking water standards (NDEP Guidance dated November 2, 1990). Benefication wastes for which the meteoric water mobility extract exhibits a concentration less than 10 times the drinking water standard are considered benign (NDEP Guidance dated November 2, 1990). The results of the Saval, Steer, Burns Basin and New Deep waste rock meteoric water mobility procedure indicate that although several samples had slightly elevated arsenic, selenium, nitrate, and sulfate concentrations, the results are all less than 10 times the respective drinking water standard and are considered benign.

Geotechnical Considerations

Geotechnical considerations are primarily associated with waste rock dump stability. Dump stability factors include: 1) earthquake motions (seismicity); 2) the existence of unstable ground as evidenced by landslides or other movement features; 3) terrain steepness; 4) the clay content of foundation soils; 5) saturated foundation soils and springs; 6) dump slope steepness; 7) dump material properties; and 8) vegetation. A hazard analysis addressing each of these items was prepared for the waste rock dump sites. The following is a summary of the conditions examined in this analysis.

Seismicity

The Project area is located on the northern edge of the Basin and Range Province. This region experiences moderately high rates of tectonic and seismic activity but is located near the boundary of relatively stable areas in northern Nevada and less active regions to the north. The mine expansion area is located in Seismic Zone 2, as defined by the Soil Conservation Service (Kennedy/Jenks Consultants 1993d). A horizontal earthquake force of 0.10 g is the minimum design force for this seismic zone. This corresponds to an estimated return period of 250 years or the magnitude of the earthquake that may occur once every 250 years (Knight Piesold and Co. 1991).

Landslides

Aerial photographs and field observations by IMC geologists were used to determine if any landslides occur within the areas to be disturbed by any of the action alternatives (IMC 1993c). One small inactive landslide less than an acre in size occurs in the headwaters of the North Fork of Jerritt Creek, but would not be affected by the mine expansion activities (IMC 1993c). No other features indicative of natural instability have been identified within the areas proposed for disturbance.

Terrain Steepness

The GIS was used to classify the terrain within the Project area into several slope steepness categories. The natural topography slopes range from moderate slopes to sheer cliffs associated with rock outcrops. The drainage bottoms in the waste rock dump sites have slopes less than 30 percent. Side slopes above the drainages are generally steeper than 40 percent. It is assumed that foundation slopes steeper than 30 percent along a cross-section through an angle of repose slope can be a hazard relative to base sliding.

Foundation Soils

The soils of the Project area were classified and mapped during a soil survey conducted in 1992. The clay content and thickness of the soils are discussed in the Soils Technical Report and summarized in the soils section in Chapter 3.

Measurements of depths to bedrock indicate that the soils in the Project area are generally from two to four feet deep, but locally are as deep as 80 inches in drainages. The soils generally are sandy and gravelly silts. Soils with high clay contents are limited in extent and have only been mapped as a narrow band along Jerritt Creek. Silty clay loams range in thickness up to 60 inches.

Clays can have relatively low shear strength, can develop high pore pressures during dumping and can have relatively high consolidation characteristics, if saturated. The hazard increases as the thickness of the clay layer increases.

Saturated Foundation Soils and Springs

A survey for springs and seeps was conducted within the Project area during 1993. This survey identified 23 springs and 8 seeps in the Project area, as described in the groundwater section in Chapter 3. Most of the springs and seeps are less than 0.1 acre in size and many flow only in direct response to snowmelt during the spring and early summer months.

Riparian areas, springs or seeps can indicate the location of saturated foundation soils which could develop high pore pressures during dumping or cause other stability concerns. No areas of perennial snow accumulation occur within the waste rock dump sites proposed under any of the action alternatives.

Vegetation

The vegetation types occurring within the Project area were mapped during field surveys conducted between 1986 and 1993, as described under the vegetation section in Chapter 3. These surveys indicate that sagebrush/grasslands are the dominant community type, followed by mature aspen and north-facing mountain brush. Mature aspen typically occur on north facing slopes in the drainage bottoms. North-facing mountain brush community type is normally found as discontinuous patches located on steep slopes with a northerly aspect.

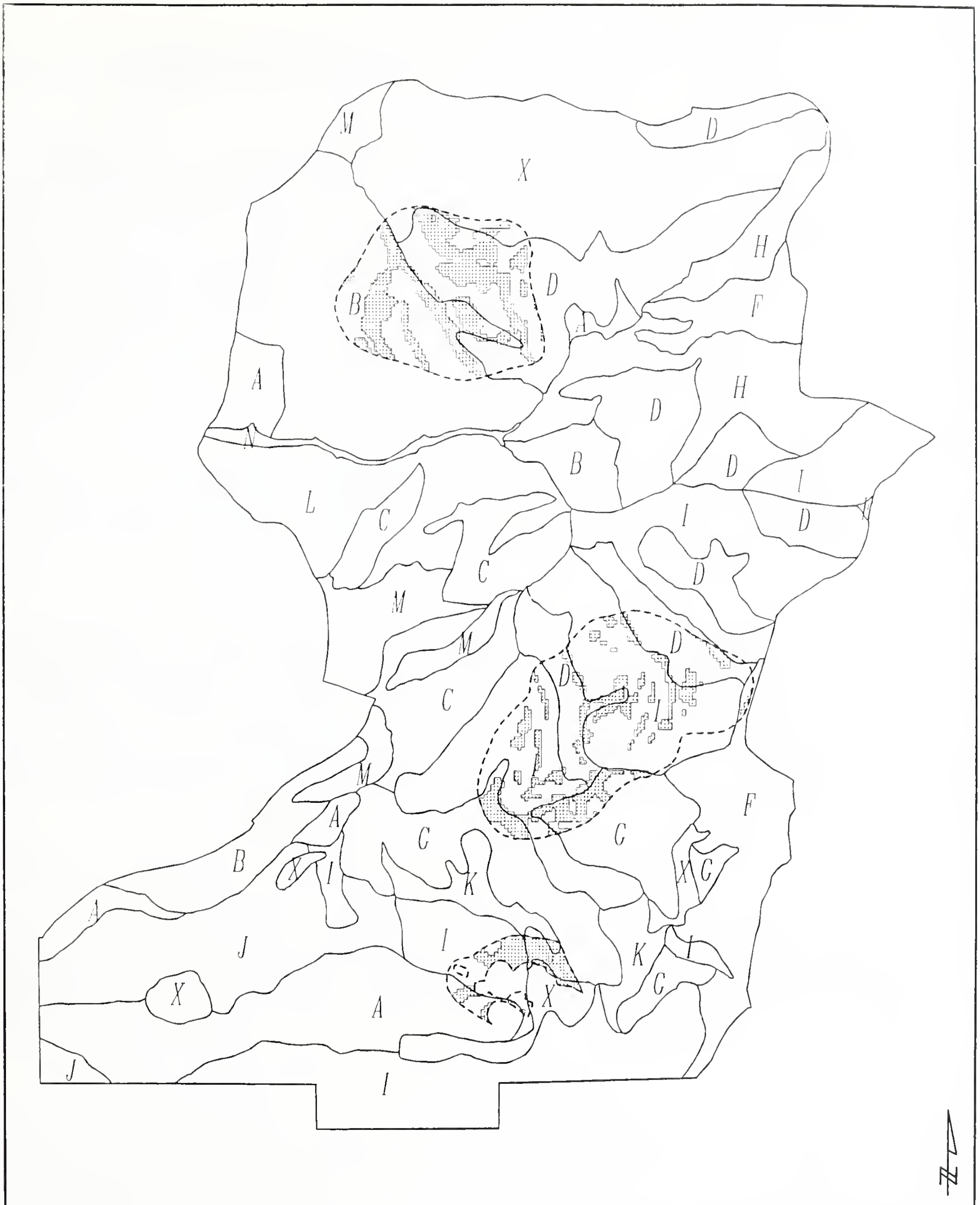
Dumping on top of dense vegetation ground cover can create potential sliding surfaces beneath slopes or clog the base drainage of the dumps.

Soil Resources

The availability and suitability of soils for use as growth medium are components of the reclamation potential issue raised during public and interagency scoping. Soil availability is a function of thickness and natural slope steepness. Suitability of soils for use as growth medium is based on physical and chemical characteristics. During the Order 3 soil survey conducted in 1992, information pertaining to soil availability and suitability was collected.

The analysis area for soils is the Project area. Soils were evaluated using existing data and maps, color aerial photography, and field surveys undertaken in August and September 1992. Background geological information used in preparing the soil maps and descriptions was obtained from a previous study by Hawkins (1973). Soil mapping has previously been conducted by the USFS, the Soil Conservation Service (SCS), and Environmental Research & Technology, Inc. (ERT) in 1979. A detailed soils map was developed for the Project area during 1992 to a Order 3 level as defined by the SCS (USDA, SCS). The soil mapping units delineated within the Project area are shown on Map 3.2.

Soils were mapped as associations, which consist of two or more soil series and allowable inclusions. The availability and suitability of each soil series for use as growth medium were documented during the soil survey. Availability of soil for use as growth medium is directly related to thickness and the steepness of the natural slopes. The uppermost soil horizons ranged from about 4 to 60 inches in thickness. Depth to bedrock ranged from about 10 to 80 inches. Soils less than about 12 inches in thickness are typically considered too shallow to remove with heavy equipment. Natural slope steepness influences the amount of soil that can be safely accessed. Recovering soils from slopes steeper than 30 to 40 percent is normally considered to be unsafe for heavy equipment. The primary



LEGEND

A = Sumine-Pemty-Tusel Association
B = Sumine Pemty-Tusel Association (Calcarcous)
C = Sumine-Agassiz-Lezgo Association
D = Bullump-Pemty-Cleavage Association
E = Lezgo-Hapgood-Sumine Association
F = Bullump-Pemty-Agassiz Association
G = Sumine-Bullump-Agassiz Association
H = Hapgood-Bullump-Hackwood Association
I = Hackwood-Hapgood-Agassiz Association
J = Tusel-Bullump Hapgood Association
K = Hapgood-Bullump-Lezgo Association
L = Tusel-Sumine-Graley Association
M = Lezgo-Agassiz-Sumine Association
N = Crooked Creek-Hussa Association
X = Area of Major Disturbance
———— Soil Association Boundaries
------ EIS Pit Boundaries
EIS Pit Areas With Slopes < or = 30%

SCW 11/13/93

Soil Associations Within the Project Area Showing Slopes Less Than 30% Within the EIS Pit Boundaries

Scale in Miles

0 1/8 1/4 1/2 1

Map 3.2

factors limiting the suitability of the soils within the Project area for use as plant growth medium are coarse fragment content, texture, and carbonate accumulations.

Suitability classifications for the soils were developed in cooperation with the SCS. Soil series rated as having a poor suitability for growth medium would be avoided as a source of growth medium to the extent operationally feasible. The mixture of some soils having a poor suitability rating with those having a fair or good rating would not be expected to interfere with revegetation success. Soil series with a poor rating include the Agassiz, Cleavage, and Graley. The Pernty soil series was rated as fair to poor for revegetation. As a result, only 50 percent of the Pernty soils would be considered suitable for salvaging. The Hackwood and Hapgood soil series have the best suitability rating for revegetation. The soil associations that include these two soil series are generally dominated by aspen stands, which would facilitate identification during soil removal.

Soil salvaging operations would focus on recovering suitable material in sufficient quantities within those portions of the pits that have slopes of 30 percent or less. The soils available for salvaging within the pits on slopes equal to or less than 30 percent are shown on Map 3.2. Additional growth medium would be recovered during mining as benches are developed on steeper slopes.

Parent material for soils within the Project area consists primarily of early Paleozoic sedimentary rock and minor material derived from igneous intrusions in the form of dikes and sills. Dominant rock types are argillite, chert, quartzite, and limestone. Argic (clay-rich) soils have formed where underlain by argillite and limestone, while loamy, pebbly soils have formed over bedded chert and quartzite rocks. Areas underlain by massive chert exhibit little soil development. Carbonate accumulation is present in soils on southfacing slopes and ridgetops underlain by limestone bedrock or colluvium.

Most of the soils in the Project area belong to three great groups: *Cryoborolls*, *Argixerolls and Haploxerolls*. Soils which have formed on slopes with a south aspect and on ridgetops are predominantly *Argixerolls* and *Haploxerolls*. Soils found on north and east facing slopes, some ridges and in high basin bottoms are predominantly *Cryoborolls*. Valley bottoms are narrow with generally insignificant soil development. Within the Project area, significant occurrences of valley bottom soil development are restricted to Jerritt Canyon and along Burns Creek. Characteristics of soil groups within the Project area are described below.

Cryoborolls occur on the northern and eastern slopes, on some ridges, and on high basin floors in the Project area. Soils within the Project area classified as *Cryoborolls* include the Hackwood, Hapgood, Lezgo and Tusel Series. These soil series are deep to very deep and tend to be well-drained. Slopes vary from 4 to 75 percent. Developed (A and B soil horizons) horizons range from 16 to 60 inches. Depth to bedrock ranges from 40 to over 80 inches. Textures include silt loams, gravelly silt loams, very gravelly sandy or clay loams, extremely gravelly loams and sandy clay loams. Suitability for salvage is fair to excellent depending on soil depth, slope and texture. Revegetation potential is fair and permeability ranges from rapid to moderately slow depending on percent clay content.

These soils support the following types of vegetation: big sagebrush, snowberry, rabbitbrush, slender brome, Idaho fescue, quaking aspen, tall oniongrass, chokecherry, and arrowleaf balsamroot.

Argixerolls are found on south and west facing slopes and on some ridges where carbonate bedrock provides the parent material. Soils within the Project area classified as *Argixerolls* include the Bullump, Cleavage, Graley, Pernty and Sumine Series. Soils in these series are generally shallow, ranging to deep, and are well-drained. Slopes vary widely from 2 to 75 percent and permeability is moderately slow to slow due to relatively high clay content. Developed horizons are relatively thin, ranging from 7 to 15 inches, with the exception of the Bullump soil series which has thick developed horizons ranging from 20 to 40 inches. Depth to bedrock varies from 14 to 40 inches, except in the Bullump Series, where the range is 40 to 80 inches. Textures include very cobbly and extremely gravelly loams, very gravelly clay loams and clays. Suitability for salvage is poor to marginal due to clay and gravel content, except for the Bullump Series soils which are highly suitable. Revegetation potential is generally poor to fair. Vegetation supported by these soils includes: big sagebrush, snowberry, serviceberry, bluebunch wheatgrass, brome, Thurber needlegrass, low sagebrush, rabbitbrush, Idaho fescue, Great Basin wildrye, cheatgrass, and antelope bitterbrush where soil is carbonatic.

Haploxerolls occur primarily on ridges and upper side slopes where parent material is siliceous bedrock. Soil series within the Project classified as *Haploxerolls* include the Agassiz Series. These are well-drained shallow soils with thin developed horizon of 4 to 12 inches. Depth to bedrock ranges from 10 to 20 inches and slopes vary widely from 2 to 75 percent. Textures include very cobbly loams, gravelly loams and extremely gravelly loams. Suitability for salvage is marginal due to thin organic surface layers and high gravel content. Permeability is moderate and revegetation potential is poor. These soils support the following vegetation: low sagebrush, bluegrass, Idaho fescue, and bottlebrush squirreltail.

Within the Project area there are minor occurrences of rock outcrop and talus, of Cryorthent and Cryumbrept soils on the upper mountain slopes and ridges, and Fluventic Haplaquolls along the stream channels. These and other minor inclusions were not quantified nor described in the soil associations.

Calculations of K factor (soil erodibility) values for soils within the Project area indicates they have generally low to moderate susceptibility to erosion where disturbed. Undisturbed soils have very low to moderate susceptibility to erosion.

Climatology and Air Quality

Abatement of fugitive dust (particulate emissions) was identified through public and agency scoping as an issue related to air quality. Air quality is affected by climatology, or weather patterns. Wind and precipitation, for example, can affect the air quality in a specific location by causing particles to be transported downwind or washed out.

The analysis area for climatology focuses on the Project area and, for purposes of examining air quality standards, includes an area within 60 miles (100 kilometers) of the Project area. The nearest Class I area, Jarbidge Wilderness, is located approximately 30 miles (50 kilometers) northeast of the Project area. Because existing air quality and climatology data for the Project area are limited, data sources include areas to the east and south of the Project area.

Climatology

The climate in the Project area follows general trends for the state of Nevada, but is also strongly affected by local topographic features, specifically, the Independence Mountains.

Wind Patterns

The surface wind pattern is highly dependent on local variations in topography. The Independence and North Fork Valleys generally channel strong prevailing winds in a north-south direction.

Several components of the mountain-valley wind systems dominate the local air flows in the Jerritt Canyon area. The north-south oriented Independence Mountains cause a weak diurnal surface wind pattern. Shallow upslope winds result from heating of the valleys on both sides of this range during the daytime. The western slopes of the range experience a westerly upslope flow originating from the Independence Valley. Easterly slope winds flow up the east side of the range from the North Fork Valley. During strong prevailing westerly wind conditions, the easterly upslope winds may disappear. At night, the direction of the flow pattern is reversed. Weak, shallow, gravity-driven drainage winds flow down both sides of the Independence Mountains. Any large canyons in the range, such as Jerritt Canyon, channel and enhance the drainage of mountain winds.

The general wind pattern is predominantly westerly and southwesterly. Hourly average wind speeds range from a minimum of one mile per hour to 34 miles per hour at the mill site located to the east of the Project area.

Precipitation and Temperature

Average precipitation within the Project area varies from about 12 inches at the 6,000 foot level to more than 26 inches above the 8,000 foot level (ERT 1979d), the majority of which falls as snow during the winter. The climate is typical of the Northern Great Basin with rather severe winters and mild to hot summers. Some snow persists in the higher elevations until July, and additional precipitation in the summer falls during thunderstorms. Average annual precipitation for Project area watersheds is included on Table 3.2.

Most of the precipitation supplied to the Project area is lost through evapotranspiration. Estimates by the USGS suggest that over 80 percent of precipitation

Table 3.2
Average Annual Precipitation for Project Area Watersheds

Watershed	Area (Square Miles)	Precipitation (in/yr)
Jerritt Creek		
Upper Subbasin	3.09	26
Lower Subbasin	5.95	18
N. Fork Jerritt Creek		
Upper Subbasin	2.10	26
Lower Subbasin	1.34	18
S. Fork Jerritt Creek	4.49	18
Mill Creek	1.63	18
Burns Creek	6.67	18
Snow Canyon Creek[1]	9.16	26

Source: Environmental Research & Technology 1979. Surface Water Technical Report, pages 18-19.
Note: [1] Only a small portion of this watershed with no water course falls within the Project area.

in this vicinity is lost through evapotranspiration near its point of deposition. It is either lost immediately upon falling or later in the year following seasonal storage as snow or soil moisture. Of the approximately 20 percent of total precipitation that becomes runoff or groundwater, nearly all is ultimately lost through evapotranspiration within the river valleys (ERT 1979d).

The Project area elevation affects temperature. At the highest elevations, the temperature range is less than at lower elevations. Winter temperatures may be warmer and summer temperatures cooler than at lower elevations. Data collected on the eastern side of the Independence Mountains and adjacent to the general study area indicate minimum temperatures from 0° to -8° Fahrenheit and maximum temperatures in the 90°s at the 6,600 and 7,600 foot elevations.

Air Quality

The background quality of air in the Jerritt Canyon area is excellent. The air quality parameter of primary interest due to proposed mining activities is particulate matter less than 10 microns in size (PM_{10}) from emissions of fugitive dust. The National Ambient Air Quality Standard (NAAQS) for PM_{10} is 50 micrograms per cubic meter ($\mu g/m^3$) annual arithmetic average and 150 $\mu g/m^3$ maximum 24 hour average. Other regulated pollutants which may be emitted into the air as a result of mining activities include sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen dioxide (NO_2).

The only air quality data in or adjacent to the Project area are from monitoring sites near the Jerritt Canyon mill. PM_{10} concentrations were measured at two sites near the mill from April 1990 to May 1991. One site was downwind from the mill facilities and the other was set up as a background site upwind from the mill. The arithmetic average of the PM_{10} values measured during this time was 10 $\mu g/m^3$ at both monitoring sites, thus indicating that the mill did not contribute particulate matter in the PM_{10} size range at concentrations higher than background PM_{10} levels (Desert Research Institute 1991a-e).

$S0_2$ concentrations are not routinely measured in Elko County. Given the absence of SO_2 sources, other than mine-related activities in the Jerritt Canyon Project area, it can be assumed that background SO_2 levels are minimal. The 1980 FEIS indicated that, based on air quality modeling, the SO_2 effects from mine emissions are expected to be minimal. The maximum predicted concentrations were 12 percent of state and federal standards. The maximum predicted concentrations were also predicted to occur close to the mill rather than from excavating or other mining operations that would take place in the proposed Project area.

The area surrounding Jerritt Canyon is designated attainment for all criteria pollutants (SO_2, CO, NO_2, PM_{10}, ozone, and lead), meaning that the area complies with all NAAQS for these pollutants. The region surrounding the Jerritt Canyon facilities is designated Group III for PM_{10}, meaning that the EPA, in conjunction with NDEP, has determined that there is less than 20 percent probability that there would be exceedances of the federal PM_{10} ambient air quality standard (USDI, BLM 1989).

The Prevention of Significant Deterioration (PSD) Class I area nearest to Jerritt Canyon is the Jarbidge Wilderness, approximately 30 miles (50 kilometers) northeast of Jerritt Canyon. There are no integral vistas associated with the Jarbidge Wilderness (USDI, BLM 1989).

NDEP has issued air quality permits for surface area disturbance and for a portable crushing and screening system for IMC's existing operations at Jerritt Canyon. The permit for surface area disturbance includes 1,951 acres of pit area, 3,823 acres of waste or overburden piles, 25 acres of ore storage areas, 735 acres of haul roads, 1,500 acres of plant site, 12 acres of leach pads, and 25 acres for miscellaneous uses, for a total of up to 8,071 acres. This permit requires that fugitive dust emissions from all disturbed areas be controlled by use of the best practical methods such as watering, chemical stabilization, or other controls.

In March 1993, NDEP issued air quality permits for construction of a mine crushing and screening system. This system includes: 1) a primary jaw crusher, apron feeder, and associated conveyors; 2) two primary screens, splitter box, conveyors, and radial stacker; 3) two secondary cone crushers and associated conveyors; and 4) diesel generators. The permit specifies monitoring measures to ensure that particulate emissions are properly controlled.

As part of its application for air quality permits, IMC used dispersion models to predict impacts on air quality from the proposed portable mine crushing and screening system at the Jerritt Canyon mine. The predicted concentrations of PM_{10} from these sources range from 7.04 to 72.08 $\mu g/m^3$ for the 24-hour averaging period, and from 1.60 to 20.27 $\mu g/m^3$ for the annual averaging period. The national ambient air quality standards (NAAQS) for PM_{10} are 150 $\mu g/m^3$ for the 24-hour averaging period and 50 $\mu g/m^3$ for the annual averaging period.

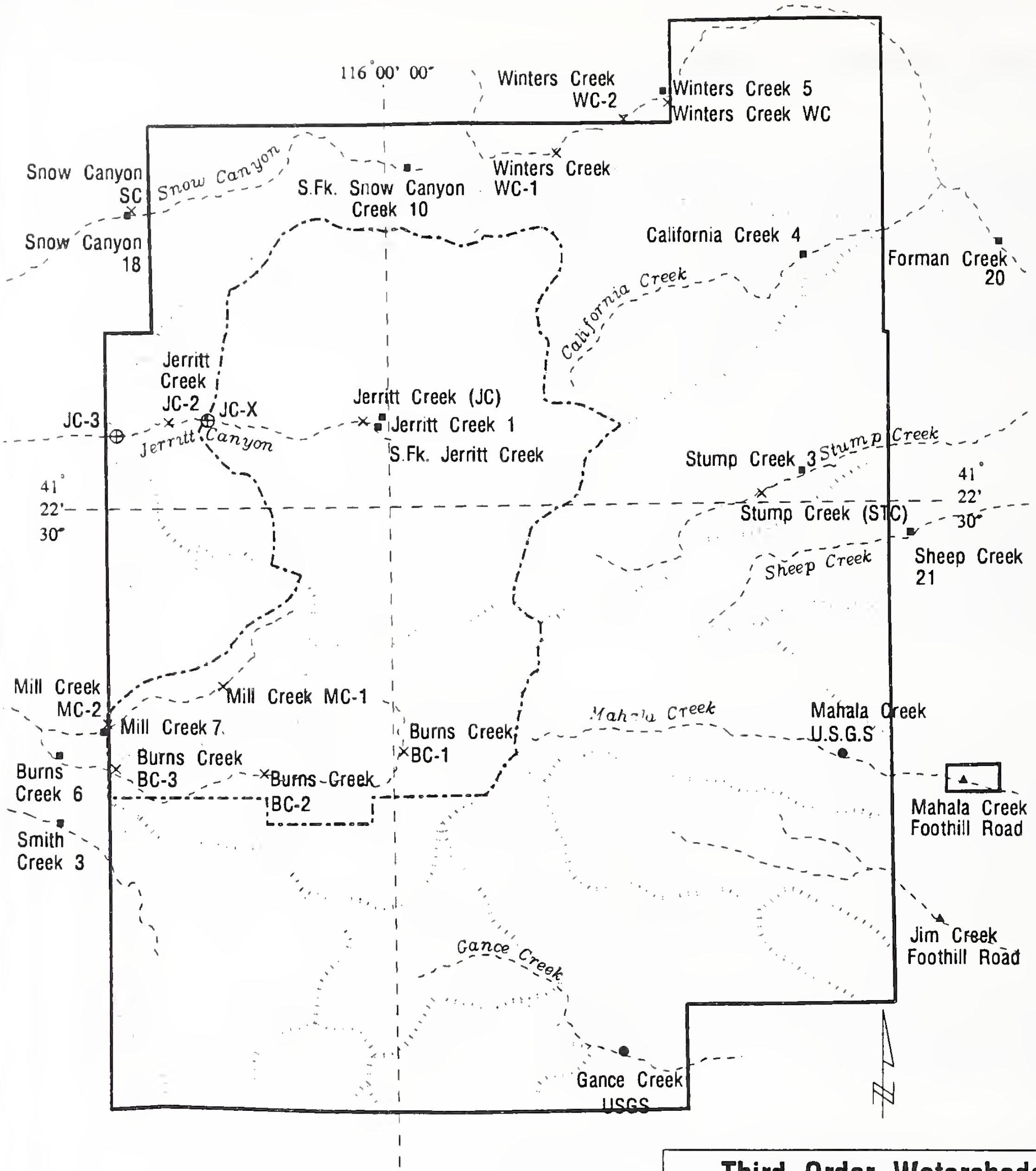
Surface Water Resources

The general study area is located within the southernmost reaches of the Snake River Basin. The main waterbodies in the Snake River Basin are Big Goose Creek, Salmon Falls Creek, Shoshone Creek, East Fork of the Jarbidge River, Jarbidge River, West Fork of the Bruneau River, South Fork of the Owyhee River, the Owyhee River, Wilson Reservoir and Wild Horse Reservoir (NDEP 1992).

The primary hydrologic features of the region surrounding the general study area are the South Fork of the Owyhee River to the west and the North Fork of the Humboldt River to the east. The most significant hydrologic feature in the general study area itself is the drainage divide formed by the ridgeline of the Independence Mountains. Streams draining the eastern side of this divide are tributary to the North Fork of the Humboldt River which drains to the Humboldt Sink in the Great Basin. There are no tributaries in the Project area that drain to the North Fork of the Humboldt River. Drainages on the west side of the divide flow into the South Fork of the Owyhee River, which eventually discharges to the Snake River. Western slope tributaries within the Project area include Jerritt Creek and Burns Creek, which both drain to the South Fork of the Owyhee River, and Mill Creek, a tributary to Burns Creek. Map 3.3 displays watershed boundaries of these drainages and the locations of surface monitoring stations.

Historical data indicate that peak runoff from the Independence Mountains occurs in May and June due to melting of winter snowpacks. An average of 68 percent of the annual flow occurs between March and June (ERT 1979d). The hydrograph in Figure 3.1 presents flow data collected from 1959 to 1984 on the South Fork of the Owyhee River at the USGS stream gage (Gage No. 13177200) at Spanish Ranch near Tuscarora, Nevada.

The CEA province for surface water analysis consists of third order watersheds within the Project area and includes: Jerritt Creek; Burns Creek; Mill Creek; Snow Canyon; and a very small portion of an unnamed watershed located between Mill Creek and Burns Creek. Only a small area of the Snow Canyon watershed, in which there are no watercourses, falls within the bounds of the Project area. The total area of third order watersheds and the percentage of existing disturbance within each are displayed in Table 3.3. The Mill Creek and Snow Canyon watersheds would not be affected by any of the



Third Order Watersheds With Water Monitoring Stations and Streams

LEGEND

- USGS Stream Gage
- Saval Ranch Research Station Water Quality Sampling Station
- Jerritt Canyon 1978-79 Water Quality Sampling Station
- Jerritt Canyon 1981-93 Water Quality Sampling Station
- Point for Sediment Yield and Runoff Studies
- Project Area
- Watershed Boundaries
- General Study Area
- USGS Streams

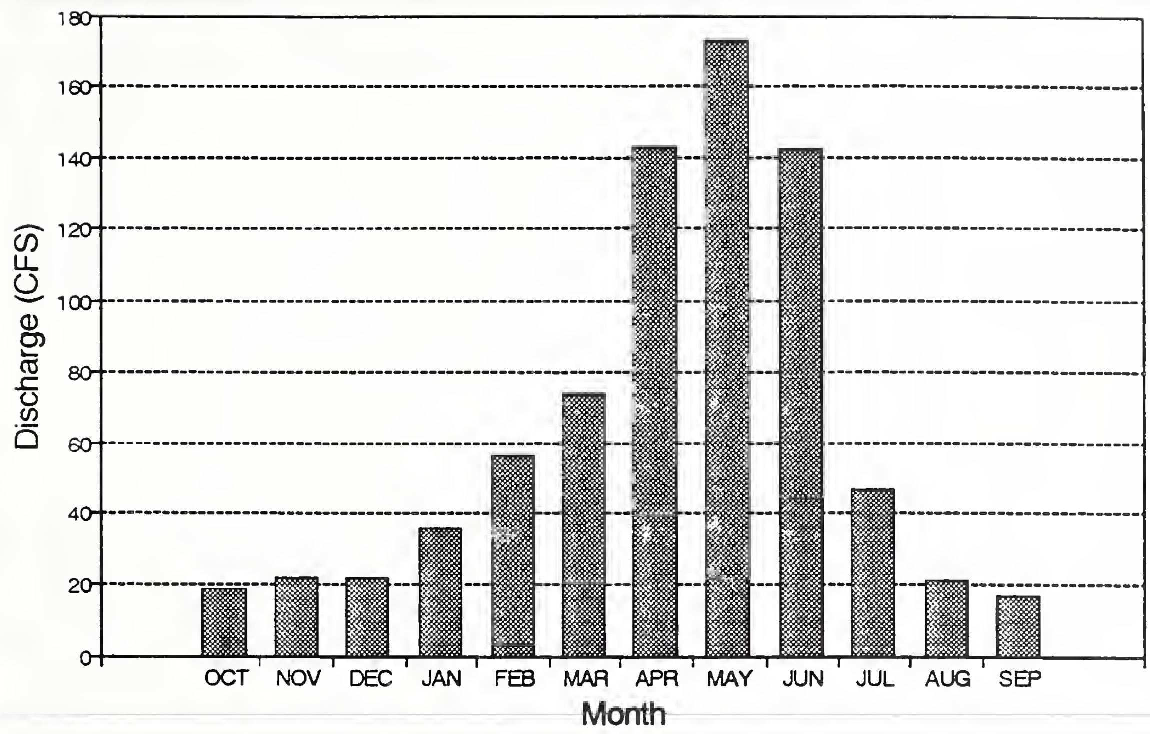
Scale in Miles

0 1.5 3

Map 3.3

11/16/93

Figure 3.1
Historical Monthly Mean Discharge
South Fork Owyhee River at Spanish Ranch near Tuscarora, Nevada



action alternatives, therefore, these watersheds are not addressed in the remainder of this document.

Surface Water Quantity

USGS classifies Jerritt and Burns Creeks as intermittent or perennial streams within the Project area. Stream flow data collected over the past 15 years and field observations suggest that the majority of these streams are actually intermittent or ephemeral within the Project area.

Jerritt Creek

Jerritt Creek is classified by the USGS as an intermittent or perennial stream within the Project area. The Jerritt Creek watershed is approximately 12.7 square miles (8,106 acres) in size. Stream flow data are limited and include measurements obtained during 1978, 1979, 1989, 1991, and 1992 which suggest the majority of this stream is intermittent. Average stream discharge was less than 0.01 cubic feet per second (cfs) in September of 1978. Readings in 1979 indicated a minimum discharge of 0.5 cfs, when adequate flow

Table 3.3 Approved Disturbance by Watershed (in Acres)[1]			
Watershed	Total	Approved Disturbance	Percent Disturbed
Jerritt Creek	8,106	1,420	17.5
Burns Creek	4,040	504	12.5
Mill Creek	982	192	19.6
Snow Canyon	6,337	198	3.1

Source: USFS GIS data base, June 3, 1993.

Note: [1] Includes all of watershed within USFS boundary.

depths enabled measurement, and a peak flow of 8.7 cfs. These data were recorded at gaging station no. 1, located on the main stem of Jerritt Creek just above the confluence of the South Fork of Jerritt Creek, also referred to as Steer Canyon. The area of the Jerritt Creek watershed monitored at station no. 1 contained 3.3 square miles (2,112 acres). Station no. 2, located on the South Fork of Jerritt Creek just above its confluence with Jerritt Creek, gaged a drainage area of 4.4 square miles (2,816 acres). A minimum discharge of 4.8 cfs, when flow was occurring, and peak flow of 80.1 cfs were recorded in 1979 (ERT 1979d). The accuracy of the recorded peak flow of 80.1 cfs is questionable when compared with discharge data obtained for the same period in neighboring watersheds of similar or greater area.

Flow measurements were obtained at station JC between September 1984 and June 1993. This station is located on the Jerritt Creek mainstem just below the Steer Canyon confluence. Averages of these data indicate a minimum flow of 0 cfs and maximum flow of 16.8 cfs with a mean flow of 1.6 cfs (IMC 1992e and IMC 1993d). At station JC-2, located at the confluence of Steer Canyon and Jerritt Creek, stream flow was too low to gage in March and April 1992 and the stream was dry when sampling efforts were made in May and June 1992 (IMC 1992e and IMC 1993d).

Field work was done by the USFS from 1989-92 at the forest boundary to estimate bankfull discharge (1.5 year event), average annual discharge and low discharge (equal to or exceeded 95% of the time) using mathematical relationships of substrate size, channel geometry, slope and watershed area. The results of this work indicated a bankfull discharge of 28.4 cfs, an average annual discharge of 4.3 cfs and a low discharge of 0.4 cfs.

Burns Creek

Burns Creek is ephemeral in the upper reaches, then intermittent and finally perennial farther downstream within the Project area. The Burns Creek watershed is approximately 6.3 square miles (4,038 acres) in size. Stream flow data are limited and include measurements obtained in 1979, 1988, 1989, 1990, 1991 and 1992. In 1979, flow measurements were obtained at station no. 6, just above the Mill Creek confluence, indicating a minimum discharge of 2.5 cfs, when flow was occurring, and a peak flow of 40.0 cfs (ERT 1979d).

Discharge data for Burns Creek were acquired at station BC-3, located just above the Mill Creek confluence, during the years 1988 to 1993. Recorded flows during this period were a minimum of 0 cfs, a maximum of 14.6 cfs, and mean of 4.5 cfs (IMC 1992e and IMC 1993d). Burns Creek typically is dry or has very low flows much of the year.

Field work was done by the USFS from 1989-92 at the Forest boundary to estimate bankfull discharge, average annual discharge and low discharge using mathematical relationships of substrate size, channel geometry, slope and watershed area. The results of this work indicated a bankfull discharge of 12.1 cfs, an average annual discharge of 2.8 cfs and a low discharge of 0.3 cfs.

Surface Water Quality

General Water Quality - South Fork Owyhee/Snake River Basin

The South Fork of the Owyhee River was classified as "water quality limited" (NDEP's 1979 Water Management (208) Plan) because temperatures of 33.3 percent of the samples taken exceeded the standard of 21°C (May-October) or 13°C (November-April). The maximum reading was 13 percent over the standard (NDEP 1992).

The 1991 Water Management (208) Plan for the Non-Designated Area of Nevada indicates that with the exception of eutrophic conditions in Wilson and Wild Horse reservoirs, low flows and summertime temperature problems at various points in the streams, there were no other chronic water quality problems identified within the Snake River Basin (NDEP 1992).

Surface Water Sampling Program - Project Area

Water quality data were collected on streams in the general study area every month from September 1978 to August 1979 as part of the baseline studies for the original Jerritt Canyon Project EIS (ERT 1979g). Samples were collected from the surface water stations shown on Map 3.3. Field measurements included temperature, pH, dissolved oxygen and total alkalinity. The following parameters were also included in sample analysis: chemical oxygen demand (C.O.D.); color; turbidity; total dissolved solids; ammonia; nitrate; total phosphate; cyanide; calcium; magnesium; potassium; sodium; sulfate; chloride; metals; and coliform bacteria.

Monthly water quality data collection resumed in 1981 on Jerritt Creek and additional water quality monitoring stations were established between 1986 and 1988, at the locations shown on Map 3.3 (IMC 1992e). Station JC was established on Jerritt Creek just below the Steer Canyon confluence and station JC-2 was established downstream on the mainstem. The JC station has been sampled since July of 1981. The JC-2 station was sampled twice in 1992. Sampling has been conducted at one station on Burns Creek (BC-3) since 1987, and from two stations on Burns Creek (BC-1 & BC-2) since 1988.

Sampling parameters in the more recent program have changed slightly from the 1978-1979 study. Field parameters now include flow, temperature, pH and specific conductance. Ammonia, cyanide, and coliform bacteria are no longer measured. In 1992, total suspended solids (TSS), arsenic, and metals were added to the analysis list.

Summaries of surface water quality monitoring data from the 1978-1979 study and from the 1981-1992 sampling program are presented in Table 1 and Table 2, respectively, in Appendix A. Surface water quality standards are included in Appendix B. Data from both investigations indicate that the study area streams contain moderately hard, calcium carbonate type water. Water tends to flow mainly in response to spring runoff, and concentrations of dissolved constituents tend to vary depending on the relative components of precipitation, surface water runoff, and groundwater that enter the stream.

A comparison of data gathered in the 1981-1992 program with data from the 1978-1979 study reveals that, in general, pH values have remained between 6.2 and 8.6. Average pH values during 1981-1992 ranged from 8.0 to 8.5. Average TSS ranged from 8.0 mg/l (downstream) to 22.0 mg/l (upstream) at two monitoring sites in Jerritt Creek. The monitoring station above the existing Burns Basin pit averaged 278.0 mg/l but TSS levels dropped to 16.0 mg/l and 9.0 mg/l at downstream monitoring sites below the mining disturbance areas. Total dissolved solids (TDS) appear to have increased in Burns Creek since the 1978-1979 study, but have consistently remained below the "beneficial use" standard except on one occasion after a major storm event.

Chloride measurements for Jerritt Creek taken from 1981 to 1992 were generally higher than in the earlier study but did not exceed the "beneficial use" standard for chloride in the South Fork of the Owyhee River system or the EPA National Interim Drinking Water Regulations standard for public drinking water supplies. Jerritt Creek, tributary to the South Fork of the Owyhee, is not a public drinking water supply.

Total phosphorus values appear to be lower in the recent studies where comparisons can be made to 1978-1979 data. Nitrate values have decreased in Jerritt and Burns creeks since the 1978-1979 study. Total iron also appears to have decreased. Arsenic was added to the sampling list in the recent studies but did not exceed the current National Primary Drinking Water Standard Maximum Contaminant Level (MCL) of 0.1 mg/l at any sampling station for any sampling event. Other metals which had exceeded MCLs in the original study were chromium and lead, but these were not sampled in the recent program.

The only stream within the Project area which supports a fishery is Burns Creek. According to the pre-mining data, average chromium concentrations exceeded the chronic criterion and average copper and zinc concentrations exceeded both the chronic and acute EPA freshwater aquatic life criteria. The one lead sample above detection limits (0.07 mg/l) exceeded both the acute and chronic criteria. Mercury data obtained from Burns Creek station BC-3 in 1987 and 1988 never exceeded the detection limit of 0.0005 mg/l.

Groundwater Resources

The primary issue associated with groundwater is the potential for acid rock drainage to affect the quality of groundwater. Other issues are the potential for groundwater to be impounded in the pits and effects to the flow of Niagara and Van Norman Springs.

Groundwater occurs throughout the Project area at depths ranging from the ground surface in areas of springs to several hundreds of feet in upland areas. The consolidated sedimentary and igneous rocks of the Independence Mountains generally exhibit low permeability, but transmit water locally through fractures and limestone solution cavities. Local groundwater barriers formed by faults or by low permeability rocks have created a complex pattern of perched and semi-perched groundwater (Eakin and Lamke 1966).

Groundwater Quantity

Data on groundwater elevations from exploration drill holes and four groundwater monitoring wells indicate that groundwater within the Project area occurs in perched zones and in a deeper regional groundwater water table. The regional groundwater system in the vicinity of the Project area is assumed to encompass the western slopes of the Independence Mountain Range from the drainage divide between Jerritt Canyon and Snow Canyon on the north to Burns Creek on the south and extending into the Independence Valley on the west. The elevation of the regional groundwater surface varies with topography. Hydrogeologic cross sections indicate that both perched groundwater and unperched groundwater flow is controlled by faults, solution cavities or karst features in limestones, and the permeability of the various rock units. Groundwater is locally perched in argillized (clay altered) layers or in gouge zones associated with low angle faults. Groundwater levels measured in three monitoring wells in the New Deep mine area exhibited minor seasonal fluctuations of less than 35 feet, consistent with what would be expected of a regional groundwater surface. Groundwater flow is typically unconfined, although locally confined conditions were observed during drilling. None of the existing pits encountered the regional groundwater surface but several have intersected perched zones. The elevation of the regional groundwater surface is estimated to be at approximately 6,100 feet in the New Deep mine area, 6,382 feet in the Saval and Steer mine area, and 6,500 feet in the Burns Basin mine area. Water that enters the existing pits evaporates or infiltrates the fractured rock in the pit bottoms, and none is impounded.

The majority of groundwater recharge within the Project area and the adjacent valleys occurs as precipitation, mainly snow, falling in the mountains. Groundwater discharge occurs as flow from springs, evapotranspiration, and seepage to the creeks and their tributaries (Eakin 1962). Average annual recharge and discharge have not been estimated for the Independence Mountains or for Independence Valley.

Water production varies throughout the Project area but is generally low. Water was reported in 462 holes out of the approximately 1,800 holes drilled in the Saval, Steer and New Deep mine areas. Water production was measured in drill holes in which water flow was greater than five gallons per minute (gpm). Flows of 5 to more than 25 gpm were reported from some exploration holes in fracture zones, and some holes encountered flows as high as 100 gpm. Water production is controlled by fractured zones associated with faults, solution cavities associated with silicification, and a relict karst system in limestone in the Burns Basin area. The temperature of groundwater in the New Deep area ranges from 36 to 95°F, indicating localized geothermal conditions.

A karst system of interconnected solution cavities is present in some areas in the carbonate rocks of the Burns Basin mine area (USFS 1985a). A fluorescein dye tracer study performed in 1985 indicated that the spring located in Burns Creek about one half mile inside the western Forest boundary drains the karst system underlying the Burns Basin mine area. The tracer was not observed in any other springs.

Springs and Seeps

A spring and seep survey conducted in the Project area in the summer of 1993 identified 23 springs and 8 seeps in the Project area (Map 3.4). Spring flow data obtained during the 1993 survey is summarized in Table 3.4. With the exception of Niagara and Van Norman Springs, all of the springs that were measured had flows less than 20 gpm and most were less than 5 gpm. Flow in Niagara Spring has been measured monthly for the past ten years and averages 3,599 gpm, although the rate recorded is highly variable, ranging from 300 to 8,620 gpm. Van Norman Spring flows have also been measured for the past ten years and average 1,233 gpm, with a range of 444 to 6,700 gpm. These springs emanate from high angle north-south trending range front faults that form the western boundary of the Independence Mountains.

Groundwater Quality

Water quality analyses of samples from groundwater monitoring wells in the New Deep mine area (shown on Map 3.4) are summarized in Table 3.5. The groundwater in this area is calcium magnesium bicarbonate type water with an average TDS of 310 mg/l and average pH of 7.1. The quality of this water generally meets or exceeds primary state and federal standards established for drinking water, irrigation, and livestock, with the exception of iron and manganese. No groundwater quality data is available for the Saval, Steer or Burns Basin areas other than sampling results from springs and seeps. During development drilling in the summer of 1993, attempts to acquire additional water quality samples were unsuccessful due to the limited water encountered in all of the mine areas.

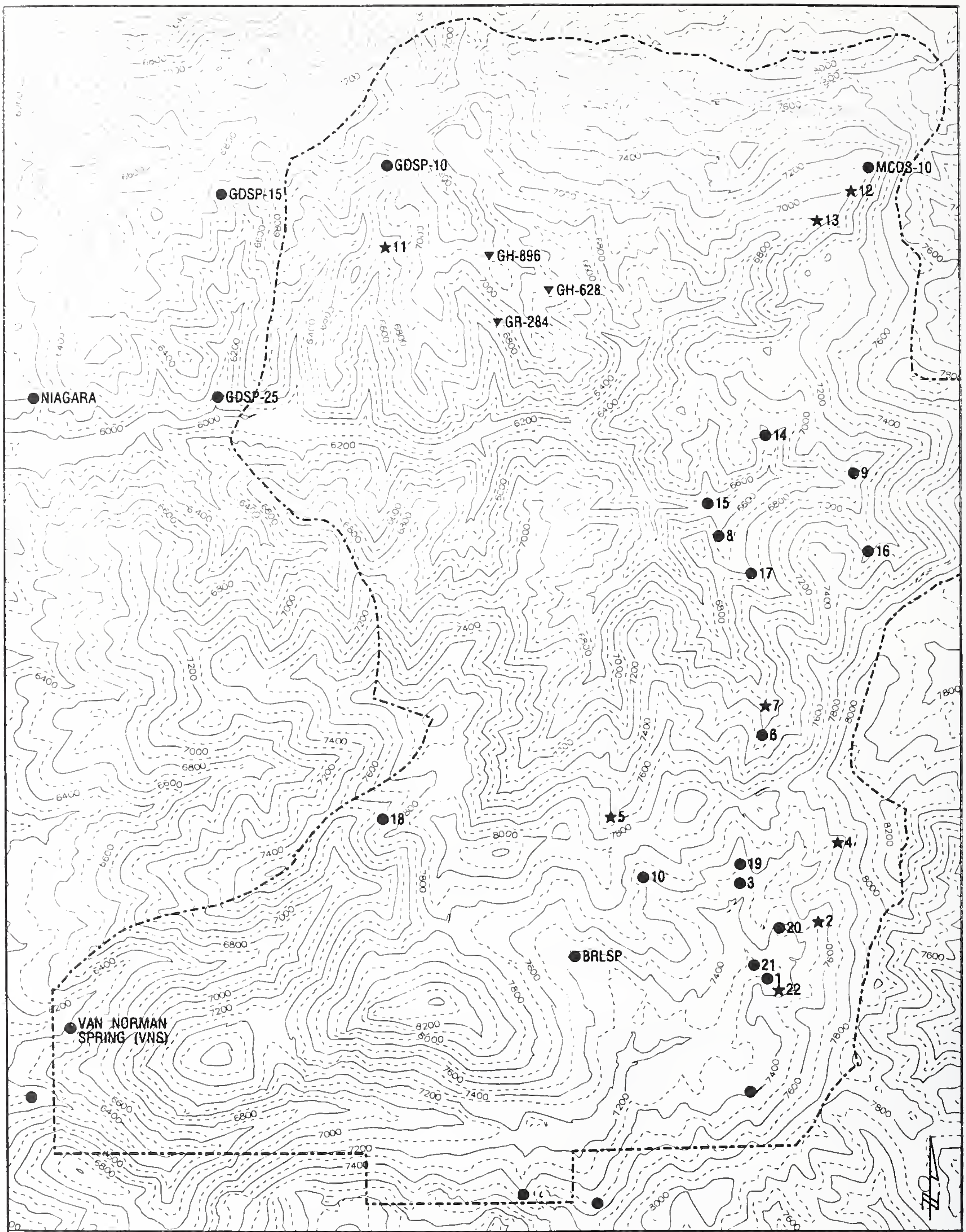
Water samples were collected from the springs and seeps within and adjacent to the New Deep, Saval, Steer, and Burns Basin mine areas. Water quality analysis results are

Table 3.4
Spring and Seep Classification and Flow Rates

Spring/Seep ID Number	Estimated GPM	Classification	Elevation (feet)
1	<1	spring	7,300
2	-	seep	7,500
3	<0.5	spring	7,420
4	-	seep	7,740
5	-	seep	7,625
6	0.5	spring	7,290
7	-	seep	7,130
8	1	spring	6,620
9	0.5	spring	6,850
10	<0.5	spring	7,600
11	-	seep	6,725
12	2	seep	7,740
13	-	seep	6,900
14	0.5	spring	6,775
15	2	spring	6,450
16	1.75	spring	6,825
17	-	spring	6,900
18	10	spring	7,650
19	NA	spring	7,500
20	10	spring	7,400
21	<0.1	spring	7,280
22	-	seep	7,380
BRL-SP	20	spring	7,380
GDSP-10	NA	spring	6,850
GDSP-15	3	spring	6,725
MCDS-10	17	spring	7,4[illegible]0
GDSP-25	NA	spring	6,025
Niagara	3,599[1]	spring	6,350
Van Norman Spring	1,233[2]	spring	6,210
4 unnamed springs in far South section of project area	NA	spring	7,550 7,400 7,390 6,100

Source: IMC 1993

Note: NA = Not Available
[1] average value 2/82 to 5/92
[2] average value 1/83 to 5/92



LEGEND

- ● Spring Locations
- ★ Seep Locations
- ▼ New Deep Groundwater Monitoring Wells
- -·-·-·- Project Area Boundary

SCW 11/13/93

Springs, Seeps, and Monitoring Wells

Scale in Miles

0 1/8 1/4 1/2 1

CONTOUR INTERVAL 100 FEET

Map 3.4

Table 3.5
Water Quality Analysis Results
Monitoring Wells GH-896, GR-284, GH-628A[1]

	GH-896	GR-284	GH-628A
Aluminum	0.03	<0.01	<0.01
Antimony	0.004	0.030	0.003
Arsenic	<0.001	<0.021	0.014
Barium	0.085	0.030	0.074
Beryllium	<0.0001	<0.001	0.014
Cadmium	<0.0001	<0.0001	0.0003
Calcium	55.2	67.3	59.1
Chromium	<0.0002	0.0009	0.0010
Copper	<0.0002	<0.001	0.009
Iron	0.004	<0.0001	<0.02
Lead	0.007	<0.001	0.001
Magnesium	36.8	43.3	34.2
Manganese	0.157[2]	<0.075	0.0063
Mercury	<0.0002	<0.0002	<0.001
Nickel	0.007	0.004	0.009
Potassium	1.7	2.4	2.1
Phosphorus	<0.001	<0.0002	<0.001
Selenium	<0.0002	0.043	<0.001
Silver	<0.0001	<0.0002	<0.0001
Sodium	36.8	36.8	0.082
Silica	0.084	0.084	14.00
Hardness	289	346	288
Thallium	0.002	0.002	0.002
Zinc	0.084	0.043	<0.002
Chloride	3.7	4.6	2.6
Fluoride	0.3	0.2	<0.002
Sulfate	31.1	82.5	43.6
Nitrate	<0.0002	<0.0002	0.17
Nitrite	<0.0001	<0.05	<0.05
Conduct.(μmhos)	550	655	558
pH (pH units)	7.00	7.20	7.10
Turbidity (NTU)	2,840.0	357.0	85.6
TDS	270.0	361.0	299.0
TSS	1,430.0	165.0	173.0

Note: All analyses in mg/l unless otherwise noted
< Indicates values less than the limit of detection
[1] Location of monitoring wells shown on Map 3.4
[2] Does not meet state and federal drinking water standards

summarized in Table 3.6. The similarity of groundwater chemistry from springs and seeps, particularly those that emanate from the regional groundwater system, and from monitoring wells suggests that spring and seep water quality is a general indicator of groundwater quality throughout the Project area.

Springs GDSP-10 and MCDS-10 in the New Deep mine area have calcium magnesium sulfate type water, an average pH of 7.85, and high total dissolved solids (TDS) and sulfates that exceed secondary drinking water standards. The high TDS and sulfate concentrations for these two springs may indicate groundwater in equilibrium with ore deposits or the influence of adjacent and upgradient waste rock dumps. The sulfate in the groundwater may be the result of oxidation of pyrite and/or dissolution of sulfate minerals. As shown in Table 3.6, these spring samples exceed some of the secondary standards for drinking water and agriculture use.

The remainder of the springs in the Project area have calcium magnesium bicarbonate and calcium bicarbonate type waters. These types of water are typical of groundwater in equilibrium with limestone and dolomite. Values for pH ranged from 6.2 to 8.0, and TDS concentrations were between 60 to 386 mg/l. These springs generally meet primary and secondary drinking water and agricultural use standards, with the exception of secondary standards for iron and manganese.

Wetlands

Potential impacts to wetlands were identified as an issue for EIS analysis. The discharge of dredged or fill material into waters of the United States, which includes special aquatic sites such as wetlands, is regulated under Section 404 of the Clean Water Act. Wetlands serve a variety of functions, including wildlife habitat. The following discussion examines existing conditions for waters of the United States including wetlands within the Project area.

Wetlands within existing mine operations areas and within proposed expansion areas were delineated by IME Wetlands Consultants and Gibson & Skordal in 1992 (IMC 1992d, IME 1992, IMC & IME 1993). The objective of these studies was to delineate the extent of waters of the United States subject to Corps of Engineers (Corps) jurisdiction pursuant to Section 404 of the Clean Water Act. The studies evaluated the extent of all drainage channels satisfying the definition of "waters of the United States" as well as all adjacent and isolated jurisdictional wetlands.

Section 404 of the Clean Water Act requires that a Corps permit be obtained prior to discharging dredged or fill material into waters of the United States including associated wetlands. Waterbodies constituting "waters of the United States" include lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce (IMC & IME 1993). Wetlands are jointly defined by the Corps and EPA as those areas that are inundated or saturated at a frequency and duration sufficient to support, and that under normal circumstances do

Table 3.6
Water Quality of Springs and Seeps in the Jerritt Canyon Mine Expansion Analysis Area[1]

Parameter	Units	GDSP-10 (Avg)[2]	GDSP-25 (Avg)[2]	BRLSP (Avg)[2]	VNS (Avg)[2]
pH	pH units	7.74	7.355	7.275	7.76
Bicarb.Alk.	mg/l	371	237	130	222
Bicarb.Alk.	meq/l CaCO	6.1	4.88	2.08	NA
Carb.Alk.	mg/l	NA	NA	NA	NA
Cl	mg/l	8.25	4.5	5.1	4
SO_4	mg/l	1295.5[3]	53.95	3.4	36
NO_3	mg/l	1.905	<0.05	0.185	0.3
NO_2	mg/l	<0.05	<0.05	<0.05	NA
Na	mg/l	13.65	5.92	3.075	0.3
P	mg/l	0.1	1.6	1.1	1.05
Ca	mg/l	298.5	61.8	33.2	55.9
Mg	mg/l	190.5	33.4	9.36	24.4
Al	mg/l	0.48	0	0.35	NA
As	mg/l	<0.004	0.011	0.012	0.03
Ba	mg/l	0.069	0.047	0.009	NA
Cd	mg/l	0.0015	<0.002	<0.04	<0.01
Cr	mg/l	<0.003	<0.002	<0.05	<0.05
Cd	mg/l	0.0025	<0.004	<0.02	<0.02
Fe	mg/l	1.06[3]	0.004	0.157	<0.02
Ba	mg/l	0.0035	0.0035	<0.05	<0.05
Li	mg/l	<0.003	0.069	<0.003	NA
Mn	mg/l	0.709[3]	0.004	0.009	NA
Hg	mg/l	<0.0004	<0.0002	<0.0005	<0.0005
Ni	mg/l	<0.04	<0.04	<0.04	<0.01
Se	mg/l	0.001	<0.04	0.0005	0.001
Ag	mg/l	<0.002	<0.002	<0.002	NA
Zn	mg/l	0.069	0.0115	0.004	<0.02
F	mg/l	<0.1	0.1	<0.1	NA
B	mg/l	0.023	0.007	<0.006	NA
P	mg/l	0.05	<0.01	0.02	NA
Si	mg/l	14.8	6.7	9.45	9.5
TDS	mg/l	2097[3]	296.5	132.5	265
Cond.	µmhos	1610	529	217	NA

Note:
- < Less than limit of detection
- 1 Spring locations shown on Map 3.4.
- 2 Average of two samples taken in 1992 and 1993
- 3 Does not meet state and federal drinking water standards
- NA Not Analyzed

Table 3.6, Continued
Water Quality of Springs and Seeps in the Jerritt Mine Expansion Analysis Area[1]

Parameter	Units	Niagara 11/19/92	GDSP-15 (Avg)[2]	MCDS-10 9/22/92	1 6/11/93	2 6/11/93
pH	pH units	7.56	7.74	7.96	26.1	6.65
Bicarb.Alk.	mg/l	247	307	184	NA	NA
Bicarb.Alk.	meq/l CaCO	NA	6.16	NA	4.46	3.18
Carb.Alk.	mg/l	NA	NA	NA	NA	NA
Cl	mg/l	[illegible]	5.55	67	2.5	3.3
SO_4	mg/l	47	27.2	1410[3]	14.7	20.3
NO_3	mg/l	0	0.275	36[3]	0.06	<0.05
NO_2	mg/l	NA	9.15	NA	<0.05	<0.05
Na	mg/l	5.1	5.55	29.6	5.7	16.2
K	mg/l	1.3	0.8	6.8	1.1	0.7
Ca	mg/l	69.5	69.45	371	51.1	32.1
Mg	mg/l	29.5	35.95	220	26.1	18.3
Al	mg/l	NA	<0.02	NA	1.24	0.17
As	mg/l	<0.02	0.006	0.002	0.006	<0.05
Ba	mg/l	NA	0.206	NA	0.297	0.143
Ca	mg/l	<0.01	<0.002	<0.01	<0.002	<0.002
Cr	mg/l	<0.06	0.006	<0.05	0.004	0.003
Cu	mg/l	<0.02	<0.002	<0.02	<0.004	<0.004
Fe	mg/l	0.05	<0.002	0.14	1.63[3]	0.143
Ba	mg/l	<0.05	<0.05	<0.05	0.003	0.002
Li	mg/l	NA	<0.05	NA	<0.05	<0.05
Mn	mg/l	NA	0.005	NA	0.005	0.006
Hg	mg/l	<0.0005	<0.0004	<0.0005	<0.002	<0.002
Ni	mg/l	<0.04	<0.04	<0.04	NA	NA
Se	mg/l	<0.0005	0.0005	0.002	<0.004	<0.04
Ag	mg/l	<NA	<0.002	NA	<0.002	<0.002
Zn	mg/l	<0.02	0.005	<0.02	0.019	0.004
F	mg/l	NA	26.1	NA	<0.1	0.2
B	mg/l	NA	0.017	NA	0.003	<0.04
P	mg/l	NA	0.04	0.03	NA	NA
Si	mg/l	9	9.15	10	[illegible].3	10.1
TDS	mg/l	386	345	2566[3]	216	183
Cond.	μmhos	NA	603	NA	437	341

Note: < Less than limit of detection
[1] Spring locations shown on Map 3.4
[2] Average of two samples taken in 1992 and 1993
[3] Does not meet state and federal drinking water standards
NA Not Analyzed

Table 3.6, Continued
Water Quality of Springs and Seeps in the Jerritt Canyon Mine Expansion Analysis Area[1]

Parameter	Units	3 6/11/93	4 6/11/93	5 6/18/93	6 6/18/93	7 6/18/93	8 6/17/93	9 6/17/93
pH	pH units	7.47	6.65	6.22	6.78	7.26	6.68	7.04
Bicarb. Alk.	mg/l	NA	NA	NA	NA	NA	NA	NA
Bicarb. Alk.	meq/CaCO	4.5	3.32	0.8	4.56	5.62	4.14	5.44
Carb. Alk.	mg/l	NA	NA	NA	NA	NA	NA	NA
Cl	mg/l	49.3	2.1	2	6.4	4.6	4	6.4
SO_4	mg/l	33.7	16.1	3.4	18.5	64.1	48.9	19.9
NO_3	mg/l	3.68	<0.05	0.64	2.86	0.18	<0.05	0.97
NO_2	mg/l	<0.05	<0.05	<0.05	<0.05	<0.002	<0.05	<0.05
Na	mg/l	6.28	8.67	2.01	8.2	11	10.8	10.5
K	mg/l	1	0.8	1.6	1.3	2.8	3	1.6
Ca	mg/l	69.3	54.9	13.5	62.4	82.5	57	60.6
Mg	mg/l	36.4	20.2	5.81	28.9	33.2	27.4	34.5
Al	mg/l	0.1	0.23	7.2	4.56	1.23	3.64	1.35
As	mg/l	<0.001	0.019	0.038	<0.001	0.016	0.015	0.007
Ba	mg/l	0.434	0.209	1.11	0.309	0.38	0.438	0.271
Cd	mg/l	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ca	mg/l	0.003	<0.004	0.006	<0.002	0.004	0.004	0.003
Cu	mg/l	<0.004	<0.004	0.016	<0.004	0.006	0.015	0.005
Pb	mg/l	0.427	0.632[3]	6.82[3]	1.89[3]	2.05[3]	5.24[3]	1.52[3]
Pb	mg/l	0.002	0.003	<0.04	0.005	0.004	0.069	0.004
Li	mg/l	<0.003	<0.05	0.006	0.039	<0.05	0.005	0.004
Mn	mg/l	0.028	0.038	0.18[3]	0.089	0.069	0.135[3]	0.059
Hg	mg/l	<0.0002	<0.0002	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Ni	mg/l	NA	NA	NA	NA	NA	NA	NA
Se	mg/l	<0.04	<0.04	<0.04	<0.04	40.0·	<0.04	<0.04
Ag	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zn	mg/l	0.115	0.026	0.051	0.026	0.023	0.055	0.034
F	mg/l	0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
B	mg/l	0.017	0.019	0.006	<0.006	0.048	0.034	0.017
P	mg/l	NA	NA	NA	NA	NA	NA	NA
Si	mg/l	9	7.6	<0.1	8.2	12.3	10.8	8.3
TDS	mg/l	332	171	60	252	361	270	283
Cond.	µmhos	648	333	97.9	477	626	484	540

Note:
< Less than limit of detection
[1] Spring locations shown on Map 3.4.
[2] Average of two samples taken in 1992 and 1993
[3] Does not meet state and federal drinking water standards
NA Not Analyzed

support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas (IMC & IME 1993).

All drainages within the study area were examined during the 1992 field investigation and a determination was made at each site whether waters of the United States, other than adjacent or isolated wetlands, were present. Estimated average widths of delineated drainage channels within the Project area ranged from one to ten feet (Gibson and Skordal 1992, IMC & IME 1993). The majority of waters delineated are in the upper reaches of the drainages and are ephemeral to intermittent with average widths of four to six feet (Gibson and Skordal 1992, IMC & IME 1993). Where springs or seeps occur in association with drainage channels, wetland vegetation is often present. No lakes or ponds were delineated within the areas studied. A number of small sediment traps which have been constructed downstream of active mine and exploration sites were delineated as impacted channels (IMC & IME 1993). Waters of the U. S. other than wetlands are displayed on the detailed maps in Appendix C.

Wetlands, both isolated and those adjacent to waters, were delineated using diagnostic environmental characteristics specified in the Corps manual. One wetland indicator for each parameter (hydrology, soil, and vegetation) must normally be found in order to make a determination that an area is a wetland (IMC & IME 1993). In the course of the field investigations, it was determined that the boundary of vegetation types dominated by certain hydrophytic plant associations coincided consistently with the boundaries of hydric soils. This correlation permitted mapping of wetland boundaries based on occurrences of hydrophytic vegetation.

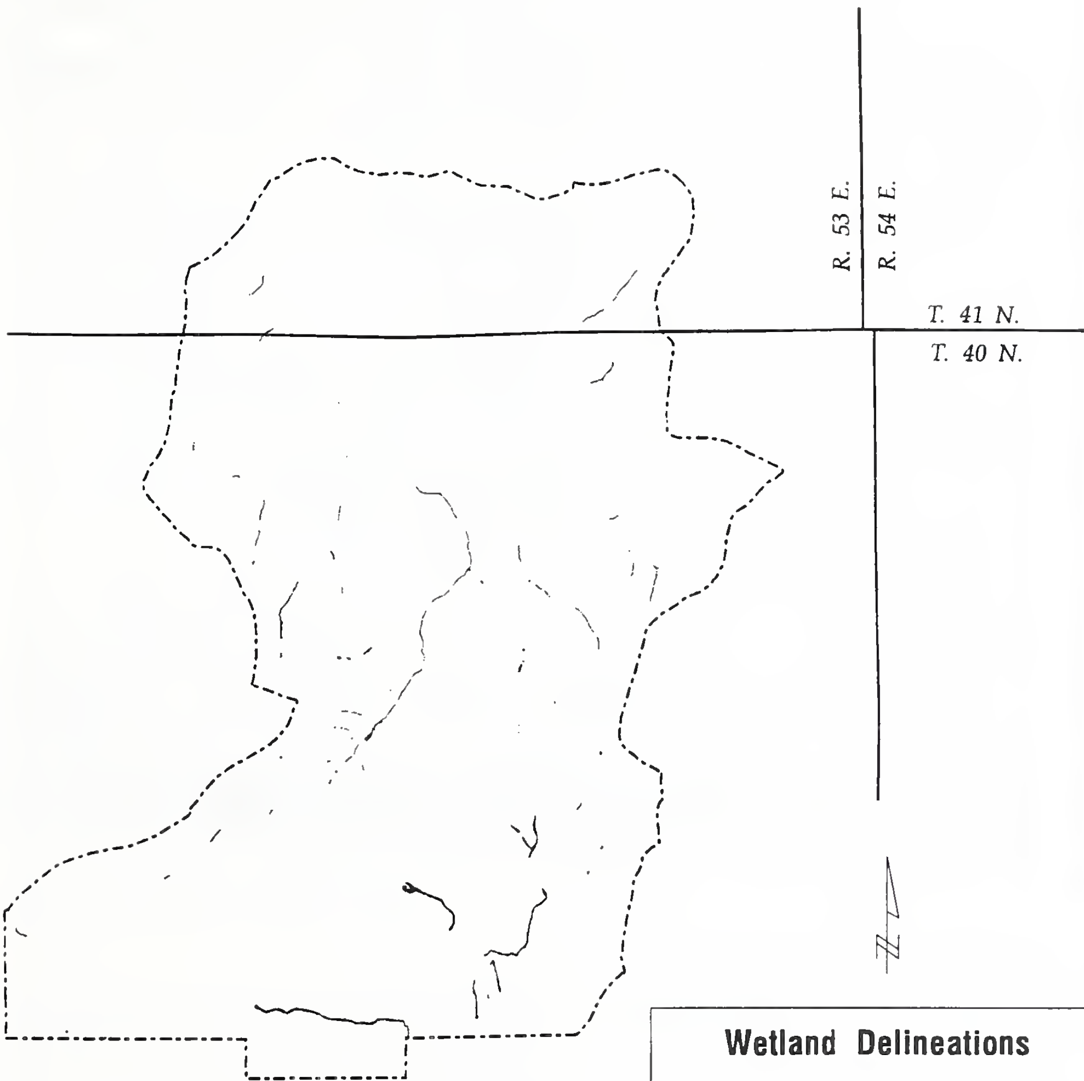
The extent of jurisdictional wetlands within and adjacent to the Project area is presented in Map 3.5. Detailed maps of wetlands within the Project area are included in Appendix C. Study results indicate that wetlands occur most commonly along drainage bottoms of canyons where there is an apparent discharge of groundwater. The three typical types of wetlands identified in the study area include: 1) riparian wetlands located adjacent to drainage bottoms; 2) springs and seeps adjacent to drainage bottoms; and, 3) isolated springs and seeps (IME 1992, IMC & IME 1993).

Riparian wetlands adjacent to drainage bottoms are found in canyons having incised channels. The riparian wetlands occur above the ordinary high water mark. Plant communities associated with the riparian wetlands appear to be sustained either by seasonal surface water flooding or from an elevated groundwater table present during the growing season. This wetland type is typically dominated by a variety of herbaceous perennial species. Annuals typically occur only on disturbed sites such as those resulting from downcutting or lateral movement of the stream channel. This wetland type often lacks a well-defined shrub or tree component due to the seasonal nature and apparent scouring action of high water flows.

Plant species and soils characteristics are essentially identical for springs and seeps adjacent to drainage bottoms and isolated springs and seeps. These areas are characterized by soils that are saturated at the surface either by an elevated groundwater table or from

Jurisdictional wetlands were delineated during the 1992 and 1993 field seasons. The United States Army Corps of Engineers has reviewed and approved the delineation for areas subject to disturbance by the various Alternatives.

The width of most features are exaggerated for display purposes.



Wetland Delineations

LEGEND

- Wetlands
- Project Area Boundary

Scale in Miles

0 1 2

Map 3.5

11/16/93

seasonal surface flooding. Saturation at or near the surface typically occurs on these sites for extended periods of time during the early part of the growing season. The plant communities consist of a mixture of perennial grass, sedge, rush, forb, and shrub species. Willows are the dominant woody plant species associated with these two wetland types. Total plant cover on these sites typically ranges from about 40 to 70 percent.

Data collected as part of the wetlands delineation was further evaluated to identify the specific plant community types in the wetlands. Eleven wetland plant community types were identified in or near the wetlands types and streams.

1. Spreading bentgrass (*Argrostis stolonifera*)
2. Tufted hairgrass (*Deschampsia cespitosa*)
3. Streamside bluebells (*Mertensia ciliata*)
4. Miscellaneous Unclassified Herbaceous
5. Kentucky bluegrass (*Poa pratensis*)
6. Quaking Aspen/Mesic Forbs (*Populus tremuloides*)
7. Sandbar willow (*Salix exigua*)
8. Geyer willow/Mesic Graminoids (*Salix geyerana*)
9. Yellow willow/Mesic Forbs (*Salix lutea*)
10. Yellow willow/Mesic Graminoids (*Salix lutea*)
11. False-Hellbore (*Veratrum californicum*)

Wetlands and waters of the U. S. have been affected by existing operations. Table 3.7 displays the existing and anticipated impacts as a result of currently approved operations. Mitigation for these impacts has been started and includes riparian and watershed enhancement, streambank stabilization, spawning habitat improvement, rest-rotation grazing, fencing to reduce grazing impacts, and wetland creation. Efforts are underway to provide additional mitigation for existing disturbance. These efforts are described in Chapter 4.

3.3 Biological Environment

Aquatic Resources and Fisheries

The issues associated with aquatic resources are primarily related to surface and ground water. Related issues include effects to any threatened, endangered, sensitive, or candidate fish species. The analysis area for aquatic resources is third order watersheds.

Physical Habitat Characteristics

The following information is based on a review of published literature, NDOW and USFS stream survey data, and surface water monitoring conducted by IMC. Available data pertinent to characteristics of stream channels within the Project area are from the habitat condition survey conducted jointly in 1978 by the USFS and NDOW, unless otherwise noted. Due to the dynamic nature of stream channels, existing conditions (average width, depth, velocity, etc.) may have changed since the 1978 survey.

Table 3.7
Summary of Existing Impacts to Waters of the United States Including Wetlands

Location	Wetlands Existing Impacts (Acres)	Waters (Stream Channel) Existing Impacts: Acres	Waters (Stream Channel) Existing Impacts: Linear Feet
Jerritt Canyon Mining Operation	0.934	0.510	6,901
Burns Basin Mining Operation	1.566	1.836	19,227
Winters Creek Mining Operation	1.048	0.047	685
California Mountain Mining Operation	0.025	0.131	2,075
TOTALS	**3.573**	**2.524**	**28,888**

Source: IMC, 1992b. Pre-Discharge Notification.

Note: Additional mitigation for existing impacts is being coordinated with the U.S. Army Corps of Engineers and is described in Chapter Four.

Jerritt Creek

In September 1978, Jerritt Creek averaged less than three feet in channel width and less than 0.1 foot deep. The average gradient is approximately six percent and the average stream discharge was less than 0.01 cfs in the fall of 1978. The natural stream sediment load was determined to be fairly high.

Bank stability was described in 1978 as poor for Jerritt Creek and its tributaries with a 33 percent of optimum bank stability rating. Because of poor bank stability and low to intermittent stream flows, Jerritt Creek was rated a non-fishable water (USDA,USFS & NDOW 1978).

Saval and Steer Canyons

These two stream drainages are small ephemeral tributaries to Jerritt Creek with no fisheries potential. The drainage has an average depth of one inch, average width of 2.3 feet, and an average gradient of 7.2 percent (USDA, USFS and NDOW 1978).

Burns Creek

Burns Creek is characterized by moderate undercutting and sloughing with some ungulate trampling to the edge of the channel, causing an increase in siltation during high run-off. Average landform gradient next to the stream is approximately 18 percent. The unstable streambed and banks limit value to fisheries. A portion of the stream channel in the upper reach is inundated by the Burns Basin waste rock dump and a sediment trap immediately downstream of the dump. Burns Creek averaged approximately 4 feet wide and 3 inches deep, with a volume of less than 1 cfs and an average stream gradient of 4.3 percent during September, 1978.

In 1978, bank stability was described as moderate for Burns Creek with a 68% of optimum bank stability rating. Because of moderate bank stability and perennial stream flows, Burns Creek was rated as a fishable water 0.9 miles above the Forest boundary from elevations of about 6,160 to 6,580 feet.

Biological Characteristics

Macroinvertebrates are good biological indicators of disturbances to water quality and changes in physical habitat. The benthic macroinvertebrate fauna of the streams within the Project area consists largely of stonefly, caddisfly, mayfly, and truefly insects. The species assemblages identified were largely indicative of well oxygenated clean water environments (USDA, 1980). Detailed aquatic macroinvertebrate sampling results are presented in the Jerritt Canyon FEIS aquatic biology technical report (ERT 1979f).

Drainages in the Project area that flow to the west include Burns Creek, Mill Creek, and Jerritt Creek and its tributaries, Saval and Steer Creeks. All of these except Burns Creek are ephemeral or intermittent and do not sustain reproducing fish populations within the Project area, though trout exist in the lower reaches of Jerritt Creek, outside of the Project area (USDA, USFS & NDOW 1978). The trout in Burns Creek are discussed under the section on wildlife.

Vegetation

The primary issues associated with the vegetation resources of the Project area include: 1) the potential for threatened, endangered, candidate, or sensitive plant species to be affected; 2) effects to vegetative diversity; and 3) aspen fragmentation.

The regional vegetation in the Independence Mountains consists of a combination of the Great Basin sagebrush type and the sagebrush steppe that occurs further north (Kuchler 1975). At the higher elevations there are areas of Great Basin pine forest and subalpine fir forest. The majority of the general study area and the Project area is composed of a mosaic of sagebrush grasslands, mountain brush, and aspen.

Vegetation in the Independence Mountains was mapped by the USFS in 1986 using ECODATA sampling methods described in the *Ecosystem Classification Handbook* (USDA, USFS 1987) and GIS. ECODATA mapping of the general study area and the Project area was field verified and refined by WESTEC botanists in the early fall of 1992 and summer of 1993. The ECODATA sampling method defines the dominant vegetation types that occur within an area based on the two or three dominant plant species present. For the

Independence Mountains, 74 vegetation dominance types were delineated and mapped. During the 1992 and 1993 field surveys, the dominance types and boundaries between types were verified and new data was collected on aspen and wet meadow sites. Existing impacts to vegetation resources were determined using the CEA, and include Forest Service roads and trails, mineral exploration roads, and mining disturbances.

Threatened, Endangered, Candidate, and Sensitive Plants

A literature search and partial field survey were conducted in 1992 by JBR Consultants Group (JBR) to determine if threatened, endangered, candidate, or sensitive plant species occur or potentially occur in and near the Project area. A list of threatened, endangered, candidate and sensitive plant species potentially occurring within the Project area and general study area was prepared by IMC and JBR in cooperation with the USFS, NDOW, BLM, and USFWS. This list would be verified in consultation with the USFWS between the Draft and Final EIS.

Habitat requirements for threatened, endangered, candidate and sensitive species in terms of soils, geologic setting, associations with other plants, and other aspects were used to identify areas of potential habitat within the Project area and general study area. This information was used during site specific field studies conducted in early summer of 1993. The 1993 survey was conducted at the phenologically appropriate time and concentrated on areas where potential habitat for the threatened, endangered, candidate and sensitive plant species occurred within the Project area. Field verification of the presence or absence of these plant species or their habitats was also conducted during refinement of the vegetation mapping in 1992 and 1993.

Threatened and Endangered Species

The literature reviews and field surveys did not identify any threatened or endangered plant species or their habitat that occur or may potentially occur in the Project area.

Candidate and Sensitive Species

The USFWS candidate species that are a concern for the Project are classified in Categories 2 or 3. Species in Category 2 may warrant listing as threatened or endangered in the future, but sufficient biological information to support listing is lacking. Category 3 species are those taxa that once were considered for listing as threatened and endangered but are no longer under such consideration. Category 3 is subdivided into several subcategories. Subcategory 3C species are those species that were found to be more abundant or widespread than previously believed and/or those that are not subject to any identifiable threat.

Sensitive species are a USFS classification that pertains to those plants for which population viability is a concern. This is evidenced by: 1) a significant current or predicted downward trend in population numbers or density, or 2) a significant current or predicted downward trend in habitat capability that would reduce the species' existing distribution. Plants listed as Category 2 or 3 in the Project area are also included on the USFS' list of sensitive species and are discussed below with candidate species.

The Northern Nevada Native Plant Society (NNNPS) maintains a list of species for which population viability is a concern. Two species are included on the threatened, endangered, candidate and sensitive species list for the Project area that also fall in two NNNPS categories: 1) watch species, potentially vulnerable taxa in need of monitoring or further data to determine status, and 2) species deleted from consideration by NNNPS because they are presently considered secure, taxonomically indistinct, or for other reasons. These species are also included in the USFWS and USFS classifications discussed above.

The following is a description of those Category 2 and 3 and sensitive species that have the potential to occur in or near the Project area.

Habitat for Lewis' buckwheat (*Eriogonum lewisii*), a USFWS Category 2, USFS sensitive species and NNNPS watch list species, occurs on exposed rocky ridges with low sagebrush (*Artemisia arbuscula*) at elevations above 7,800 feet in northern Elko County, Nevada. The nearest documented population of Lewis buckwheat occurs approximately 1,000 feet east of the Project area. Intensive field surveys within the Project area on sites with potential habitat for Lewis buckwheat in 1993 did not reveal additional populations beyond those mapped outside of the Project area in 1992.

Meadow pussytoes (*Antennaria arcuata*) is classified as a USFWS Category 2, USFS sensitive, and NNNPS watch list species. It is a composite and a member of the Sunflower or Asteraceae Family. Potential habitat includes small, bare or lichen-covered spots of soil in sedge-grass meadows and the edges of wild hay meadows that are not permanently wet. This species is found at elevations between 5,250 and 6,400 feet. The nearest documented population of meadow pussytoes is approximately nine miles southeast of the Project area in the vicinity of Gance Creek. Habitat for meadow pussytoes is unlikely to occur in the Project area because the elevations are typically higher than those at which this species occurs. This species was not found within the Project area or surrounding areas during the field surveys.

Howell dimersia (*Dimersia howellii*) is a USFWS Category 3C species and a USFS sensitive species. It has been deleted from consideration by the NNNPS because it is presently considered secure. This annual plant is a member of the Sunflower Family and is currently known to occur in parts of Elko, Humboldt, Lander, and Washoe counties, Nevada, as well as in parts of California, Idaho, and Oregon. Its known habitat is foothills and low mountains on dry gravelly soil, mostly volcanic in nature. The species occurs in association with sagebrush (*Artemisia spp.*) and has been reported in the southern Independence Mountains. The nearest documented occurrence of this species is approximately 5 miles from the Project area in the vicinity of Gance Creek. This plant species was not found within the Project area during the field surveys.

Broad fleabane (*Erigeron latus*) is a USFWS Category 2, USFS sensitive, and NNNPS watch list species. This perennial plant is a member of the Sunflower Family and is known to occur in Elko County, Nevada and Owyhee County, Idaho. It occupies thin or gravelly soil or rocky hillsides and outcrops of volcanic origin at elevations ranging from 5,200 to 6,700 feet. Associated species include *Artemisia*, *Haplopappus*, *Eriogonum* and *Phoenicaulis*. The nearest documented occurrence of broad fleabane is located approximately four miles southeast of the Project area. It is unlikely that potential suitable habitat for broad fleabane occurs in the general study or Project areas due to the lack of volcanic rocks in the area. Surveys for broad fleabane within the Project area during 1992 and 1993 did not reveal the presence of this species.

Grimes vetchling (*Lathyrus grimesii*) is a Category 2 species. It has been petitioned for listing as an endangered species. The closest known locality of this is approximately ten miles north of the Project area, in the Jacks Creek area. The grimes vetchling was not observed within the Project area during the 1992 and 1993 plant field surveys, nor in earlier USFS plant surveys (Lake, pers. comm., June 1993). Recent surveys for this plant in the Jacks Creek area by the USFS and IMC revealed that it is more widely distributed than originally thought.

Vegetative Diversity

Vegetative diversity in the Project area is in part a function of the distribution and species composition of plant communities in the analysis area, and is described here in terms of the community types defined for the area.

The 74 vegetation dominance types mapped in the Project area have been grouped into ten community types in this analysis. Community types are defined in the USFS ECODATA Handbook as areas in which the dominant and/or indicator plant species are similar. Community types have also been defined as an assemblage of populations of plants in a common spatial arrangement (USDA, USFS 1993c). The community types were defined in terms of their extent and distribution as well as average canopy cover heights. Canopy heights were calculated from the average of all stems, including saplings, in the understory and overstory. The ten community types, listed in order of abundance are: sagebrush/grasslands, aspen (mature aspen and snowbank aspen), north-facing mountain brush, sagebrush/snowberry, low sagebrush/grasslands, south-facing mountain brush, herbaceous meadows, riparian, snowbank forb, and subalpine fir/pine (See Map 3.6 and Table 3.8).

<u>Sagebrush/Grassland</u>

The sagebrush/grassland community type occurs primarily on terrace deposits, alluvial fans, volcanic uplands, and along stream bottoms. This community type is dominated by sagebrush species (*Artemisia sp.*). It intergrades extensively with the sagebrush/snowberry, north-facing mountain brush, and aspen community types on cooler, moister exposures, and with low sagebrush/grasslands and south-facing mountain brush

Table 3.8 Vegetation Types in the Project and General Study Area (Existing Conditions)				
Type	**Project Area**		**General Study Area**	
	Acres	**%**	**Acres**	**%**
Sagebrush/Grasslands	4,711	43.4	20,421	46.4
Aspen				
Mature Aspen	1,538	14.2	5,967	13.5
Snowbank Aspen	61	0.6	528	1.2
North-Facing Mountain Brush	1,331	12.3	2,913	[illegible].6
Sagebrush/Snowberry	546	[illegible].0	6,855	15.6
Low Sagebrush/Grasslands	375	3.5	3,253	7.4
South-Facing Mountain Brush	0	0.0	234	0.[illegible]
Herbaceous Meadow	34	0.3	40	0.1
Riparian	34	0.3	286	0.6
Snowbank Forb	10	0.[illegible]	44	0.1
Subalpine Fir/Pine	0	0.0	6	0.0
Rock/Talus	79	0.7	290	0.7
Disturbance[1]	2,131	19.7	3,137	7.1
Total[2]	**10,849**	**100.0**	**44,055**	**100.0**

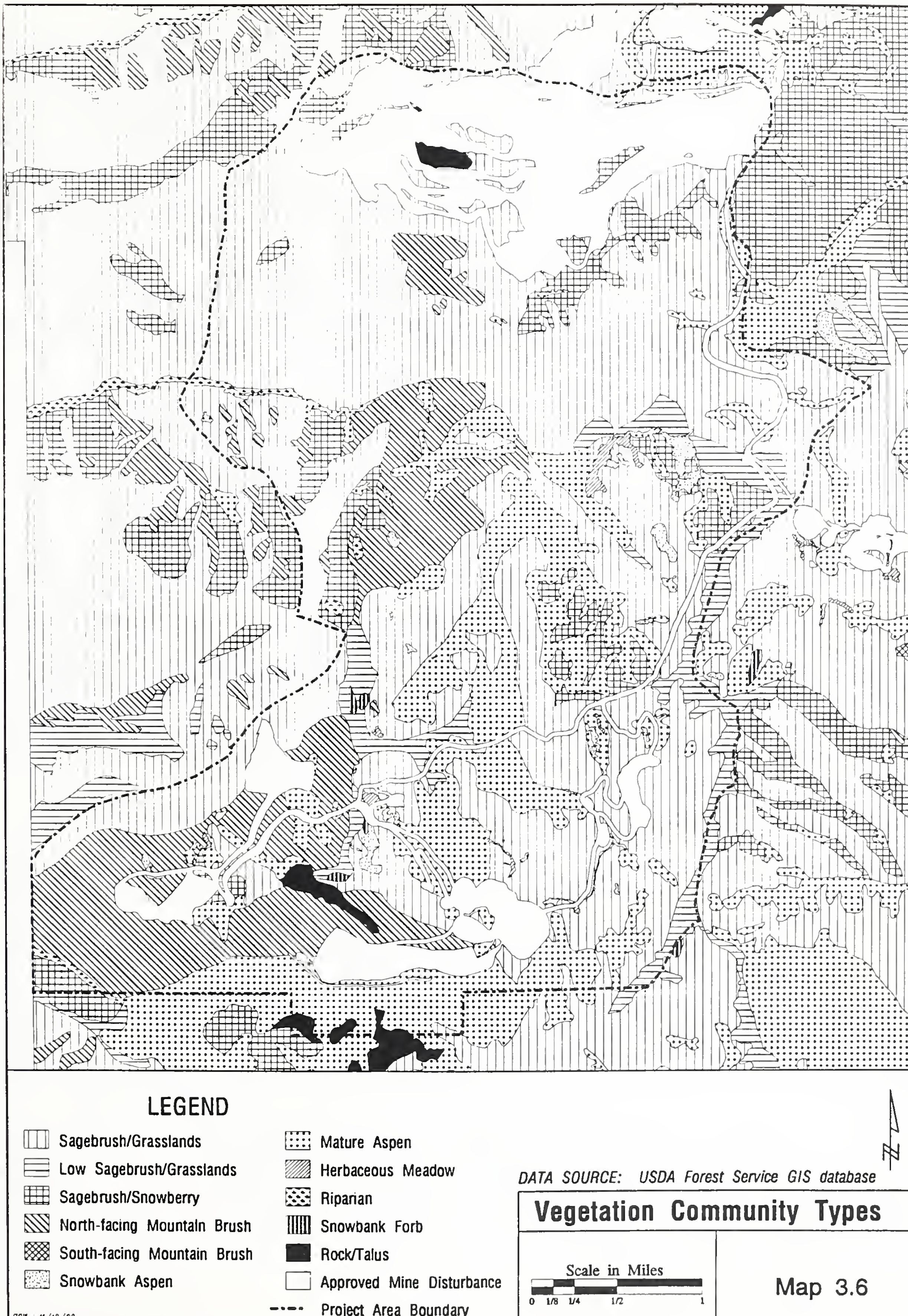
Source: USFS GIS Data - June 1993.

Note: [1] Disturbance includes existing/approved mining disturbance, exploration disturbance, USFS roads, etc.
[2] Total includes an 82 acre (0.2%) disjunct USFS parcel included in the General Study Area which was not surveyed for vegetation.

along ridgelines and on drier sites. The sagebrush/grassland community type occupies approximately 4,711 acres (43 percent) of the Project area and approximately 20,421 acres (46 percent) of the general study area. Previous disturbance of the sagebrush/grassland community type totals 1,239 acres within the Project area.

Aspen

The aspen community type occurs primarily on north-facing slopes above 6,000 feet and on sites with high soil moisture. Stands of aspen (*Populus tremuloides*) are located near



LEGEND
Sagebrush/Grasslands
Low Sagebrush/Grasslands
Sagebrush/Snowberry
North-facing Mountain Brush
South-facing Mountain Brush
Snowbank Aspen
Mature Aspen
Herbaceous Meadow
Riparian
Snowbank Forb
Rock/Talus
Approved Mine Disturbance
Project Area Boundary
DATA SOURCE: USDA Forest Service GIS database
Vegetation Community Types
Scale in Miles
0 1/8 1/4 1/2 1
Map 3.6
SCW 11/13/93

springs, along drainages, and in the canyon bottoms adjacent to the riparian zones. This community type is important to wildlife and livestock due to the multiple vegetative layers and the thermal and visual cover afforded by the structural nature of the vegetation.

ECODATA distinguishes two aspen dominance types, snowbank and mature. The snowbank dominance type is analyzed separately from other larger (mature) aspen dominance types because it is structurally very different in size of mature trees, density of trees, canopy cover, and wildlife/livestock use. The growth form of the snowbank aspen is brushy, dense, and low in stature. The snowbank aspen type was estimated to have 90 percent canopy cover with an average height of 6 feet and diameter-at-breast-height (dbh) of 2 inches. The snowbank aspen dominance type typically occurs on steep, windblown and snow-deposited slopes.

Mature aspen are divided into five dominance types, all with mature growth form and structural characteristics which distinguish them from the snowbank aspen type. The five mature aspen dominance types in the Project area were estimated to have 65 percent aspen canopy cover and 38 percent shrub canopy cover. The average height of the mature aspen was 15 feet, and the dbh was 5 inches.

Based on the USFS ECODATA classification and GIS mapping of the six aspen dominance types, there are approximately 61 acres (<1 percent) of the snowbank aspen dominance type and 1,538 acres (14 percent) of the mature aspen dominance types in the Project area. There are also approximately 528 acres (1.2 percent) snowbank aspen dominance type and 5,967 acres (14 percent) of the mature aspen dominance type in the general study area. Past disturbance of the snowbank aspen type is about 8.7 acres within the Project area. Approximately 326 acres of mature aspen have been previously disturbed inside the Project area.

North-facing Mountain Brush

The north-facing mountain brush community type is found in discontinuous patches on steep north-facing slopes at intermediate to high elevations, and less frequently on rocky slopes with various aspects. The north-facing mountain brush community type is found in proximity to several other community types including: aspen, sagebrush/snowberry, riparian, low sagebrush/grassland, sagebrush/grassland, and subalpine fir/pine. Boundaries between these community types are occasionally indistinct, giving rise to transitional areas. Snowberry (*Symphoricarpos spp.*), serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) were found to be the dominant shrub species in this community type during field verification of vegetation mapping.

The north-facing mountain brush community type occupies approximately 1,331 acres (12 percent) of the Project area and approximately 2,913 acres (6.6 percent) of the general study area. Approximately 211 acres of this community type have been disturbed within the Project area in the past.

Sagebrush/Snowberry

The sagebrush/snowberry community type is located on steep slopes with various aspects. It is underlain by deep, well-drained soils and exhibits substantial variation from the lower elevation drier sites to the higher elevation mesic sites. During field verification and vegetation mapping, mountain big sagebrush (*Artemisia tridentata)*, snowberry, and cheatgrass (*Bromus tectorum*) were found to be the dominant species in this community type.

The sagebrush/snowberry community type occupies approximately 546 acres (5 percent) of the Project area and about 6,855 acres (16 percent) of the general study area. Past disturbance of this community type totals about 296 acres (2.7 percent) within the Project area.

Low Sagebrush/Grassland

The low sagebrush/grassland community type is primarily located in discontinuous patches on the uppermost windswept peaks and ridges and on slopes with shallow soils. The dominant shrub species of this type is low sagebrush (*Artemisia arbuscula*). It is found in proximity to a few community types including aspen, sagebrush/snowberry, and subalpine fir/pine. Boundaries are occasionally indistinct and give rise to transitional areas with other community types.

Within the general study area, the average shrub canopy cover of the low sagebrush/grassland community type sampled was estimated to be 40 percent. Ground cover in this community type typically exhibits good diversity of vegetation, but the continuity of plant species distribution is poor.

The low sagebrush/grassland community type occupies approximately 375 acres (3.5 percent) of the Project area and about 3,253 acres (7.4 percent) of the general study area. Previous disturbance of this community type within the Project area is about 34 acres (0.3 percent).

South-facing Mountain Brush

The south-facing mountain brush community type is located on steep southerly facing slopes and is underlain by shallow well drained soils. This community type is found in proximity to sagebrush/grassland and riparian community types along the lower slopes of canyon bottoms. This type differs significantly in dominant plant species composition and other ecosystem characteristics from the north-facing mountain brush community type.

Dominant shrub species in this community type include antelope bitterbrush (*Purshia tridentata*), mountain big sagebrush (*Artemisia tridentata vaseyana*), and rabbitbrush (*Chrysothamnus nauseosus*). Field verification and mapping determined that plant species composition was dominated by antelope bitterbrush and rabbitbrush within the general study area.

The south-facing mountain brush community type occurs on less than one acre in the Project area and occupies approximately 234 acres (0.5 percent) of the general study area. No previous disturbance of this community type has occurred in the Project area.

Herbaceous Meadow

This community type occurs primarily along drainage bottoms and around hillside springs. Plant species composition is dominated primarily by grasses, sedges and rushes.

The herbaceous meadow community type occupies approximately 34 acres (0.3 percent) of the Project area and accounts for approximately 40 acres (0.1 percent) of the general study area. Approximately 2.7 acres (0.02 percent) of this community type has been disturbed within the Project area in the past.

Riparian

This community type occurs along drainages of perennial and intermittent streams, and around springs. It is defined by the presence of taller phreatophytic (water loving) shrub and tree species, typically willow (*Salix spp.*). The riparian community type is found in close proximity to several community types including aspen, wet meadow, north-facing mountain brush, south-facing mountain brush, and sagebrush/snowberry.

The average shrub canopy cover of the riparian communities sampled in the general study area was estimated to be 51 percent. Willow and chokecherry contributed the most extensive cover. Shrub heights were relatively tall, averaging from 6 to 8 feet, and average dbh was 5 inches. Because of the availability of water, forage, and shade typically associated with the riparian communities, this is one of the most important community types in the Project area for indigenous wildlife and livestock.

The riparian community type occupies approximately 31 acres (0.3 percent) of the Project area and accounts for approximately 286 acres (0.6 percent) of the general study area. Approximately 1.6 acres (0.01 percent) of this community type have been disturbed within the Project area in the past.

Snowbank Forb

The snowbank forb community type is a stunted form of forb-dominated vegetation found in small pockets where snowmelt occurs later than the surrounding areas. These isolated pockets have shallow, well-drained soils and lack shrub and sagebrush vegetation due to the presence of saturated soils for long periods of time. The dominant species that are found in this community type include needlegrass (*Stipa spp.*) and silvery lupine (*Lupinus argenteus*). This community type occupies approximately 10 acres (0.1 percent) of the Project area and 44 acres (0.1 percent) of the general study area. Past disturbance of this community type totals about 1.4 acres (0.01 percent) within the Project area.

Subalpine Fir/Pine

The subalpine fir/pine community is located on steep slopes at higher elevations. Subalpine fir (*Abies lasiocarpa*) is found entirely on the steep north-facing slopes of the highest peaks of the Independence Mountain Range. Pines found within this community type are whitebark pine (*Pinus albicaulis*), found at elevations as low as 7,750 feet, and a few scattered limber pine (*Pinus flexilis*) in the Jacks Peak area north of the general study area (Loope, 1969). They are found on various aspects in the same vicinity as the fir, and often growing with the fir. This community type commonly occurs in areas of moderately deep, well-drained soils. It is found in proximity to aspen, sagebrush/snowberry, low sagebrush/grassland, and north-facing mountain brush community types.

The subalpine fir/pine community type occupies less than one acre (<0.1 percent) of the Project area and approximately 6 acres (<0.1 percent) of the general study area. The subalpine fir/pine community type has not been previously disturbed within the Project area.

Aspen Habitat Fragmentation

Aspen habitat fragmentation was identified as an issue during interagency scoping for the proposed Project. Aspen was identified as a key community type in the Independence Mountains during development of the CEA analysis for several reasons: 1) aspen provide unique habitat characteristics for wildlife species; 2) aspen communities and flora and fauna that utilize them are in greater need for management emphasis because there is no "pool" of plants and wildlife species in the area for colonization; and 3) aspen play key roles in the migration of most wildlife species from area to area in the Independence Mountains (USDA, USFS 1992a). Aspen habitat is relatively rare throughout Nevada. Aspen vegetation is estimated to cover approximately 330,139 acres in Nevada, or less than 0.5 percent of the total area of the state (Born et al, 1992).

Aspen habitat fragmentation is a function of the distribution and distance between the stands. The relationship between the larger stands and smaller "steppingstone" stands which allow for the movement of plants and animals is also an important consideration.

Aspen habitat in the Project area generally occurs in a naturally fragmented state, as shown on Map 3.6. Small aspen stands occur widely scattered throughout the northern portion of the Project area and occur in the vicinity of springs and along drainages. In the Saval and Steer and Burns Basin mine areas, several large interconnected aspen stands occur on north-facing slopes and along canyon bottoms. These stands typically contain openings with other community types. They have been locally fragmented into smaller stands by existing disturbance.

Attempts were made to analyze effects to aspen habitat fragmentation in terms of the distance between aspen stands and stand size. However, the GIS technology available was not adequate to perform the detailed spatial analysis required (Anderson, pers. comm., 1993). Effects to aspen fragmentation are therefore analyzed in terms of the acreage of direct removal. The province for analysis of effects to aspen habitat is third order watersheds in the Project area. Within the Jerritt Canyon watershed, approximately 132 acres (14 percent) of the 921 acres of aspen in the watershed have been previously disturbed. In the Burns Creek watershed, approximately 194 acres (14 percent) of the 1,359 acres of aspen in the watershed have been previously affected.

Approximately 335 acres (17 percent) of the 1,934 acres of aspen present in the Project area prior to mining have been previously disturbed. The existing area of 1,599 acres of aspen in the Project area is displayed in Table 3.8. Approximately 583 acres (8 percent) of the 7,078 acres of aspen present in the general study area prior to mining have been previously disturbed. The existing area of 6,495 acres of aspen in the general study area is displayed in Table 3.8.

Other Issues Related to Vegetation

Wetlands

Wetlands and other jurisdictional waters of the U.S. were delineated during field surveys conducted in 1992 throughout the Jerritt Canyon mine area (discussed under wetlands and waters of the United States). The wetlands were delineated using diagnostic vegetation, soils, and hydrology characteristics specified in the 1987 Corps of Engineers Delineation manual. During the field investigations it was determined that the boundary of wetland areas corresponds closely with the boundary of hydrophytic vegetation. Wetland areas in the Project area were therefore delineated on the basis of several plant community types defined using the USFS Riparian Type Classification System (IMC and IME 1993). These plant community types correspond in part to the herbaceous meadow and riparian community types defined using the ECODATA system.

Reclamation Potential

Interim, concurrent and final reclamation has been ongoing in areas disturbed by existing mining operations. Interim reclamation efforts have established vegetative cover in areas that would be disturbed again, such as haul road cut slopes, growth medium stockpiles, oand other areas. final and concurrent reclamation of mine waste dumps and portions of mined-out pits, including revegetation of partial pit backfill areas, is underway and additional final reclamation would be performed as mining progresses. Approximately 194 acres of disturbance designated for final reclamation have been reseeded. Most disturbed areas are currently being mined or have been mined recently and limited amounts of final reclamation have been possible.

Wildlife

The primary issues associated with wildlife include potential effects to the following: 1) endangered, threatened, candidate, or sensitive species, 2) goshawk *(Accipiter gentilis)* habitat, 3) mule deer *(Odocoileus hemionus)* habitat, 4) sage grouse *(Centrocereus urophasianus)* brooding habitat, 5) golden eagles (*Aguila Chrysaetos*), and 6) upland game birds, furbearers, and trout. Related issues include effects to other wildlife species and aspen habitat fragmentation.

The description of the existing environment for wildlife in the Project area is based on a combination of field surveys and literature reviews, plus assumptions derived from the vegetative communities described under vegetative diversity. When wildlife habitat is based on plant communities instead of actual observations, it is referenced throughout this document as potential habitat.

Many of the wildlife resources within the Project area were evaluated using a system of resource value ratings (RVR's). The RVR's were established during development of the CEA and are based upon literature reviews and local knowledge of specific wildlife habitat characteristics. Specifically, RVR's have been established for northern goshawks, mule deer habitat, sage grouse brooding habitat, blue grouse (*Dendragapus obscurus*) habitat, beaver (*Castor canadensis*) habitat, and cavity nester habitat. Habitat attributes are used to determine value to wildlife species rather than relying on wildlife sightings. Existing impacts to wildlife habitat are determined using the CEA include Forest Service roads and jeep trails, exploration roads, and mining disturbances.

Endangered, Threatened, Candidate, and Sensitive Species

A literature search was conducted in 1992 by JBR Consultants Group (JBR) to define the habitat requirements and determine if endangered, threatened, candidate (Category 2 or C2), or sensitive animal species occur or potentially occur in the Project area. A list of those animal species which may occur within the general study and Project areas was prepared by IMC and JBR in cooperation with the USFS, NDOW, BLM, and USFWS. The list of threatened, endangered, candidate and sensitive species potentially occurring within the Project area is provided in Table 3.9. This list would be verified in consultation with the USFWS between the DEIS and FEIS.

Field surveys designed to determine whether these species or their habitats potentially occur within the Project area were conducted in 1992 and 1993. The information obtained from the literature review and field surveys is summarized in the following sections.

<u>Endangered Species</u>

The USFWS endangered species classification pertains to any species which is in danger of extinction throughout all or a significant part of its range. Bald eagles (*Haliaeetus leucocephalus*) and peregrine falcons (*Falco peregrinus anatum*), are the only species listed as endangered that have the potential to occur within the Project area. The bald eagles are annual winter migrants in Nevada. Peregrine falcons are residents in Nevada. A few bald eagles may pass through the Project area in the winter, but do not nest in the Project area. Peregrine falcons have not been seen in or near the Project area, but may pass through the area on their way to other locations.

Table 3.9
Threatened, Endangered, Candidate, Sensitive and Management Indicator Species Occurring or Potentially Occurring Within the Project Area

	Category	
Species	**USFWS[1]**	**USFS[2]**
Mammals		
Western Big-Eared Bat	2	S
Spotted Bat	2	-
Preble's Shrew	2	-
Sierra Nevada Red Fox	-	-
Lynx	2	S
Pygmy Rabbit	2	-
Mule Deer	-	MIS
Birds		
Bald Eagles	E	-
American Peregrine Falcon	E	-
Northern Goshawk	2	S/MIS
Flammulated Owl	-	-
Loggerhead Shrike	-	-
White-Faced Ibis	-	-
Sage Grouse	-	MIS
Fish		
Redband Trout	2	-
Trout Species	-	MIS
Amphibians		
Spotted Frog	2	S
Invertebrates		
Mattoni's Blue Butterfly	2	-

Source: JBR Consultants Group, 1993b.

Note: [1] USFWS (U. S. Fish & Wildlife Service) Categories:

E = Endangered Species - any species which is in danger of extinction throughout all or a significant portion of its range.

T = Threatened Species - any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

2 = Candidate, Category 2 Species - taxa which may warrant listing as threatened or endangered, but for which sufficient biological information to support a rule to list is lacking.

[2] USFS (U. S. Forest Service) Categories:

S = Sensitive Species - species identified by the Regional Forester for which population viability is a concern, as evidenced by: (1) significant current or predicted downward trend in population numbers or density, or (2) a significantly current or predicted downward trend in habitat capability that would reduce the species' existing distribution.

MIS = Management Indicator Species - Species selected by the USFS for one or more of the following reasons: (1) they are economically and socially important, (2) they are readily monitored and have high visibility and adequate numbers, (3) they are found in all areas of the Forest, (4) they are somewhat representative of all wildlife species which use a particular vegetative type, (5) they are sensitive to changes in habitat and act as a barometer of the condition and trend of vegetative types, and (6) specific vegetative types provide key habitat for the species during its life cycle.

Threatened Species

The USFWS threatened species classification pertains to any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) is the only species listed as threatened that has the potential to occur in the vicinity of the Project area. This species occurs outside of the Project area on the east side of the Independence Mountain Range, in the area of a haul road used to bring ore off the Jerritt Canyon Project mine to the existing mill site. This habitat has been analyzed in previous documents. Modifications to the approved POO for the Jerritt Canyon Project addressing drainage and sediment control along the mine to mill haul road are being evaluated to protect surface resources, including Lahontan cutthroat trout habitat. Agreement between the USFS and IMC on the modifications is expected in the fall of 1993. Consultation with the USFWS regarding these modifications would occur before approval.

Candidate (Category 2) Species

During the NEPA process, the USFWS provides a list of candidate species that may be present in the area. The candidate species are currently being reviewed by the USFWS and are under consideration for possible listing as endangered or threatened. Candidate species are included here for consideration as it is possible that one or more could be proposed and listed before the project is completed. USFWS Category 2 species that are also listed as sensitive by the USFS are also discussed in this section. The following is a description of those Category 2 species that occur or have the potential to occur in or near the Project area.

Preble's shrew (*Sorex preblei*) is a Category 2 species that occurs in marshy areas such as creeks and bogs bordered by willows and other woody plants, in moist or dry woodlands, and occasionally in wetter areas of open conifer tree stands and montane sagebrush communities. The nearest known sighting of this species occurred at approximately 6,500 feet in elevation about four miles east of the Project area in 1984 (JBR, 1993a). Potential habitat for Preble's shrew may be present along drainages at the lower elevations within the Project area.

Pygmy rabbit (*Brachylagus idahoensis*) is a Category 2 species that occurs in relatively dense and tall sagebrush, greasewood communities, dense stands of rabbitbrush, and on floodplains dominated by rabbitbrush. The nearest known documented sighting of pygmy rabbits occurred about four miles east of the Project area at lower elevations. This species was not observed during the 1992 and 1993 field surveys within the Project area, but potential habitat may exist at the lower elevations.

Sierra Nevada red fox (*Vulpes vulpes necator*) is a Category 2 species that dens in natural rock cavities and holes in the ground. This species hunts rodents and insects in openings and meadows within coniferous forests (JBR 1993b). No Sierra Nevada red fox were observed during the field surveys of the Project area and it is unlikely that this species occurs in the Independence Mountains (JBR 1993a).

Lynx (*Felis lynx canadensis*) is a Category 2 and USFS sensitive species that generally occurs in boreal forests, clearings, bogs, thickets, and rocky outcrops (JBR, 1993b). Denning occurs in mature forest stands. The most recent records for lynx in Nevada date to the 1890s, when lynx were reported to be present in the Jarbidge and Owyhee areas (JBR 1993b). It is therefore unlikely that lynx inhabit the Independence Mountains and none was observed during the field surveys of the Project area.

Western big-eared bat (*Plecotus townsendii*) is a Category 2 and USFS sensitive species that roosts in caves, inactive mine shafts, rock outcrops, and old buildings. This bat species occurs in juniper-pine forests, shrub-steppe grasslands, deciduous forests, and mixed coniferous forests from sea level to 10,000 feet in elevation (JBR 1993b). Mist net surveys conducted during 1980, 1991, and 1992 within the Independence Mountains did not reveal the presence of western big-eared bats (McAdoo, 1981; USFS files; JBR 1993a).

Spotted bat (*Euderma maculatum*) is a Category 2 and USFS sensitive species that occurs in a variety of habitats including open ponderosa pine, desert scrub, pinyon-juniper, and open pasture and hay fields (JBR 1993b). This bat species roosts in rock crevices high up on steep cliff faces. No occurrences of spotted bats have been reported from northeastern Nevada (JBR 1993a).

Because both bat species rely heavily on water sources for both watering and food, isolated ponds within the Project area are potential habitat.

Loggerhead shrike (*Lanius ludovicianus*) is a Category 2 bird species that is typically associated with greasewood and sagebrush communities (JBR 1993b). This species also occurs in valleys and foothills, juniper or pinyon-juniper woodlands, mahogany stands, and the edges of ranches and towns. The population status of the loggerhead shrike is of greatest concern in the eastern United States. The nearest known sighting of loggerhead shrikes occurred at lower elevations on the east side of the Independence Mountains (JBR 1993a). This species was not observed during the 1992 and 1993 field surveys, but suitable habitat exists within the Project area.

White-faced ibis (*Plegadis chihi*) is a Category 2 species that nests in emergent marshes in colonies with herons and egrets. The nearest potential habitat for this species occurs in the Independence Valley and along the North Fork of the Humboldt River (JBR 1993b). No white-faced ibis were observed within the Project area during the field surveys for the mine expansion.

Redband trout *(Oncorhynchus mykiss gibbsi)* is a Category 2 species that occurs in the Owyhee River drainage system on the west side of the Independence Mountains. The nearest documented redband trout population is in Schmitt Creek, which is located about one-half mile south of the Project area (NDOW 1993). Burns Creek has been identified by NDOW as potential habitat for redband trout. At this time it is not known whether these trout are present in Burns Creek or if the closely related rainbow trout (*Oncorhynchus mykiss*) is the species that occupies this drainage. Burns Creek is ephemeral in its upper reaches and perennial at lower elevations. A fishery extends approximately one mile upstream from the Forest boundary. Total fishable length is 0.9 miles, from the elevation of 6,160 feet to 6,480 feet above mean sea level (AMSL). Trout numbers in Burns Creek were low (approximately 123 fish per mile) in 1978 (USDA, USFS and NDFG 1978).

The spotted frog (*Rana pretiosa*) is a USFWS Category 2 species, also classified as sensitive by the USFS, that is commonly found near permanent water. However, this species may move a considerable distance from water after breeding, often frequenting mixed conifer and subalpine forests, grasslands, and brushlands of sagebrush and rabbitbrush (JBR 1993a). The nearest documented sighting of this species occurred approximately three and one-half miles east of the Project area (JBR 1993a). No evidence of this amphibian was observed during the 1992 and 1993 field surveys of the Project area, although potential habitat for this species exists in the Project area.

Potential habitat for Mattoni's blue butterfly (*Euphilotes rita mattonii*), a USFWS Category 2 species, occurs on ridgetops in the Saval/Steer/Jerritt Canyon area where populations of slenderbrush buckwheat (*Eriogonum microthecum* Nutt. var. *laxiflorum*), the host plant for the larval stage of Mattoni's butterfly, have been documented. No Mattoni's butterflies were observed during the 1992 and 1993 field surveys. Since the Mattoni's butterfly typically occurs in the upper and lower Sonoran zones and pinyon-juniper woodlands, its presence in the Project area is unlikely.

Sensitive Species

Sensitive species are a USFS classification that pertains to those animals for which population viability is a concern. This is evidenced by: 1) a significant current or predicted downward trend in population numbers or density, or 2) a significant current or predicted downward trend in habitat capability that would reduce the species' existing distribution. The following describes the USFS sensitive species that occur or have the potential to occur within the Project area and that have not been previously discussed under the Candidate species section.

The flammulated owl *(Otus flammeolus)* inhabits forests in northeastern Nevada, possibly including the Independence Mountains (Anderson, pers. comm., 1993). Flammulated owls occur in aspen forests in eastern Nevada, but are more commonly found in ponderosa pine forests in other areas. These owls usually nest in abandoned flicker or other woodpecker nest cavities, from seven to twenty-five feet above the ground. Though no nest sites have been documented, habitat for flammulated owls is likely present within the Project or general study area.

The northern goshawk is a Category 2, USFS sensitive, and USFS management indicator species. Since the MIS status of species is most relevant to this analysis, goshawks are discussed in the next section.

Management Indicator Species

The Humboldt National Forest LRMP and FEIS completed in 1986 identified the northern goshawk, mule deer, sage grouse and trout as management indicator species (MIS). These four species were selected as MIS by the USFS for one or more of the following reasons: 1) they are economically and socially important, 2) they are readily monitored and have high visibility and adequate numbers, 3) they are found in all areas of the Forest, 4) they are somewhat representative of all wildlife species which use a particular vegetative type, 5) they are sensitive to changes in habitat and act as a barometer of the condition and trend of vegetative types, and 6) specific vegetative types provide key habitat for the species during its life cycle (USDA, USFS 1986a-b).

Northern Goshawk

The northern goshawk is listed by the USFWS as a Category 2 species and by the USFS as sensitive, in addition to being an MIS. This species is present within the general study and Project areas. As an MIS, the goshawk is considered a barometer to the condition and trend of old growth cottonwood-aspen and fir stands found in riparian areas on the Forest. If the habitat requirements for the goshawk are met, habitat diversity will be provided for such species as woodpeckers, some other cavity nesting species, and other hawks and owls (USDA, USFS 1986a). Where goshawks occur in Nevada they are typically found in intermediate woodlands, such as aspen stands, interspersed with sagebrush or meadows. They require large trees, generally hardwoods for nesting that are 30 to 40 feet above the ground. Goshawks eat a variety of prey, particularly small mammals and birds. The CEA province for goshawk is defined as the home range, which is an area within a 1.75 mile radius (6158 acres) of each nest. Several goshawk nests are within the Project area and some goshawk home ranges extend into the Project area.

An intensive study of goshawks is being undertaken at the present time by a graduate student from Boise State University to determine the status and trend of the Independence Mountains' goshawk population. Recent information from that study indicates that historic goshawk nests identified in previous surveys as nests 074, 127, and 128 have not been recently occupied by goshawks (Younk 1993). Nest 074 is considered to be a red-tailed hawk nest, based on nest location and construction. Nests 127 and 128 are not characteristic of goshawks and are most likely nests of Cooper's hawk or other bird species. These three nests are still listed as goshawk nests by NDOW and have been evaluated as such for the purposes of this analysis. Seven confirmed goshawk nests (nests 026, 027, 037, 039, 134, 136 and 143) occur within the Project area or have home ranges that extend into the Project area. Goshawks are known to use alternate nests from one year to the next. The seven confirmed goshawk nests are considered to represent four nesting territories.

The three historic goshawk nests (074, 127, and 128) are located within one nesting territory that is inside the Project area. Portions of the home ranges for these nests have been previously disturbed. Approximately 763 acres (12 percent) have been previously disturbed within the home range of nest 074. Nests 127 and 128 are about 1,100 feet apart and existing disturbances have affected about 804 acres (13 percent) and 988 acres (16 percent) of their home ranges, respectively.

Goshawk nests 026 and 027 are located outside of the Project area, but in the same nesting territory. These two nests are about 4,375 feet apart and their home ranges extend over the Jim Creek/Burns Creek watershed divide into the southeastern portion of the Project area. Nest 027 was utilized by goshawks in 1991 and 1992. This nest is closer to the existing mining operations than nest 026. Past home range disturbance for nest 026 is 160 acres (3 percent) and 427 acres (7 percent) for nest 027.

The nests identified as 037, 039, and 143 are located outside of the Project area in separate nesting territories. Nests 037 and 039 have home ranges that extend into the northeastern portion of the Project area. The home range for nest 143 extends into the southwestern portion of the Project area. All three of these nests were used by goshawks in 1991 and 1992. Approximately 390 acres (6 percent) have been previously disturbed in the home range of nest 037. Past home range disturbance for nest 039 totals about 310 acres (5 percent). Home range disturbance is currently about 126 acres (2 percent) for nest 143.

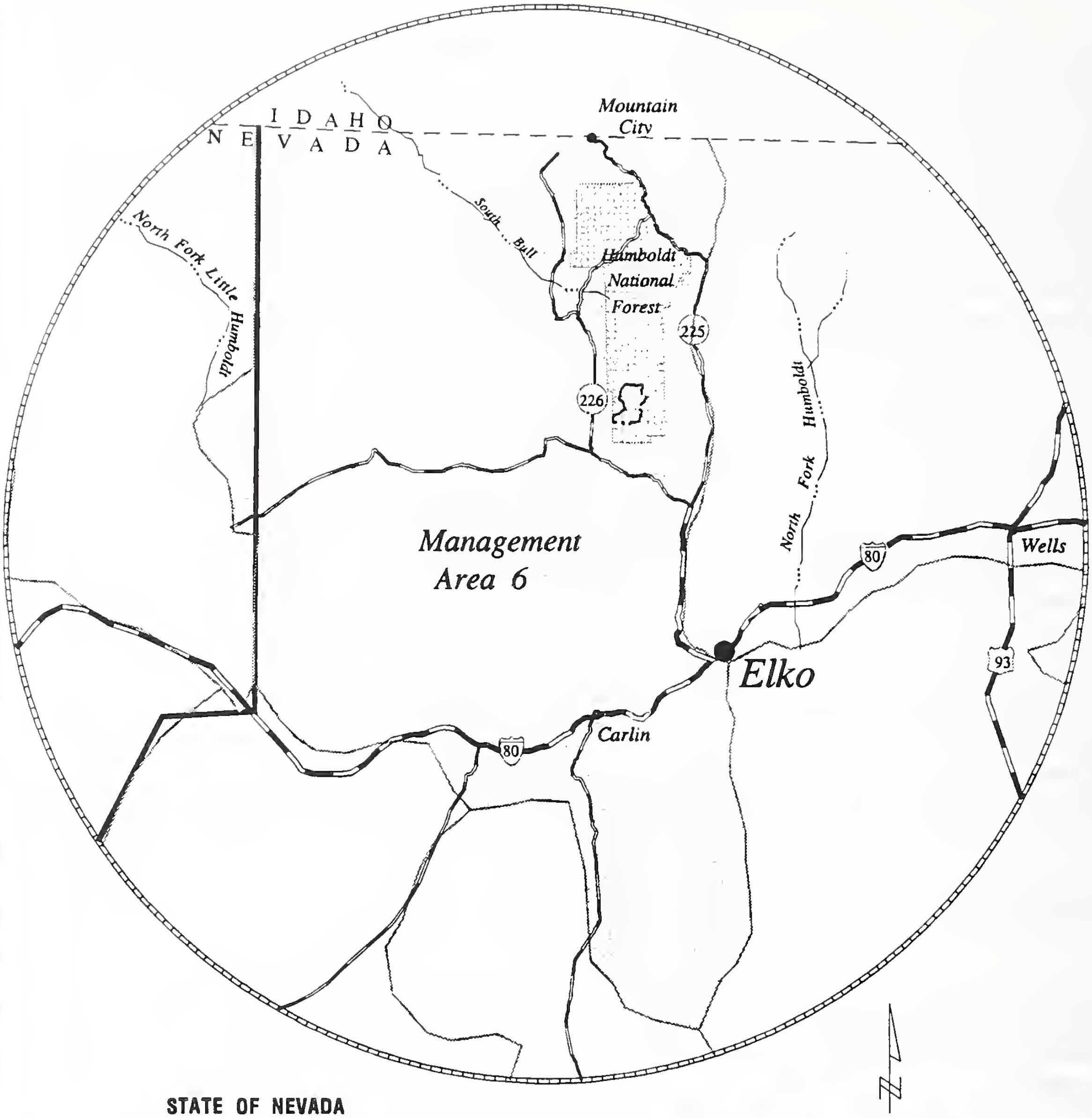
Goshawk nests 134 and 136 are located inside the Project area in the same nesting territory. These two nests are about 1,875 feet apart and are in close proximity to the active mining operations. Nest 134 was occupied in 1991 and nest 136 was used by goshawks in 1992. Previous home range disturbance for these two nests is very similar, at about 670 and 673 acres, respectively.

<u>Mule Deer</u>

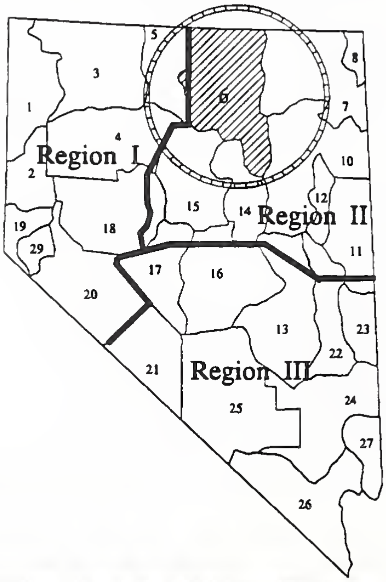
Mule deer are present within the general study and Project areas. If the habitat requirements for mule deer are met, habitat diversity will be provided for many other wildlife species. In addition, mule deer are considered to be a barometer for the condition and trend of many of the Forest's non-timbered areas (USDA, USFS 1986a).

The Independence Mountains mule deer herd is in NDOW Area 6, which includes most of the Independence, Bull Run, and the Tuscarora mountain ranges. (See Map 3.7) The Project area encompasses summer and winter range, as well as fawning habitat. Mule deer transitional range, where deer move between their winter and summer ranges, also exists in the Project area. Transitional range has not been mapped or quantified by the agencies.

Surveys by NDOW indicate that the Area 6 deer population increased during the period from 1990 to 1992 due to above-average recruitment. The November 1992 buck/doe ratio was 23:100, a slight decrease from the 1991 ratio of 25:100 (Hess 1993). The spring 1993 fawn/adult ratio was 16:100, which is the lowest ever recorded (Hess 1993). The fawn loss of 71 percent was the highest ever recorded (Hess 1993). The Area 6 herd experienced a record die-off during the 1992-1993 winter season due to abnormally heavy snowfall (Lamp, pers. comm.). More than 230 deer were found dead in Jerritt Canyon in the spring



STATE OF NEVADA
BIG GAME MANAGEMENT AREAS
WITH NDOW REGIONS



Nevada Department of Wildlife
Big Game Management Area 6

Boundaries for the big game management areas were digitized from the 1993 Big Game Hunting Map prepared by the Nevada Department of Transportation.

Boundaries for the three Nevada Department of Wildlife regions were obtained from the 1992 Fishing Seasons and Regulation Handbook, Nevada Department of Wildlife.

County boundaries and road features were obtained from digital TIGER/Line files, produced by the United States Bureau of Census.

Scale in Miles
) 23.5 47

Map 3.7

11/16/93

of 1993 as a result of the heavy snowpack (Gray, pers. comm.). The long-term trend is down over the last 20 years. The buck harvest from 1973-91 was less than half of what it was during the period of 1956-72. This decline can be attributed to deteriorated habitat conditions on many of the Area 6 winter and transitional ranges (Hess 1993).

Natural and man-induced activities have affected mule deer habitat throughout the NDOW Management Area 6. Range wildfires have destroyed large tracts of deer habitat. More than 65 percent of the deer winter ranges in the southern portion of Management Area 6 have burned over the last few years (Hess 1993). Once these areas were burned, cheatgrass and other undesirable plants became established and combined with the persistent drought, inhibited sagebrush and other critical deer forage and cover from reestablishing. Fires in summer and transitional range have also impacted deer habitat. In 1990-91, 35,000 acres of summer and transitional range were burned (Hess 1992). In 1992 range fires burned 2,300 acres of winter range and 3,000 acres of transitional range (Hess 1993).

Existing disturbances of mule deer winter and summer ranges and fawning habitat were analyzed with the CEA using RVR's.

Winter Range

The province for mule deer winter range was identified using the Winter Range Boundary map, developed by NDOW from data gathered during deer herd counts and from available literature. In the wildlife technical report for the 1980 Jerritt Canyon FEIS (ERT 1979i), transect data in central Jerritt Canyon showed relatively strong browsing pressure of preferred browse species (i.e., serviceberry and bitterbrush). This fact, in conjunction with previous knowledge and pellet group information, suggested that Jerritt Canyon is an important winter area for mule deer. The Jerritt Canyon area historically contains the highest density of deer found anywhere in Management Area 6 as indicated by NDOW's fall deer count (Lamp, pers. comm., August 1993). There are approximately 16,204 acres of high to moderate mule deer winter range in the Independence Mountains (all on the west slope of the range) within the Humboldt National Forest. Additional key winter ranges in Management Area 6 include the Owyhee Desert, Izzenhood Range, and the Sheep Creek Range.

Wintering mule deer are usually found on the south facing exposures and windswept slopes in the sagebrush/grassland and south facing mountain brush community types located along the lower drainages. Of the 16,204 acres of high and moderate mule deer winter range identified by the CEA model in the Independence Mountains, 1,833 acres (11 percent) of high and moderate value winter range have been or will be affected by the approved mining operations.

Summer Range

Potential mule deer summer range was identified and mapped for the Independence Mountains CEA model utilizing vegetation community type data. Watershed boundaries define the geographic province for potential summer range. Of the 8,106 acres in the Jerritt Canyon watershed, approximately 591 acres (7 percent) are considered to be high to moderate RVR mule deer summer range. In the 4,038 acre Burns Creek watershed, about 44 acres (1 percent) are considered to be high to moderate RVR mule deer summer range. The CEA technical guide does not differentiate between high and moderate RVR mule deer range. Potential deer summer range is characterized by the aspen, sagebrush, and mountain brush community types in association with herbaceous meadow and riparian community types along stream courses. The potential summer range is all high elevation and is commonly found near the summit and the eastern side of the Independence Mountains. Mining activities have resulted in the disturbance of about 55 acres (9 percent) of potential mule deer summer range in the Jerritt Canyon watershed and another three acres (7 percent) in the Burns Creek watershed since 1980.

Fawning Habitat

Potential fawning habitat as identified in CEA occurs principally on slopes with a northern aspect, where stands of serviceberry, chokecherry, currant, snowberry, and Ceanothus provide hiding cover. Aspen stands, especially snowbank aspen, offer additional hiding cover and potential fawning habitat. Watershed boundaries define the geographic province for potential fawning habitat. Approximately 420 acres (5 percent) of the 8,106 acres in the Jerritt Canyon watershed are classified as high to moderate RVR areas for fawning habitat. Of the 4,038 acres in the Burns Creek watershed, about 90 acres (2 percent) are considered high to moderate RVR mule deer fawning habitat. No distinction between high and moderate RVR areas is made in the CEA technical guide. Approximately 44 acres (11 percent) of potential fawning habitat have been disturbed in the Jerritt Canyon watershed and seven acres (8 percent) in the Burns Creek watershed since mining started in 1980.

Sage Grouse

Sage grouse occur primarily in the sagebrush community types in the North Fork and Independence Valleys and at higher elevations in the Independence Mountains. This species is considered to be an indicator of the condition and trend of the sagebrush/grassland, herbaceous meadow, and riparian community types. Other wildlife species such as sage thrasher *(Oreoscoptes montanus)*, Brewer's sparrow *(Spizella breweri)*, and the common crow and raven will be provided for if the habitat requirements are met for sage grouse. Sage grouse are the primary species of upland game bird occurring in and around the Project area.

Potential sage grouse brooding habitat has been identified within the Project area and general study area. The CEA province for potential brooding habitat analysis is third order watersheds within the Independence Mountains. Approximately 3,871 acres (48 percent) of the 8,106 acres within the Jerritt Canyon watershed are considered potential sage grouse brooding habitat. About 1,273 acres (32 percent) of the 4,038 acres in the Burns Creek watershed are considered potential sage grouse brooding habitat. Sage grouse typically remain near streams and meadows during the summer months and in areas with exposed sagebrush on ridge tops at lower elevations during the winter. In spring, males prefer relatively open areas adjacent to dense sagebrush cover for strutting grounds. Sage grouse may move up to 50 miles or more throughout the year. In the winter, sage grouse feed primarily on leaves of big sagebrush, but will also utilize alkali sagebrush and low sagebrush (Back, pers. comm.). In other seasons they will feed on forbs and some insects as well as sagebrush.

Sage grouse populations in Elko County are currently estimated to be at moderate levels and stable (Stiver 1993a). 1993's spring moisture patterns were favorable and temperatures were variable but adequate to provide excellent growth (Stiver 1993a). Storms passing through the region appear to have had an adverse effect on insects, which may have resulted in fewer insects than desirable for sage grouse. Preliminary brood survey data from the region indicates fair to good sage grouse production.

Approximately 262 acres (7 percent) of potential sage grouse brooding habitat have been previously disturbed in the Jerritt Canyon watershed. Another 185 acres (14 percent) of disturbance have occurred to potential brooding habitat in the past within the Burns Creek watershed.

<u>Trout</u>

Trout were selected as an MIS because they provide an indication of water quality and of the condition and trend of riparian zones. Many species of wildlife and fish that are wholly or partially dependent upon riparian areas will be provided for if the habitat requirements for trout are satisfied. Lahontan cutthroat trout and red band trout are the primary species of interest in or near the Project area. These two species were discussed under endangered, threatened, candidate and sensitive species. The threatened Lahontan cutthroat trout occurs outside of the Project area. Fisheries values in Burns Creek are limited due to the unstable streambed and banks. Jerritt Creek and its tributaries do not sustain reproducing fish populations within the Project area.

Golden Eagles and Other Raptors

Golden eagles *(Aquila chrysaetos)* are currently nesting along large rock outcrops and cliffs in and near the Project area. Several golden eagles were observed within the Project area during the field surveys for the mine expansion. One golden eagle nest, referred to as the "pinnacle nest," is located within the disturbance area for the proposed action. This nest has apparently not been active since it was first identified in 1977, three years before mining activity began in Jerritt Canyon (JBR 1993c).

IMC is applying to the USFWS for a permit to remove the pinnacle nest prior to the nesting season. This nest is close to the Jerritt Canyon mining operations and seasonal restrictions have been established by the USFS for exploration activities within a 0.25 mile radius of the nest to avoid potential impacts on nesting eagles. Continuance of this restriction has the potential to interfere with future development or condemnation drilling operations for the mine expansion.

Because the federal Bald and Golden Eagle Protection Act requires that any application for a permit to "take" a golden eagle nest must be accompanied by documentation of the present nesting population of eagles within a ten mile radius of the nest proposed for taking, a survey was completed during 1993. Survey results noted seven golden eagle territories within a ten mile radius of the pinnacle nest. The seven territories included a total of twelve golden eagle nests, some of which are utilized as alternate nest sites. Of the seven territories, four were active in 1993, including one within the Project area and one immediately west of the Project area (JBR 1993c).

There is the possibility that the pinnacle nest may be removed prior to the nesting season before completion of this EIS, if authorized by the USFWS. Thus the potential removal of this nest along with any mitigation that may be required by the USFWS, may be viewed as part of the affected environment.

Other raptors observed in and around the Project area include red-tailed hawk *(Buteo jamaicensis)*, prairie falcon (*Falco mexicanus*), great horned owl (*Bubo virginianus*), northern harrier (*Circus cyaneus*), Swainson's hawk (*Buteo swainsoni*), Cooper's hawk (*Accipiter cooperii*), and turkey vulture (*Cathartes aura*) (ERT 1979i). One prairie falcon, one Cooper' hawk, and numerous turkey vultures were observed during 1992 field work (Coburn 1992). Other raptors known to occur within the Project area include sharp-shinned hawks (*Accipiter striatus*), long-eared owls (*Asio otus*), northern saw-whet owls (*Aegolius acadicus*), and western screech owls (*Otus asio*) (Lamp 1993).

Upland Game Birds

Upland game birds that inhabit the area include blue grouse (*Dendragapus obscurus*), chukar (*Alectoris graeca*), mourning dove (*Zenaida macroura*), and gray partridge (*Perdix perdix*) (ERT 1979).

Blue grouse breed at lower elevations, but move up to stands of conifers or to timberline in autumn. Potential blue grouse habitat represents less than one percent of the total Project area, according to the CEA methodology that uses specific characteristics of the vegetation to define suitable habitat.

Chukar were observed during the 1992 field survey primarily on upper slopes in the community types dominated by big sagebrush with an understory of cheatgrass. Grass and forb seeds are an important food source. In the spring and early summer, insects are an important forage item for growing chicks.

Mourning doves are summer residents that occur in all community types. Nesting takes place primarily in the community types dominated by trees and shrubs.

Gray partridge primarily occupy agricultural lands, especially those under irrigation. They winter at lower elevations on the valley floors. High snow depths reduced populations during the 1992-1993 winter (Stiver 1993b).

Furbearers and Predators

The general study area contains coyote (*Canis latrans*), short-tailed weasel (*Mustela erminea*), long-tailed weasel (*Mustela frenata*), raccoon (*Procyon lotor*), western spotted skunk (*Spigale putorius*), striped skunk (*Mephitis mephitis*), badger (*Taxidea taxus*), bobcat (*Felis rufus*), beaver (*Castor canadensis*) and mountain lion (*Felis concolor*).

Coyotes hunt throughout the entire Project and general study areas. The results of the Saval Ranch Study's howling survey indicate that the coyote is very common in the Independence Mountains (ERT 1979i). Coyote populations are currently estimated to be stable at moderate to high levels (Stiver 1993a). Weather and range conditions have been favorable for prey base populations (rodents and rabbits).

As evidenced by their diggings, badgers were very common throughout all habitats sampled for the 1980 Jerritt Canyon FEIS (ERT 1979). They were most numerous in the community types dominated by sagebrush at lower elevations, especially near grassy areas. Badgers feed heavily on small mammals such as ground squirrels, which they excavate from their burrows.

Available biological information and harvest data from NDOW indicate that Region II bobcat populations are gradually expanding following the low recruitment years of the mid 1980s (Stiver 1993a). However, the number of harvested bobcats decreased in 1992, compared to the 1987-91 average. This decrease was in response to low pelt prices and harsh winter conditions (Stiver 1993a).

Beaver harvests during 1992-93 were below long term averages, with 451 taken in the NDOW Region II area. Currently, beaver populations in the region are believed to be at moderate levels (Stiver 1993a). Beaver are an aquatic species found in the riparian community type near aspen stands and perennial streams or standing water. The CEA province for beaver habitat is third order watersheds in the Independence Mountains. There are about 409 acres of potential beaver habitat in the Jerritt Canyon watershed and another 500 acres in the Burns Creek watershed. Previous disturbance of potential beaver habitat within these watersheds has been about 16 acres (4 percent) and 98 acres (20 percent), respectively.

Mountain lions (*Felis concolor*) are known to inhabit the Project area. The animals are wide ranging and make use of mountainous habitats, with concentrated activity in areas with mule deer. The area that extends from the southern part of California Mountain to the headwaters of Stump Creek and into upper Burns Basin appears to be prime lion summer habitat. In past years, an estimated two lions inhabited the Independence Mountains in the vicinity of the Project area during the summer, and as many as six inhabited the area during the winter months when mule deer are concentrated (ERT 1979i). Sightings of mountain lions in the general study area have occurred regularly between 1978 and the present (McAdoo, pers. comm.) The Management Area 6 mountain lion population is at moderate to high numbers. However, with major losses of the Area 6 deer herd during the winter of 1992 - 1993, it is expected that the lion population may also decrease over time (Stiver 1993a).

Other Species

As a group, the rabbits and hares constitute a very important food base for the larger mammalian and avian predators. Species occurring in the Jerritt Canyon Project area include Nuttall's cottontail (*Sylvilagus nuttalli*), white-tailed jackrabbit (*Lepus townsendi*), and black-tailed jackrabbit (*L. californicus*). The black-tailed jackrabbit and Nuttall's cottontail are typically the most common (ERT 1979i), although in recent years white-tailed jackrabbit populations have increased (McAdoo, pers. comm.). The black-tailed jackrabbit primarily inhabits the sagebrush community type where its numbers are sometimes very high. Nuttall's cottontail occurs throughout the Project area in all habitats but prefers riparian vegetation. The white-tailed jackrabbit is a game animal in Nevada. It occurs in the higher elevations of the Project area, particularly along the edges of the sagebrush/grassland and low sagebrush/grassland community types. Coyotes, bobcats, golden eagles, and red-tailed hawks prey heavily on these animals. Rabbit populations increased in most of NDOW Region II from the mid 1980's to 1990. The population may have peaked in 1990 and declined in 1991 as evidenced by a decline in harvest. However, it appears the Elko County rabbit population peaked a few years later than the rest of Region II (Stiver 1993a).

Rodent species in the Project area include the least chipmunk (*Eutamias minimus*), Richardson ground squirrel (*Spermophilus richardsoni*), Belding ground squirrel (*S. beldingi*), golden-mantled ground squirrel (*S. lateralis*), Townsend ground squirrel (*S. townsendi*), yellow-bellied marmot (*Marmota flaviventris*), Great basin pocket mouse (*Perognathus parvus*), Ord kangaroo rat (*Dipodomys ordi*), northern pocket gopher (*Thomomys talpoides*), northern grasshopper mouse (*Onychomys leucogaster*), deer mouse (*Peromyscus maniculatus*), bushy-tailed woodrat (*Neotoma cinerea*), mountain vole (*Microtus montanus*), sagebrush vole (*Laguras curtatus*), western jumping mouse (*Zapus princeps*), and porcupine (*Erethizon dorsatum*) (ERT 1979i).

Insectivores in the Project area include Merriam's shrew (*Sorex merriami*), vagrant shrew (*S. vagrans*), and northern water shrews (*S. palustris*). Bats include little brown myotis (*Myotis lucifugus*), long-eared myotis (*M. evotis)*, long-legged myotis (*M. volans*), and small-footed myotis (*M. subulatus*), and the big brown bat (*Eptesicus fuscus*). During 1992 mist nest surveys of the two man-made stock ponds located in the north portion of the Project area, 21 bats were captured (12 long-eared myotis and 9 little brown myotis) (JBR 1993a).

Cavity nesting birds require dead trees, stumps, or branches within which they excavate a nest or utilize an existing hole or natural cavity. In the Project area they commonly utilize aspen for their nest trees. Although cavity nesting birds were not identified as a wildlife issue, they can provide an indication of aspen stand condition, which was identified as an issue. The CEA attributes of potential cavity nester habitat are defined as the mature aspen or subalpine fir/pine community types. The province for potential cavity nester habitat is third order watersheds within the Independence Mountains. Of the 8,106 acres in the Jerritt Canyon watershed, approximately 879 acres (11 percent) are classified as potential cavity nester habitat. Within the 4,038 acres in the Burns Creek watershed, about 1,358 acres (34 percent) are considered as potential habitat for cavity nesters. Aspen is the dominant tree species in the area and forms the only forest stands available to cavity nesters. These stands are important to numerous species of cavity nesting birds, as well as canopy nestings species. The existing mining operations have disturbed about 126 (14 percent) acres of potential cavity nester habitat in the Jerritt Canyon watershed and another 190 acres (14 percent) in the Burns Basin watershed. These disturbance acreages are very similar to those for aspen habitat fragmentation, as discussed in the vegetation section.

Although neotropical migrant bird species as a whole did not emerge as an issue during the EIS public scoping process, concern for these species is mounting at the national and international levels primarily because of their dependence upon tropical habitats in Central and South America during the winter. In addition to many of the bird species already mentioned, neotropical migrants include songbirds and most other species present within the Project and general study areas. As indicated by baseline data collected during the Saval Project, neotropical migrants, most of which are considered nongame birds, are very diverse and numerous within the Independence Mountains. The riparian ecosystem, with its vegetative structural diversity including herbaceous, low shrub, mid-shrub (willow), and tree (aspen) communities are inhabited with a particularly diverse array of species specialized for nesting and/or feeding within these layered habitats.

3.4 Land Use

Land Use Planning and Management

The analysis area for land use planning and management is Elko County, with emphasis on the Project area. The Project area includes only National Forest System land and private lands.

Historical uses and land ownership are primary factors in existing land use in Elko County. Nearly three-fourths of the 17,812 square miles in the county are under federal management. The BLM manages about 62 percent and the USFS administers approximately ten percent of the public lands (USDI, BLM 1989). Both the BLM and the USFS have planning documents that guide the use of the land these agencies manage. Private land use is guided in part by county and city planning documents.

Land uses in the county include agriculture, recreation, mining, towns and associated business centers, residences and infrastructure. Agriculture is the primary land use in Elko County. Over sixty percent of the land in the county is used for ranching and grazing. This includes private ranch lands and federal land used for grazing (USDI, BLM 1989). The federally managed land provides for a variety of other uses including mining, wildlife habitat, and recreation. Approximately 36 percent of the land in the county is used for recreation (USDI, BLM 1989).

Land use in the Project area is managed for multiple use by the USFS and consists of mining, livestock grazing and limited recreational use, primarily hunting. The total Project area comprises 10,849 acres of which 1,272 acres are private inholdings within the Humboldt National Forest (See Map 1.2).

Forest Plan Management Direction - Project Area Management

The Mountain City Ranger District administers the National Forest system lands in the Project area. Management prescriptions for recreation, wildlife and fish, range, timber, water and soil, land exchanges and rights-of-ways, facilities, fire protection, and minerals are included in the Humboldt National Forest LRMP with specific guidance for the Mountain City Ranger District.

The Humboldt National Forest LRMP indicates that 97.2 percent of the Forest is open to mineral entry and 99.9 percent is open to mineral leasing (USDA, USFS 1986b). Lands withdrawn from mineral entry consist primarily of wilderness areas. Of 479,215 acres in the Mountain City District, 477,500 acres are open to mining and leasing (USDA, USFS 1986b). Reserved and outstanding mineral rights on the Humboldt Forest total 30,325 acres or 1.2 percent of the Forest (USDA, USFS 1986b). Under current management direction, the policy of the Forest is to integrate the development of mineral resources with the use and conservation of other Forest resources (USDA, USFS 1986b). For locatable minerals, lands open to entry have not been restricted. In most areas, mitigation measures and management constraints are added to operating plans for mining activities to provide for environmental protection (USDA, USFS 1986b).

BLM Resource Management Plan

The BLM completed a Resource Management Plan for the Elko Resource Area in 1987. The plan states that the resource area is open to mineral entry for locatable minerals except for an 11-acre administrative site in the City of Elko. The plan's objective for mineral resources is to keep public land open for exploration, development and production while mitigating conflicts with wildlife, wild horses, recreation and wilderness resources (USDI, BLM 1989).

Elko County Land Use Planning

County land use controls include the county zoning ordinance, mobile home regulations, and state subdivision regulations. The Elko County Commissioners recently adopted an interim land use plan, The Elko County Federal Land Use Plan, which establishes county policy regarding federal decisions which may affect local custom, culture, and community stability (Moore, pers. comm.). The interim plan supports the doctrine of multiple use of federal lands for recreational and economic purposes. The county's policy regarding mining states that it is imperative to the well-being of the nation and of Elko County that mining on federal lands should remain open and free to the public. In January 1993, the County Commissioners appointed a seven member Elko County Federal Land Use

Planning Commission, which reviews proposals for use of federal lands in the county (Moore, pers. comm.).

Mining

The analysis area for mining is the Jerritt Canyon Mining district, depicted on Map 3.8. The Jerritt Canyon mining district is the largest district identified by the U.S. Bureau of Mines in the Independence Mountains. Known mineral resources within the Jerritt Canyon district include gold, silver, barite, sulfur-bearing shale, and antimony. The Jerritt Canyon Mining District includes the National Forest lands south of Jack Creek, as well as privately owned and BLM lands to the east, west, and south of the Forest boundary (USDI, Bureau of Mines 1992). Unlike many other Nevada mining districts, it has virtually no historical lode or placer mining activity for gold. The earliest records are of 1918 discoveries by sheepherders of antimony in Jerritt Canyon and in Burns Basin. Gold production has been recorded since 1981.

The majority of current mining and exploration activity in the Jerritt Canyon Mining district is centered on gold recovery. According to the US Bureau of Mines the Jerritt Canyon mining district has accounted for 96 percent of the total of gold production recorded for the Independence Mountain Range. The Jerritt Canyon mine operations produced 20 million tons of ore and 3.5 million ounces of gold by the end of 1992.

The recent emphasis on gold mining in the Jerritt Canyon Mining district has overshadowed the barite mining that was active in the south and southwest portions of the district during the oil drilling boom of the 1970's (USDI, Bureau of Mines 1992). During this period, barite was produced from at least nine properties peripheral to the Jerritt Canyon project (USDI, Bureau of Mines 1992). The Hunewill plant, which processed most of the barite rock produced, has been dismantled and removed from its former location in the Independence Valley (USDI, Bureau of Mines 1992).

Livestock Grazing

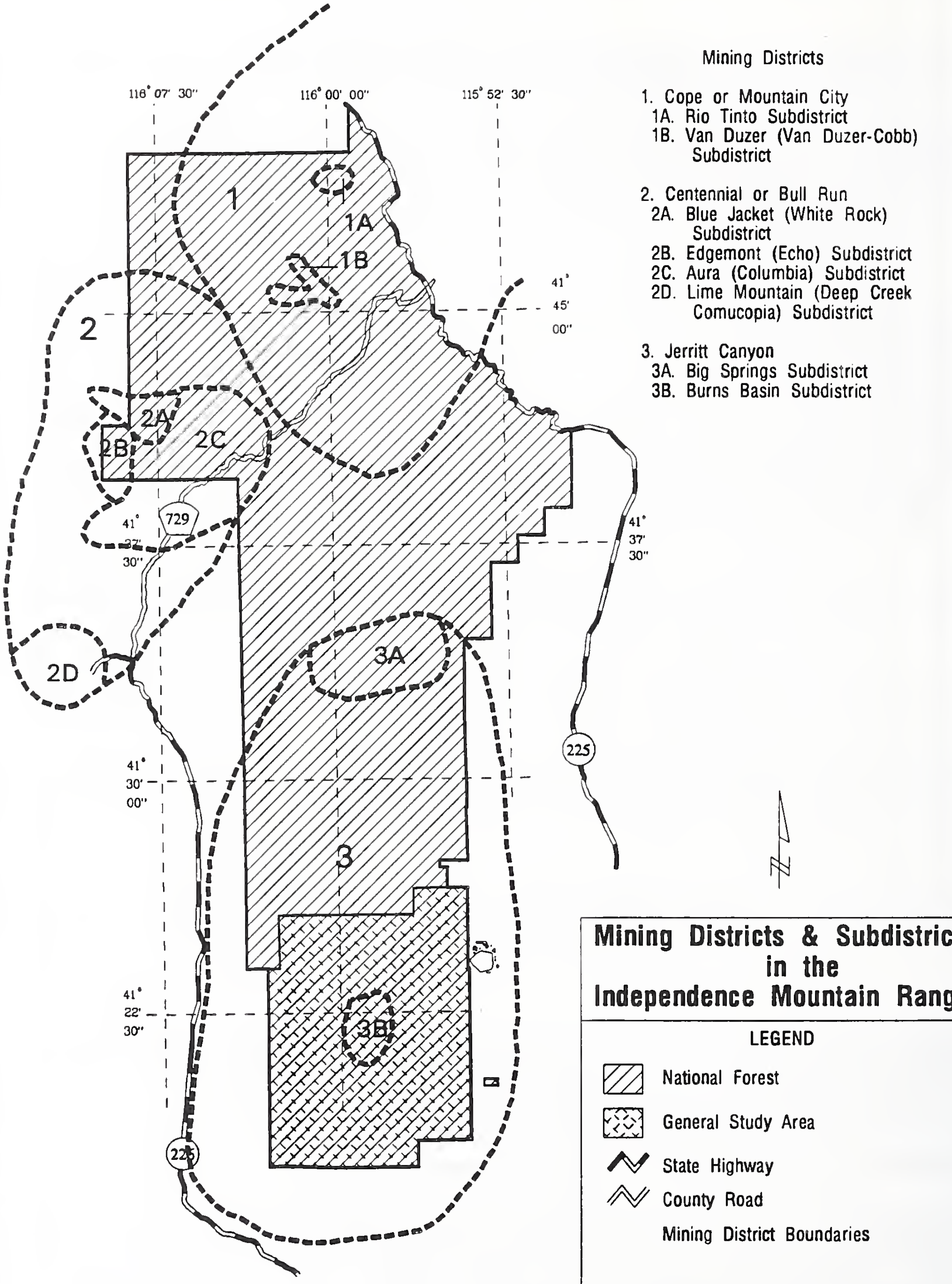
The carrying capacity of the grazing allotments was identified as an issue to be analyzed in this DEIS. Map 3.9 displays the grazing allotments in the Independence Range.

The analysis area for livestock grazing is the general study area. The general study area includes portions of Jerritt Canyon, Mill Creek, East Independence, Foreman Creek, Schmitt Creek, and Snow Canyon USFS allotments.

Jerritt Canyon Cattle and Mill Creek Allotments

Portions of these allotments are closed due to the proximity of mining activities. The open and suitable portions of the two allotments have been combined to form the Jerritt Canyon Cattle allotment. The grazing permit for the Jerritt Canyon allotment has been issued for 300 yearlings for a season from June 1 to August 15 for a total of 750 animal

DATA SOURCE: U.S. Department of Interior, Bureau of Mines, Mineral Resources of the Independence Range Special Study Area, Elko County, Nevada, 1992.



Mining Districts & Subdistricts in the Independence Mountain Range

LEGEND

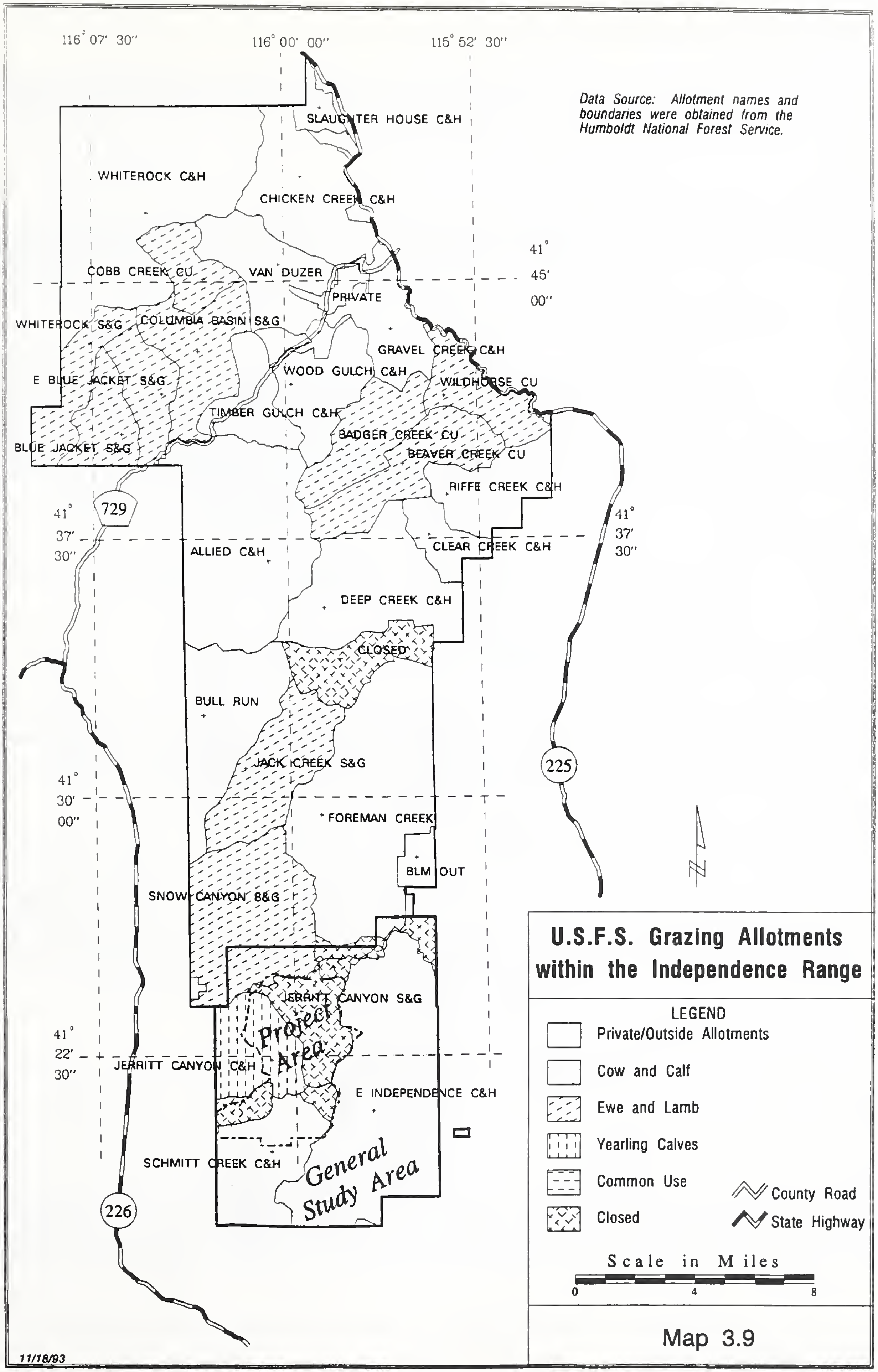
- National Forest
- General Study Area
- State Highway
- County Road
- Mining District Boundaries

Scale in Miles

0 5.5 11

Map 3.8

11/16/93



116° 07' 30"
116° 00' 00"
115° 52' 30"
Data Source: Allotment names and boundaries were obtained from the Humboldt National Forest Service.
SLAUGHTER HOUSE C&H
WHITEROCK C&H
CHICKEN CREEK C&H
COBB CREEK CU
VAN DUZER
PRIVATE
41° 45' 00"
WHITEROCK S&G
COLUMBIA BASIN S&G
GRAVEL CREEK C&H
E BLUE JACKET S&G
WOOD GULCH C&H
WILDHORSE CU
TIMBER GULCH C&H
BADGER CREEK CU
BLUE JACKET S&G
BEAVER CREEK CU
RIFFE CREEK C&H
729
41° 37' 30"
ALLIED C&H
CLEAR CREEK C&H
DEEP CREEK C&H
CLOSED
BULL RUN
JACK CREEK S&G
225
41° 30' 00"
FOREMAN CREEK
BLM
OUT
SNOW CANYON S&G
JERRITT CANYON S&G
Project Area
41° 22' 30"
JERRITT CANYON C&H
E INDEPENDENCE C&H
SCHMITT CREEK C&H
General Study Area
226
U.S.F.S. Grazing Allotments within the Independence Range
LEGEND
Private/Outside Allotments
Cow and Calf
Ewe and Lamb
Yearling Calves
Common Use
Closed
County Road
State Highway
Scale in Miles
0
4
8
Map 3.9
11/18/93

months. This Forest uses a 1:1 conversion ratio for cow/calves to yearlings. The term of this permit is conditional upon suitable land and forage being available for livestock grazing, otherwise the permit will expire December 31, 2002.

Jerritt Canyon Sheep Allotment

This sheep allotment was closed January 1993. There is no U.S. Forest System land available within the Humboldt National Forest to replace the forage lost by this closure.

East Independence Cattle Allotment

Evaluation of this allotment by the USFS in December 1992 established grazing levels not to exceed 3,225 animal months. Stocking will be conservative, in the interest of recovery of the Lahontan cutthroat trout streams in the allotment. The grazing system is a modified rest rotation with two riparian pastures, Gance and California Creeks. East of the riparian pastures, grazing will occur from range readiness, approximately May 15, until utilization levels are reached, or no later than July 1, to allow for fall regrowth in the riparian areas.

The East Independence Cattle allotment is adjacent to the Project area, but not included within the proposed mine expansion area.

Foreman Creek Cattle Allotment

This allotment was analyzed in conjunction with the East Independence Cattle Allotment in 1992. Only the farthest southeast corner of the allotment is included within the general study area. The current permit is for 748 cow/calf pairs from June 16 to September 15, for a total of 2,244 animal months.

Snow Canyon Sheep Allotment

This allotment is currently being evaluated by the USFS for livestock grazing. The evaluation will address public issues and concerns, resource concerns, and existing and desired resource condition. An EA is scheduled to be completed by November 1993.

Schmitt Creek Cattle Allotment

A portion of the Burns Basin mining area falls within this allotment. The current permit is for 296 cow/calf pairs from August 1 to October 15, for a total of 740 animal months.

Recreation and Public Access

As defined by the CEA Technical Guide, the Independence Range is the geographic province for recreational opportunity, recreational use and public access. Recreation and public access are inter-related, as the type and extent of recreation depends on the access available to the public.

Recreation

Hunting and fishing were identified through public and agency scoping as recreation issues. Statistics on actual recreational use in the Project area and General Study area are not available. Visitor statistics for the Mountain City Ranger District, which includes the Independence Range, are included in Table 3.10.

Table 3.10
Humboldt National Forest Recreation
Visitor Days of Use[1] - 1986-1992
Elko County

	Humboldt National Forest (total)[2]	Mountain City Ranger District	Jarbidge Ranger District	Ruby Mountains Ranger District
1986	606,200	85,000	63,900	225,900
1987	610,100	86,200	63,600	269,600
1988	686,200	106,900	71,300	299,100
1989	803,600	93,200	198,700[3]	317,500
1990	898,200	90,000	53,700	439,600
1991	864,900	106,900	44,300	383,100
1992	755,000	94,100	30,100	330,000
Percent Change 1986-1992	+24.5%	+10.7%	-52.9%	+46.1%

Source: Schaffran 1993.

Note: [1] Forest Service recreation data are collected on ranger districts through a combination of traffic couunters, visual observations, campground receipts and hunting/fishing statistics.
[2] Includes the Santa Rosa and Ely Ranger Districts outside of Elko County.
[3] The "Rainbow Family" National Gathering was held on the Jarbidge Ranger District in 1989.

Recreation is examined from two perspectives according to the CEA Technical Guide: 1) recreational opportunity and 2) recreational use. The province for analysis is the Independence Mountain Range. This province is entirely within the boundaries of the Humboldt National Forest and provides focus for site-specific conditions within and adjacent to the Project area. The Independence Mountain Range is one of many public recreational areas in Elko County. Other areas include National Forest and wilderness lands in the Ruby Mountains and Jarbidge Mountains, BLM managed lands, and state recreation areas.

Some recreational areas that can be accessed from Highway 226 include Jack Creek Campground on the Mountain City Ranger District, and the Wilson Reservoir and South Fork Owyhee River Special Recreation Management Areas.

The LRMP classified recreation opportunity into five Recreation Opportunity Spectrum (ROS) classes. ROS is a method of measuring the ability of designated land to meet various types of recreation uses. The five ROS classes identified were: (1) rural, (2) roaded natural, (3) semi-primitive motorized, (4) semi-primitive non-motorized, and (5) primitive. The TOC's established during the CEA process for recreation opportunity included any reduction in primitive and semi-primitive non-motorized classes from the 1986 status established in the LRMP. There are no areas designated as rural, primitive or semi-primitive nonmotorized in the Project area. The distribution of ROS classes in the Independence Range and in the Project area is shown in Table 3.11 and on Map 3.10.

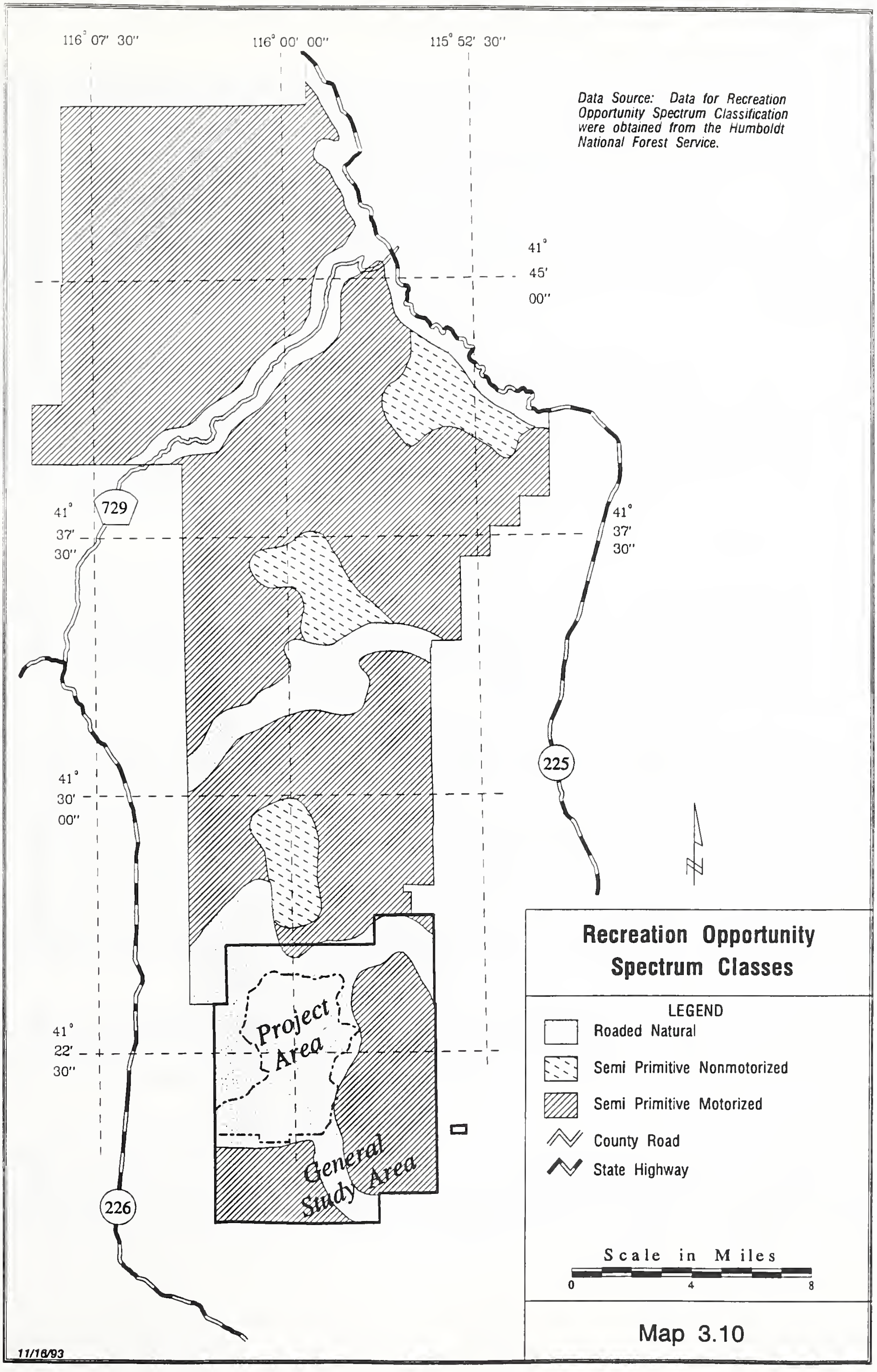
Table 3.11
Recreational Opportunity Spectrum Classes in Independence Range and Project Area

	Independence Range (Acres)	Project Area (Acres)
Rural	0	0
Roaded Natural	49,325	10,841
Semi-Primitive Motorized	167,193	8
Semi-Primitive Nonmotorized	16,412	0
Primitive	0	0
TOTAL	**232,930**	**10,849**

Source: USFS GIS database, April 7, 1993

Recreational use in the Independence Range includes use of developed recreational sites (such as picnic areas and campgrounds) and dispersed recreation, such as hiking. The TOC for recreation use established in the CEA is where demand is estimated to exceed supply.

The LRMP management prescription for recreation in the Mountain City Ranger District is to improve and maintain existing campgrounds and to emphasize dispersed recreation on the remainder of the district. There are two developed recreation sites in the Independence Range: 1) Jack Creek (no water/no fee), and 2) Wild Horse Crossing fee campground. There are no developed recreation sites in the Project area. Dispersed recreational opportunities include hiking, rockhounding, backpacking, picnicking, camping, pleasure driving, hunting, cross-country skiing, and snowshoeing (USDA, USFS 1986a).


116° 07' 30"
116° 00' 00"
115° 52' 30"
Data Source: Data for Recreation Opportunity Spectrum Classification were obtained from the Humboldt National Forest Service.
41° 45' 00"
41° 37' 30"
41° 30' 00"
41° 22' 30"
729
225
226
Project Area
General Study Area
N
Recreation Opportunity Spectrum Classes
LEGEND
Roaded Natural
Semi Primitive Nonmotorized
Semi Primitive Motorized
County Road
State Highway
Scale in Miles
0
4
8
Map 3.10
11/16/93

Recreational use in the Mountain City Ranger District has increased by approximately 11 percent over the last six years. Recreational use in the Ruby Mountains Ranger District, closer to the city of Elko, increased by 46 percent. The supply of dispersed recreation opportunities currently exceeds demand in the Independence Range according to the LRMP and USFS personnel (Schaffran, pers. comm.).

Although historical documentation of recreational use in the Project and general study area is unavailable, USFS personnel indicate the predominant recreational activity within the Project area is hunting. Hunting occurs primarily in the fall for mule deer and sage grouse.

There are no roadless or wilderness areas within or adjacent to the Project area. The CEA province for roadless areas is the identified roadless areas in the Independence Range. These areas are identified on Map 3.10 as semi-primitive nonmotorized areas. The 27,905 acre Independence Roadless Area Number 389 lies to the north of the Project area. There are no wilderness areas in the Independence Range Province. The closest wilderness area is the Jarbidge Wilderness area, approximately 30 miles from the Project area.

Public Access

The analysis area for public access is the Independence Range. The detailed analysis area is the proposed Project area. Gates and points of restriction are indicated on the 1990 Forest Visitor/Travel Map which is available at the Mountain City Ranger District and the Humboldt National Forest Office in Elko.

The CEA Technical Guide identifies four classes of access opportunities: 1) Unrestricted access, 2) Generally open access with no easements, 3) Generally closed access with no easements, and 4) Total closure. Class 1 access areas offer the public unrestricted access to National Forest System land. This generally means there is direct access from a road maintained by a unit of federal, state or local government, or there is an access easement from such a road across private land. Class 2 access areas offer unrestricted access to Forest land but no private easements have been obtained. Class 3 access areas have access restrictions across private land between a public road and the Forest land. Class 4 access areas are totally closed and not available for public access. The TOC for public access is the loss of any areas classified as Class 1 or Class 2.

The distribution of public access classes in the Independence Range and in the Project area is shown in Table 3.12 and on Map 3.11. The Class 4 area for Jerritt Canyon Project currently consists of 7,347 acres, including existing mining activities outside of the Project area.

Public access to existing mining operations within the Project area is restricted for safety reasons by use of signed gates, warning signs, and fences. The road closures and other precautionary measures are used to protect the general public from potential dangers associated with mining activities as well as to protect mine property and provide for the

Table 3.12
Public Access Classes in the Independence Range and Project Area

	Independence Acres	Project Acres
Class 1 Unrestricted	90,929	0
Class 2 Generally Open	78,154	4,526
Class 3 Generally Closed	55,384	0
Class 4 Totally Closed (for public safety)	8,463	6,323
TOTAL	**232,930**	**10,849**

Source: USFS GIS database, April 7, 1993

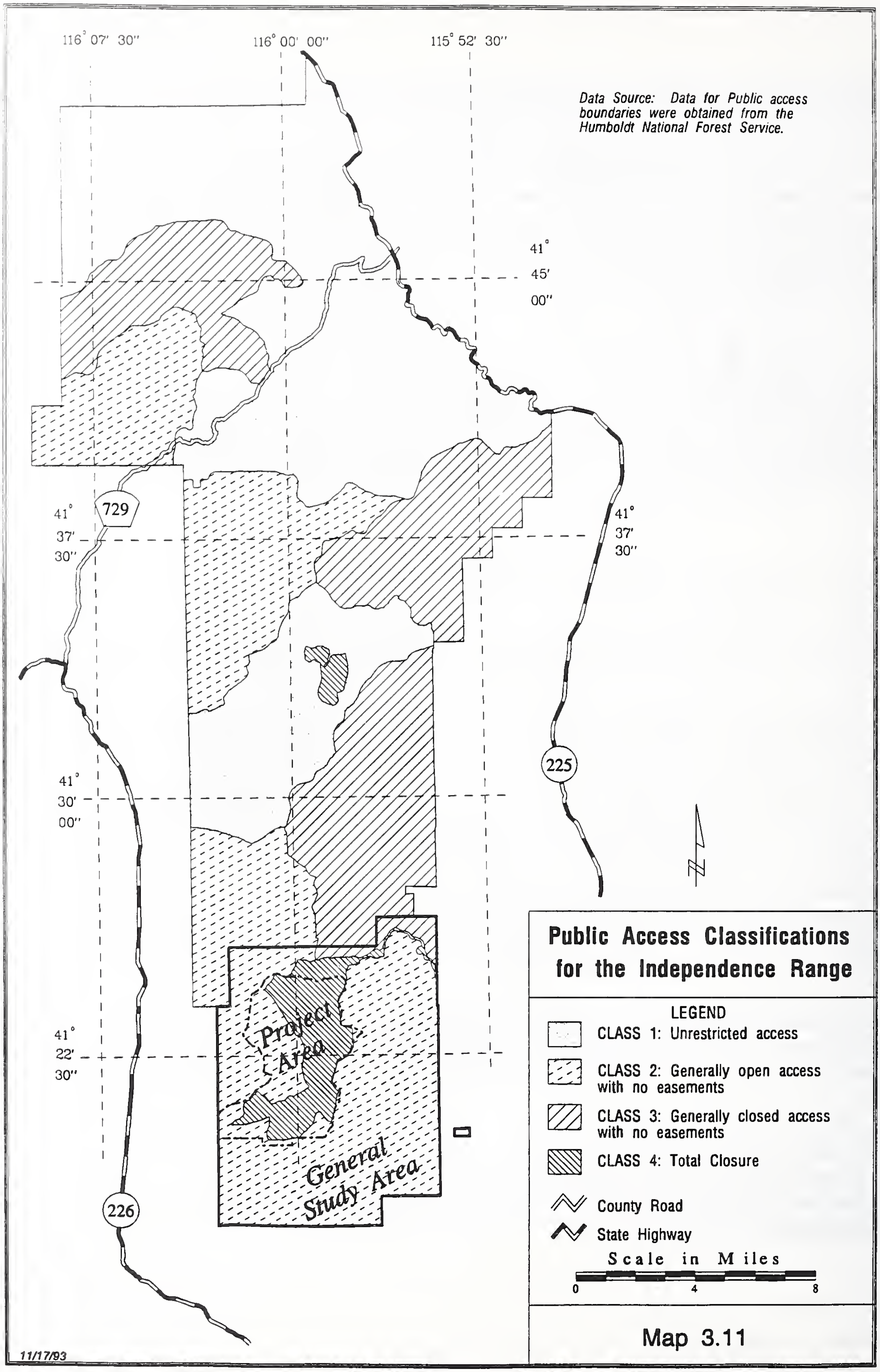
safety of IMC personnel. The area currently closed for the Jerritt Canyon mine operations is shown on Map 3.11.

Public access into the Project area is restricted by the fact that there are no public easements on roads to the Forest boundary from Highways 225 or 226 in the general study area. It is for this reason the area is classified as Class 2 Public Access. Although access is generally open as indicated by historical use, private land-owners could restrict passage across their land. USFS Roads 875 (Jerritt Canyon Creek Road) and 870 (Burns Creek Road) intersect with Highway 226 to the west, but access into the National Forest System lands requires crossing privately owned land. An unnumbered USFS road, commonly referred to as the Arana road, provides approximately one half mile of access in the northwest corner of the Project area before the road is closed near the Gracie dump. Access to the Arana Road from Highway 226 to the USFS boundary is entirely on private land. The Gance Creek Road (USFS 868) approaches the area from the southeast boundary of the Forest and terminates at the ridge overlooking Burns Basin, access to USFS road also requires crossing areas of private land.

Access for IMC operations within the Project area is primarily on haul roads and exploration roads. Primary mining access to the Project area is from Highway 225, via the private entrance road to the mill on the east side of the Independence Mountains.

3.5 Socioeconomic Environment

The analysis area for the socioeconomic environment is Elko County and surrounding counties with mining development that affects Elko County. Focus of the analysis is on existing conditions in Elko County.



116° 07' 30"
116° 00' 00"
115° 52' 30"
Data Source: Data for Public access boundaries were obtained from the Humboldt National Forest Service.
41° 45' 00"
41° 37' 30"
41° 30' 00"
41° 22' 30"
729
225
226
Project Area
General Study Area
Public Access Classifications for the Independence Range
LEGEND
CLASS 1: Unrestricted access
CLASS 2: Generally open access with no easements
CLASS 3: Generally closed access with no easements
CLASS 4: Total Closure
County Road
State Highway
Scale in Miles
0
4
8
Map 3.11
11/17/93

The FEIS for the Jerritt Canyon Project detailed the baseline socioeconomic conditions in 1979. Conditions have changed significantly since that time. This analysis of existing conditions in the study area updates the 1979 study with information from the following sources: the EA for the Jerritt Canyon Expansion (USDI, BLM 1989), the EA for the Jerritt Canyon Project Tailings Pond Dam Raises (USDI, BLM 1991b), the EA for the Alchem C dump (USDA, Forest Service 1992b), the SocioEconomic Technical Report for the Betze Project EIS (ENSR 1991), the US Bureau of the Census, the North East Nevada Development Authority (NENDA 1992a, 1992b), the Elko Chamber of Commerce and various state and local government agencies.

Map 3.12 displays the study area for socioeconomics, which encompasses Elko County and the northeastern corner of Eureka County adjoining the southwestern portion of Elko County. There are no major communities in the northwest corner of Eureka County, but there is considerable mining exploration and development along the Carlin Trend. There are four incorporated cities in Elko County: 1) the City of Elko, regional trade center and county seat; 2) Carlin, located on the southwestern boundary of Elko County adjacent to Eureka County; 3) Wells, located on Interstate 80 in the eastern half of the county; and 4) West Wendover, located near the Utah border, incorporated in 1991. Most of the population growth has occurred in the City of Elko and in Carlin (NENDA 1992b).

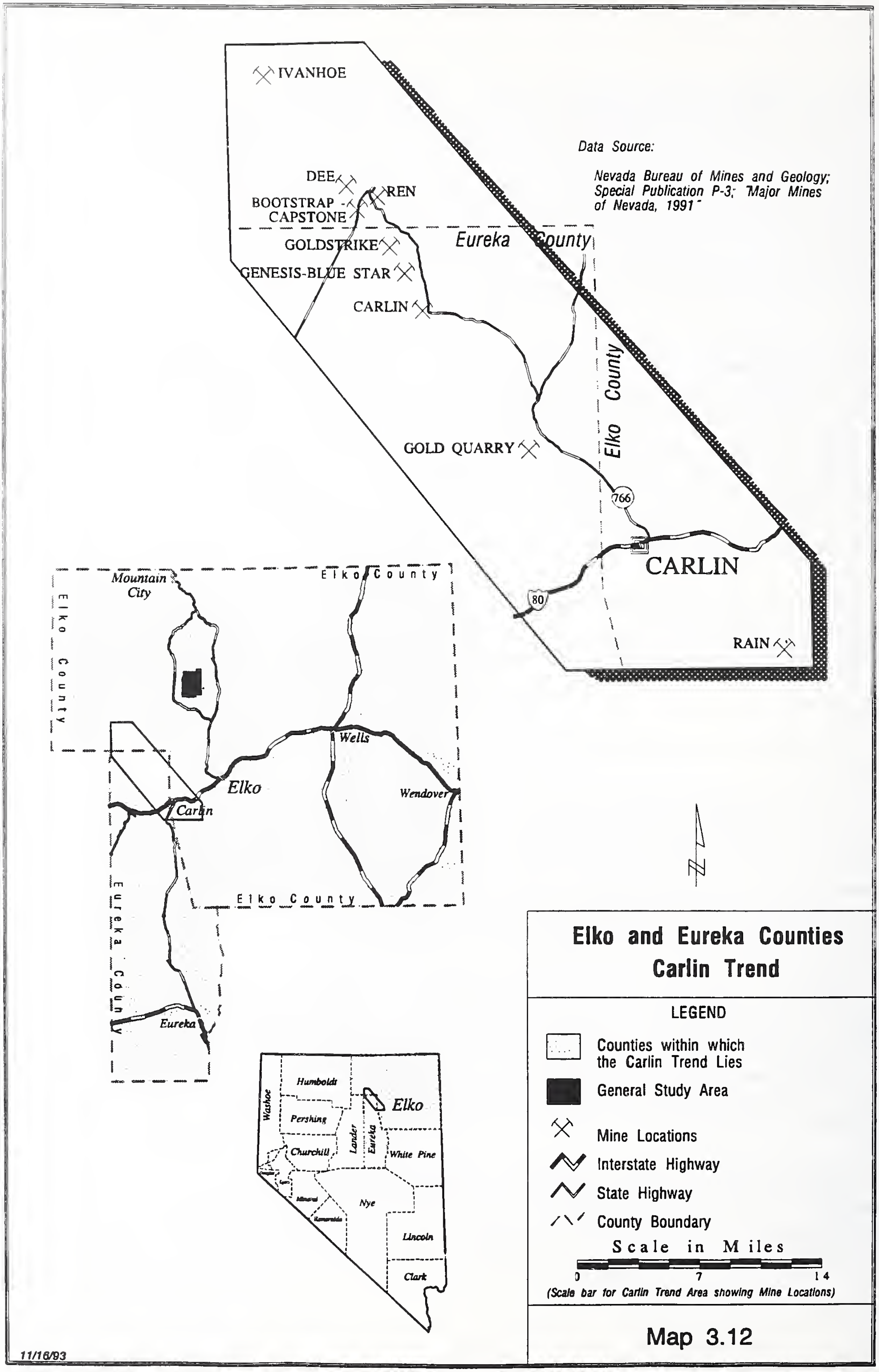
Other communities identified in the 1980 FEIS as potentially affected by the proposed action included Tuscarora, Mountain City and the Duck Valley Indian Reservation. Impacts to these communities have been minimal and little change has been observed (Boucher, pers. comm.). Existing conditions for these are summarized under other communities in Elko County.

Population

The state of Nevada experienced a dramatic period of growth from 1980 to 1990. There was a net gain of 376,270 people during this period, which represents a growth rate of 47 percent. Most of this growth can be explained by in-migration of new residents into the state due to increased employment opportunities in the gambling-related service sector and the mining and construction industries (ENSR 1991). Population characteristics for Elko County and the City of Elko are displayed in Table 3.13.

Based on U.S. Census figures, population increased by 94 percent from 1980 to 1990 in Elko County and 68 percent in the City of Elko. Rapid growth rates experienced in the late 1980's subsided significantly by 1990-1991 (NENDA 1992a). A comparison of 1980 and 1990 census data indicates trends toward increasing urbanization and in-migration into the county. The overall racial and ethnic composition of the county's population (Table 3.14) has remained relatively stable.

The population of Elko grew from 8,758 in 1980 to 14,736 in 1990 (US Bureau of the Census) and was estimated at 16,580 in 1992 (Nevada Department of Taxation and Nevada State Demographer 1992). Despite the infrastructural strains related to rapid growth, the city has adapted to this influx of newcomers, as evidenced by new residential subdivisions


IVANHOE
Data Source:
Nevada Bureau of Mines and Geology; Special Publication P-3; "Major Mines of Nevada, 1991"
DEE
REN
BOOTSTRAP - CAPSTONE
GOLDSTRIKE
GENESIS-BLUE STAR
Eureka County
CARLIN
Elko County
GOLD QUARRY
766
CARLIN
80
RAIN
Mountain City
Elko County
Elko County
Wells
Elko
Wendover
Carlin
Eureka County
Elko County
Eureka
Humboldt
Washoe
Elko
Pershing
Lander
Eureka
Churchill
White Pine
Nye
Lincoln
Clark
Elko and Eureka Counties
Carlin Trend
LEGEND
Counties within which the Carlin Trend Lies
General Study Area
Mine Locations
Interstate Highway
State Highway
County Boundary
Scale in Miles
0
7
14
(Scale bar for Carlin Trend Area showing Mine Locations)
Map 3.12

11/16/93

Table 3.13 Selected Population Characteristics Elko County, 1980-1990						
	1980		1990		% Change 1980-1990	
	City of Elko	Elko County	City of Elko	Elko County	City	County
Population[1]						
Female	4,354	8,198	7,706	15,689	61%	91%
Male	4,404	9,071	7,706	17,841	75%	97%
TOTAL	8,758[3]	17,269	14,736 (15,520)[2]	33,530 (34,570)[2]	68% 77%[4]	94% 100%[4]
Age						
Median Age, yrs.	30.7	29.7	30.0	29.4		
% Under 18 yrs.	29.9%	31.2%	30.6%	32.2%	0.7%	1%
% 65 yrs. & over	10.5%	5.0%	7.8%	6.1%	-3.7%	1.1%
Other						
% Urban		51%		61.8%		10.8%
% Rural		49%		38.2%		-10.8%
% Native[5]		37%		29.6%		-7.4%

Sources: [1] US Bureau of the Census, 1980 and 1990.
[2] Business Portrait of Northeast Nevada, NENDA 1992.

Notes: [3] Contested as low by city.
[4] Calculated using 1980 census data & 1990 NENDA estimates.
[5] Born in Nevada.

and numerous capital improvements, as described under the Public Facilities and Services. Elko was named the top small town in the US by Norman Crampton in his book, The 100 Best Small Towns in America,(Crampton 1993) released by Prentice Hall of New York in 1993. Factors used by Crampton to rate the towns in his study included: population growth, health care, crime, local spending on public education, per capita income, proportion of residents aged 25 to 34, housing costs, recreation, climate and geography (Elko Daily Free Press, Feb. 2, 1993).

The population of Carlin increased from 1,232 in 1980 to 2,270 in 1990 (NENDA 1992a). An average growth rate of 69 percent, experienced from 1985 to 1990, subsided to 4 percent, the rate of the county as a whole, in 1990-1991 (NENDA 1992a). Much of Carlin's growth is due to settlement by employees who work in the Carlin Trend mining operations located in adjoining Eureka County (ENSR 1991). (Refer to Map 3.12, Study Area).

Table 3.14
Population Distribution by Race
Elko County, 1980-1990

	1980				1990			
	City of Elko		Elko County		City of Elko		Elko County	
Racial Group[1]		% Total Pop.		% Total Pop.		% Total Pop.		% Total Pop.
White	7,704	88%	14,747	85%	13,146	89%	28,970	86%
Black	41	0.5%	81	0.5%	63	0.4%	266	0.8%
American Indian, Eskimo, Aleut	442	5%	1,468	8.5%	404	3%	2,128	6%
Asian, Pacific Islander	64	0.7%	106	0.6%	173	1%	277	0.8%
Other	507	5.8%	867	5%	950	6%	1,889	6%
TOTAL[2]	**8,758**	**100%**	**17,269**	**99.6%**	**14,763**	**99.4%**	**33,530**	**99.6%**

Source: [1] US Bureau of the Census, 1980 and 1990. The U.S. Bureau of the Census includes persons of Hispanic origin under the various racial groups listed. Census records indicate there were 1,046 and 1,842 persons of Hispanic origin in 1980 in the City of Elko and Elko County, respectively. In 1990, there were 2,215 and 4,339 in the City of Elko and Elko County.
[2] Some total percentages may be less than 100% due to rounding errors.

Unincorporated Spring Creek, approximately six miles southeast of Elko, is estimated to have a population of around 7,000 (Boucher, pers. comm.) to 8,000 (Ladd, pers. comm.).

There are no major communities in the northern half of Eureka County, where several large-scale gold mining operations are located along the Carlin Trend. Beowawe and Crescent Valley are small unincorporated towns situated on Highway 306 south of Interstate 80 which crosses the north end of the county east to west. Total population in Eureka County grew from 1,198 in 1980 to 1,547 in 1990 for an increase of 29 percent (US Bureau of the Census 1980 and 1990).

Economy and Employment

Historically, Elko County's economic base has been dependent on the service, mining and agricultural sectors. The recent expansion in gold exploration and production has resulted in overall economic diversification for the county. In 1992, three mines operating in Elko County produced 427,205 ounces of gold and 44,364 ounces of silver (Nevada Department of Minerals 1993). Since 1985, most sectors of the economy have experienced strong growth, with an average annual increase of 13.9 percent in employment for all industries reported for the June 1987 to June 1989 period (ENSR 1991). Mining and construction have become major contributors to the Elko County economy in the last few construction have become major contributors to the Elko County economy in the last few years. The largest growth in employment has been in the construction, trade and mining sectors (ENSR 1991). The total percent change in employment by industry for the period 1977 to 1990 is indicated in Table 3.15. Employment trends by industry are displayed in Figure 3.2.

Table 3.15
Employment Distribution by Industry
Elko County, 1977-1990

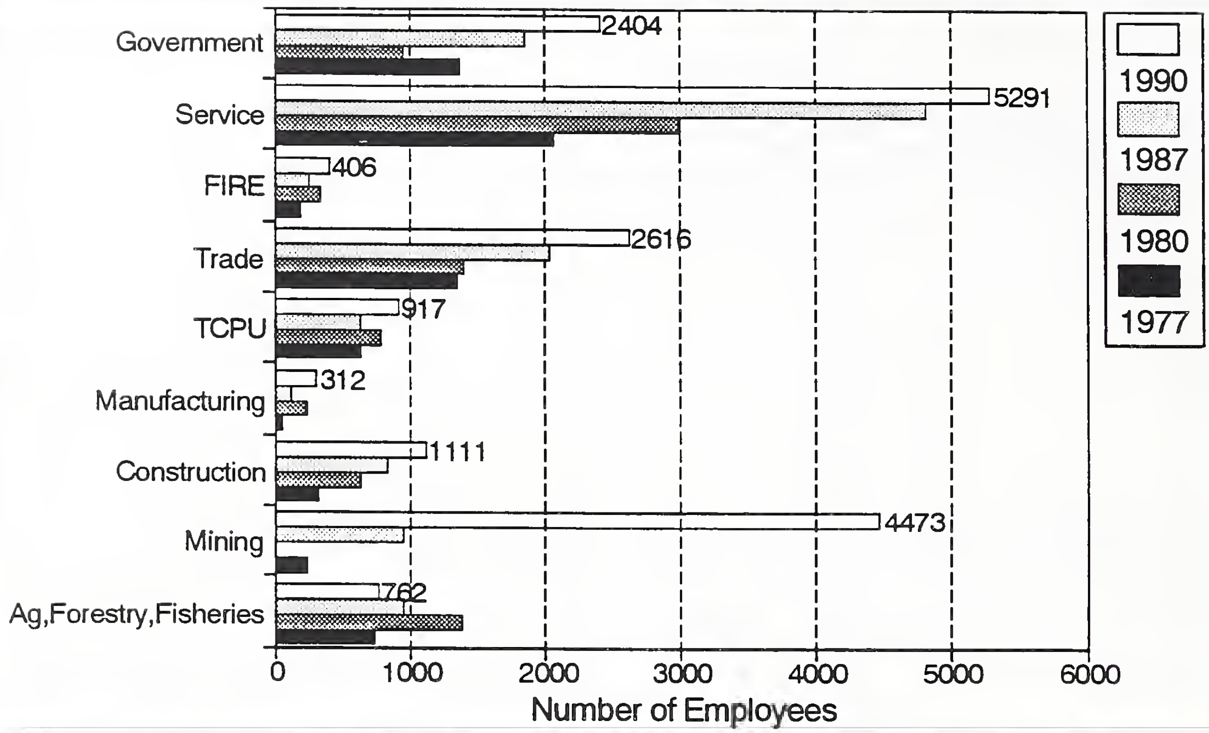
	1987[3]	1980[2]	1987[3]	1990[4]	Total % Change 1977-1990
Industry					
Agriculture, forestry, fisheries	730	1,386	950	762	4%
Mining[6]	240		950	4,473 1,290[5]	1,746% 437%[7]
Construction	320	635	830	1,111	247%
Manufacturing	50	233	130	312	524%
TCPU[8]	640	782	640	917	43%
Trade	1,350	1,396	2,020	2,616	94%
FIRE[9]	190	339	250	406	114%
Service	2,050	3,006	4,810	5,291	158%
Government	1,364	959	1,840	2,404	76%

Sources: [1] Socioeconomic Component, Technical Report, Jerritt Canyon EIS, 1979.
[2] US Bureau of the Census, Census of Population & Housing, 1980.
[3] Socioeconomic Technical Report, Betze Project EIS, ENSR, 1991.
[4] US Bureau of the Census, Census of Population & Housing, 1990.
[5] Anastassatos, Geo., Dept. of Employment Security. This figure includes only those employed by mining operations located in Elko County.

Notes: [6] Mining employees included in agriculture, forestry, fisheries mining category in 1980 Census.
[7] Calculated using 1977 figure and Dept. of Employment Security figure for Elko County.
[8] Transportation, Communication, Public Utilities
[9] Finance, Insurance, Real Estate

Table 3.15 indicates a 1990 census figure of 4,473 for mining industry employment in Elko County, which includes workers employed by mining operations located in Eureka County, but who reside in Elko County. In 1991, nine percent of the labor force in Elko County were employed by the mining industry. In Eureka County, 87 percent were

Figure 3.2
Employment By Industry
Elko County, 1977-1990



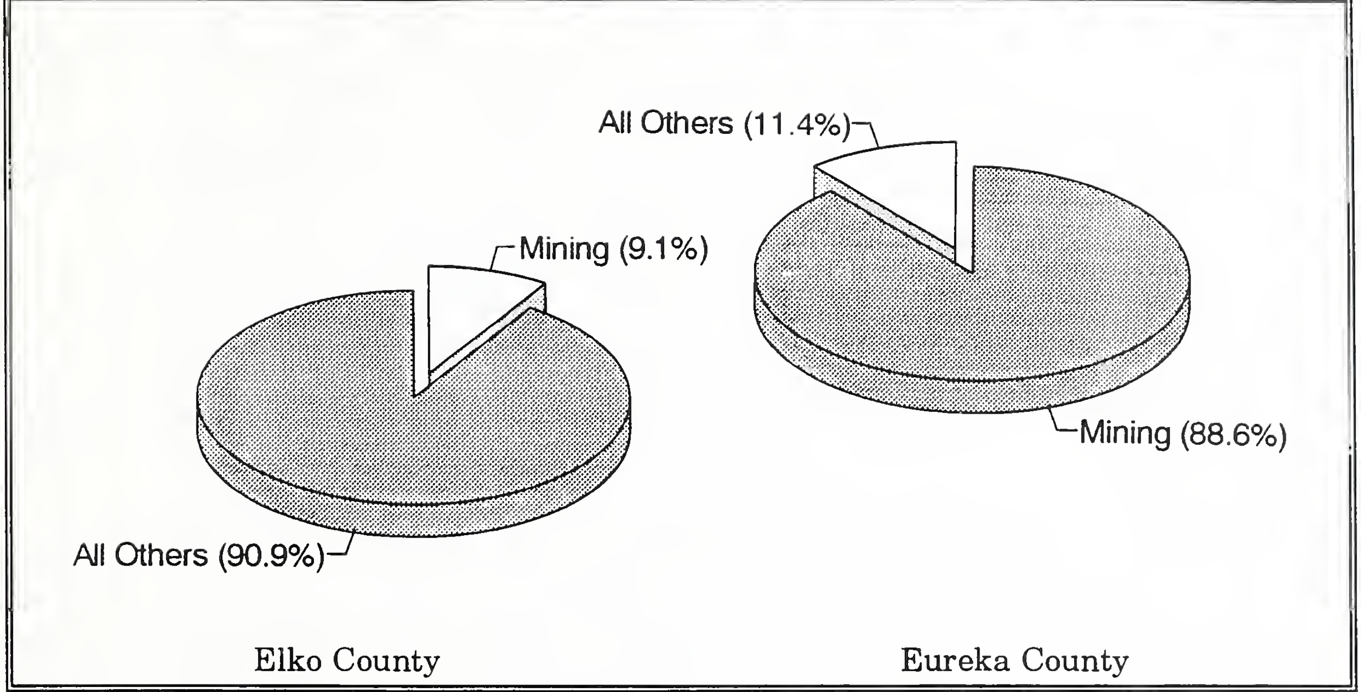
Source: [1] Socioeconomic Component, Technical Report, Jerritt Canyon EIS, 1979.
[2] US Bureau of the Census, Census of Population & Housing, 1980.
[3] Socioeconomic Technical Report, Betze Project EIS, ENSR, 1991.
[4] US Bureau of the Census, Census of Population & Housing, 1990.
[5] Anastassatos, Geo., Department of Employment Security. This figure includes only those employed by mining operations located in Elko County.

Note: FIRE - Finanace, Insurance, Real Estate.
TCPU - Transportaion, Communication, Public Utilities.

employed by the mining industry in 1991 (Anastassatos, pers. comm., March 1993). Figure 3.3 displays percentages of mining employment in Elko and Eureka Counties.

IMC has provided sizeable employment and economic benefits for Elko County over the past ten years, averaging over 600 jobs a year from 1991 to 1993. The annual payroll is $23.2 million based on an average 1993 wage of $38,700. The University of Nevada-Reno conducted a study which revealed that every job and payroll dollar generated by the mining industry creates 1.0 to 1.25 additional jobs in supporting businesses (USFS 1992b). When applied to the 600 jobs, this "multiplier" yields approximately 750 additional jobs and $16 million per year in wages within the support sector. In addition, IMC has contributed to the local economy through purchases of goods and services estimated at $78 million in 1991 and a total of $677 million since 1982 (USDA, USFS 1992b).

Figure 3.3
Mining Industry Jobs
Elko County and Eureka County, 1991



Source: Nevada Department of Employment Security

A recent wage survey conducted by the state labor department found that miners in Nevada earned an average of $38,752 in 1991, compared to an average salary of $14,850 for those employed in the retail trades industry (Elko Daily Free Press, Feb.2, 1993). The 1989 median family income for Elko County was $38,900 (U.S. Bureau of the Census 1990), 20 percent higher than the national family median income of $32,448 for that year (U.S. Department of Labor 1992).

Unemployment in Elko County, consistently lower than in the state and the nation, declined steadily from 5.3 to 4.8 to 4.6 percent respectively for the years 1988, 1989 and 1990 (ENSR 1991), and to 4.4 percent in 1991 (Clark, pers. comm.).

Housing

Along with the substantial increase in population over the last decade, there has been a corresponding increase in new housing construction. Table 3.16 displays housing stock distribution, average costs, and availability in Elko and in the county. Total housing stock increased 53 percent from 1980 to 1990. NENDA estimated the number of total housing units in the county at 13,867, with 5,817 located in the City of Elko and 890 units in Carlin (NENDA 1992b).

Table 3.16
Housing Availability in Elko County 1980 to 1990

	1980		1990	
	City of Elko	**Elko County**	**City of Elko**	**Elko County**
Housing Units[1]				
Single Family	2,130	3,906	2,943	6,128
Multi Family	759	1,470	1,303	2,247
Mobile Homes, Other	754	1,823	1,571	5,086
TOTAL	3,643	7,199	5,817	13,461
% of County	51%		43%	
Housing Costs[2]				
Average Price	$ 54,900[1]	$ 49,900[1]	$ 90,000	$ 60,000
Average Rent/month	$ 177[1]	$ 157[1]	$ 500	$ 450
Housing Availability				
Rental Vacancy Rate[1]	10%	11%	8.4%	11.1%
Houses for Sale[1]	19	65	64[2]	45[2]

Sources: [1] US Bureau of the Census, Census of Population & Housing, 1980 and 1990. (Elko County Board of Realtors had the following MLS active listings as of Nov. 25, 1992: 32 homes for sale in Elko; 44 homes for sale elsewhere in the county.)
[2] Business Portrait of Northeast Nevada, NENDA 1992.

Most of the new subdivision and housing development activity has occurred in the City of Elko (Boucher, pers. comm.). Housing starts slowed in 1992 and there are existing subdivisions within the city that have additional lots to be developed (Lipparelli, pers. comm.).

The Spring Creek area south of Elko is platted for a total of 5,409 lots with 3,940 designated for single-family units and 1,469 designated as mobile home lots (ENSR 1991). Eighty-one percent of the mobile home lots and 19.9 percent of the single-family lots were occupied as of June 1990 (ENSR 1991).

Table 3.16 indicates average housing unit prices of $90,000 for the City of Elko and $60,000 for the county as a whole during 1990. The housing stock in Carlin consists of 363 single-family dwellings, 69 multi-family units, and 458 mobile homes (NENDA 1992b). Average price for a single-family home in Carlin is $60,000 and average apartment rent is $450.00 (NENDA 1992a).

Available temporary housing includes 1,739 hotel/motel units (NENDA 1992b) and over 1000 RV spaces in five RV parks in the City of Elko. Carlin has 17 motel units and 83 RV spaces (ENSR 1991).

Financial Resources

Revenues and expenditures for Elko County and the City of Elko for fiscal years 1985-86 through 1990-91 are included in Table 3.17. The greatest increase in revenues from 1985 to 1991 came from property taxes, which increased 299 percent for the county and 233 percent for the city during this period. The significant growth in property tax revenues is due to increases in net proceeds taxes from mining and increased taxable valuation associated with additional mining and development-related activity throughout the county (ENSR 1991).

Property taxes provided 21 percent of 1990-91 county revenues, with IMC, the largest taxpayer in the county, accounting for approximately 20 percent, or $1,100,000, of all property taxes collected in 1990 (USDI, BLM 1991b). In 1991-1992, IMC was again the top property taxpayer, accounting for 14.43 percent of property taxes paid to the county (Johnson, pers. comm.). Figure 3.4 illustrates the 1991 distribution of property tax burden in Elko County.

IMC paid $1,460,000 in net proceeds taxes in 1991 (IMC 1992g). Table 3.18 displays the amounts paid by IMC for sales and use taxes, property taxes, and net proceeds taxes from 1987 to 1991, with a total of $5,096,000 paid for these taxes in 1991. In addition to state and local taxes, $8,314,880 was paid in 1991 by IMC and its employees for federal income tax withholding, FICA and FICA medical withholding, and matching FICA and FICA medical contributions (Cumming, pers. comm., 1992).

Elko was particularly affected by the growth of the mining industry in Elko and Eureka Counties during this period and experienced the majority of the population-related impacts (ENSR 1991). The city has had to rely heavily on mining companies' contributions to meet infrastructure needs (ENSR 1991). Area mining companies have reacted positively to the needs of the community, providing both funds and resources to Elko and the county (USDI, BLM 1991b). IMC made 657 donations totalling $669,170 to various entities from 1979 to 1991 (IMC 1992g).

Public Facilities and Services

A summary of public facilities and services infrastructure for Elko County and the cities of Elko and Carlin is displayed in Table 3.19. Increased demand on public facilities

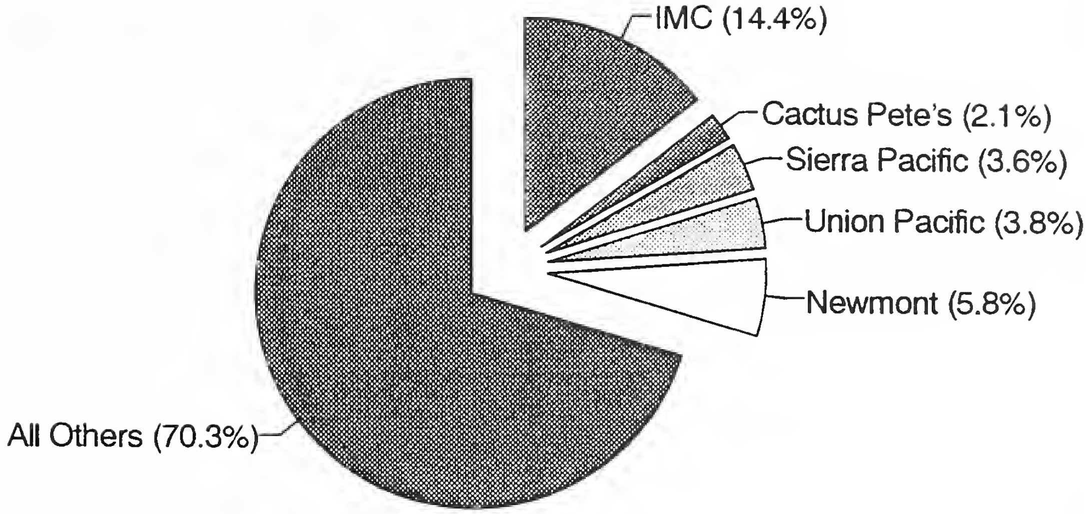
Table 3.17
Revenues and Expenditures
City of Elko and Elko County, 1985-1991[1]
($000's)

	1985-1986 Actuals		1986-1987 Actuals		1987-1988 Actuals		1988-1989 Actuals		1989-1990 Actuals		1990-1991 Actuals		1985-1991 % Change	
	City	County	City	County	City	County	City	County	City	County	City	County	City	County
Revenues														
Property Taxes	259	936	276	1,472	369	2,616	417	2,376	764	3,261	839	3,740	+223%	+299%
Other Taxes	376	529	461	404	584	13	711	1,618	817	1,990	525	2,049	+40%	+287%
All Other Sources[2] (Including Inter-governmental Resources)	4,140	6,075	4,221	6,747	5,444	7,688	6,849	10,376	7,692	11,264	7,782	11,886	+88%	+96%
TOTAL	**4,775**	**7,540**	**4,958**	**8,623**	**6,397**	**10,317**	**7,977**	**14,370**	**9,273**	**16,515**	**9,146**	**17,356**	**+92%**	**+134%**
Expenditures														
TOTAL	**4,686**	**8,357**	**5,108**	**12,918**	**6,269**	**19,051**	**6,547**	**11,933**	**9,679**	**18,813**	**12,564**	**17,356**	**+168%**	**+108%**
Excess or (Deficiency)[3]	89	(817)	(150)	(4,295)	(128)	1,266	1,430	2,411	(406)	(2,298)	(3,417)	319		

Source: [1] Nevada Department of Taxation, Combined Statements of Revenues, Expenditures and Changes in Fund Balances - Budget & Actual.
[2] Including Intergovernmental resources.
[3] Excess or (Deficiency) of Revenues over Expenditures, not including other financing sources (uses).

Note: Figures are rounded to the nearest thousand.

Figure 3.4
Percentage of Property Tax Burden Elko County, Nevada, 1991-1992



Source: Elko County Assessor's Office

Table 3.18
Taxes Paid By Independence Mining Company 1987-1991, $000's

TAX	1987	1988	1989	1990	1991
Sales & Use Tax	1,918	2,982	3,720	1,905	2,536
Property Tax	566	467	1,100	1,100	1,100
Net Proceeds Tax	1,467	1,188	920	1,440	1,460
TOTAL	**3,951**	**4,637**	**5,740**	**4,445**	**5,096**

Source: Independence Mining Company, Information Handbook, 1992.

and services has resulted in infrastructure expansion and capital improvements such as a new Law Enforcement Center, built in Elko in 1988, which houses the county jail with a

Table 3.19
Summary
Public Facilities and Services Infrastructure
Elko County, Cities Of Elko and Carlin

Facility or Service	Elko County	City of Elko	Carlin
Law Enforcement	Sheriff's Department - 42 deputies, 14 jail staff, 3 criminal investigators, 8 administrative staff (1992). Elko Law Enforcement Center built 1988; houses county jail with prisoner capacity of 115. Average: 68 inmates per day, Sept. 1992.	City Police Department - serves incorporated area. 32 sworn officers, 4 clerical, 2 animal control, 10 communications (supported by interlocal agreement with county).	Carlin Police Department - 6 sworn officers, 1 animal control, 1 part time secretary.
Fire	Northeastern Nevada Fire Protection - serves unincorporated Elko and Eureka counties with 7 paid staff and 27 volunteers. Nevada Division of Forestry also provides service to the county with 8 paid firefighters.	Elko Fire Department - automatically responds to all calls within 3 mile radius. Mutual aid agreements with Nevada Division of Forestry, Carlin, Wells, and the county. Fire Insurance Rating of IS-05. Staff: 15 paid firefighters (all EMTs), 3 clerical, 21 volunteers (some EMTs). Two facilities, 3 1000+ gallon pumper/fighter trucks, 4 smaller pumpers.	Volunteer fire department has 25 firefighters including EMTs.
Medical and Emergency	Elko General Hospital (operated by county), 50 beds, 215 staff, 24 hour emergency room, obstetrics, surgery, general. Annual average occupancy is 47 to 57% (1991). State Emergency Medical Services provides ambulance service out of Elko office. Two ambulances, volunteer EMTs and RNs (assisted by Sheriff and Fire Departments when necessary).	Elko General Hospital, alcohol and drug abuse treatment center, mental health facility, public health nurse, state rehabilitation services.	Elko General Hospital.
Water Supply	Sources include springs and wells. County provides management assistance to water districts and unincorporated towns. Spring Creek has its own community water and hydrant system.	Municipal wells; 15 million gallon storage reservoir. Peak demands range from 12 million gpd in summer to 3 million gpd in winter. Water system managed as an enterprise fund, supported by user fees.	Water system has capacity for population of 5,000.
Sewage Treatment	Private septic systems, lagoons, disposal ponds.	Sewer service provided within city limits. Front end capacity expanded to handle a population of 25,000 (1992). Biological side of plant slated for expansion to this capacity in 1993. Sewer system managed as an enterprise fund, supported by user fees.	Sewer system has capacity for population of 5,000.
Solid Waste	A new regional city/county landfill is under review	A new regional city/county landfill is under review.	City operated landfill opened in 1989.

Table 3.19, Continued
Summary Public Facilities and Services Infrastructure
Elko County, Cities Of Elko and Carlin

Facility or Service	Elko County	City of Elko	Carlin
Schools	Elko County School District includes 19 schools with a total Sept. 1992 enrollment of 8,713. Elko High, Elko Jr. High, and 3 Elko Elementary schools are over-capacity. A new high school is under construction in Spring Creek. A pay-as-you-go school building program is in effect with modular units used where needed until new facilities are completed.	Elko Grammar No. 2, Southside Elementary, Mountain View Elementary, Elko Jr. High, Elko Sr. High are all over-capacity (Sept. 1992). A new junior and senior high schools are scheduled for construction.	Carlin Combined School (K-12) at 95% capacity, Sept. 1992.
Recreation	Various services and facilities operated by municipal recreation departments and private groups. County operates County Fairgrounds.	Four city parks include: 6 tennis courts, 2 ballfields, 2 softball fields, 2 soccer fields, 2 outdoor basketball courts, 1 handball court, children's play areas, skating rink berms, indoor/outdoor heated swimming pool, softball complex. The municipal golf course is supported by user fees. The convention center is supported by percentage of room-tax receipts.	One city park/playground, 1 archery range, 2 baseball fields, 1 tennis court, 1 volleyball court.
Library	Elko County Library serves Elko, Eureka, White Pine and Lander Counties. Main library is in Elko, with 7 branch libraries staffed part-time. Two bookmobiles provide service to outlying areas.	City served by Elko County Library, main branch is in Elko.	Served by Elko County Bookmobile.
Power and Communications	Sierra Pacific Power Company is the major electricity supplier. California Pacific National is the major telephone supplier. Cellular telephone service is supplied by Alltel Mobile Communications, Inc.	Same as Elko County for electric and telephone service. Southwest Gas Company provides natural gas.	Same as Elko County for electric and telephone service. Same as the City of Elko for natural gas.
Transportation	Interstate 80, the main east-west route, passes through Carlin, Elko, Wells, Wendover. US Hwy 93 runs north-south, linking Wells and Twin Falls, ID. State Hwy 225, the main local north-south route connecting Elko, Mountain City, Owyhee, is in generally good condition, with 26 to 28 foot widths; eligible for federal funding. Elko County maintains 1,200 miles of mostly gravel roads; supported by gas tax proceeds.	The city has implemented an extensive series of street improvement projects with $2.5 million in general obligation bonds (1992). The city is seeking federal funds to install 6 traffic signals on Idaho street. Elko Municipal Airport handles 11 public flights daily. Plans to extend runway and upgrade load-bearing capacity are under review.	Streets are maintained by the city.

Source: Elko County, City of Elko, City of Carlin, Elko County School District.

prisoner capacity of 115. Average daily inmate population was 68 in September 1992, down from 88 in 1988-1989 (Watson, pers. comm.).

Public water and sewer systems in Elko and Carlin are adequate for current populations and have capacity for additional growth. The city of Elko has implemented an extensive series of street improvement projects with $2.5 million in general obligation bonds (Lipparelli, pers. comm.). The city is seeking federal funds to alleviate traffic congestion on Idaho Street. Other public facilities and services such as fire protection, medical, emergency response, recreation and library are adequate to meet demands.

The Elko County School District includes 19 schools with a total September 1992 enrollment of 8,713 (Elko County School District). September 1992 enrollment exceeded capacity at Elko High, Elko Junior High and at three of the five elementary schools in Elko. September 1992 enrollment at Carlin Combined School was 500, up slightly from 491 in June 1992 (Elko County School District). Table 3.20 displays September 1992 district enrollment statistics and building capacity percentages.

Mountain View Elementary School was built in Elko during 1991 and construction of two additional elementary schools will commence in 1993 (Elliott, pers. comm.). Mobile units are being used at several locations to provide additional classroom space with Sage Elementary consisting entirely of mobile units (Elliott, pers. comm.). A new high school opened in Spring Creek in September 1993, which is also housing Spring Creek Junior High students (grades 7 and 8) (Knutson, pers. comm.). A second senior high and junior high are to be built in the near future in the City of Elko (Elliott, pers. comm.). All new school construction takes place on a pay-as-you-go financing plan with the necessary funds collected from ad valorem taxes prior to building (Elliott, pers. comm.).

Average 1990 ACT scores for Elko County public schools were 20.8, just slightly less than the state average of 21.0 (NENDA 1992a). The national average ACT score in 1989 was 18.7 (NENDA 1992a). In 1990, Elko County students had higher average scores on both the math and verbal sections of the SAT than other public school students statewide in 1990, and nationwide in 1989 (NENDA 1992a).

The main campus of Northern Nevada Community College, located in Elko, offers post-secondary courses leading to associate degrees in the arts, sciences, and applied sciences. Average annual enrollment is around 2500 and the staff includes 34 full-time and 250 part-time instructors (NENDA 1992a).

Transportation and Energy

Interstate 80 traverses Elko County east-west, passing through Carlin, Elko, Wells and Wendover. US Highway 93 runs north-south, linking Wells and Twin Falls, Idaho.

The Jerritt Canyon mining operations are located several miles west of State Highway 225, a main north-south highway serving the area. This highway, a secondary road eligible for federal funding, is in generally good condition with road widths varying from 26 to 28 feet. Access to the mill and tailings pond area is by a private road that intersects Highway 225 approximately two miles north of Haystack Ranch. Transport of hazardous materials and oversize loads over state highways is subject to Nevada Department of Highways regulations.

Table 3.20
Selected Enrollment Statistics
Elko County School District
Fall 1992

School	Grades	# of Students[1]	Capacity[2]	% Capacity[3]
Elko Grammar No. 2	K-6	529	510	104%
Southside El.	K-6	690	650	106%
Northside El.	K-6	512	550	93%
Mountain View El.	K-6	948	660	144%
Spring Creek El.	K-6	591	650	91%
Sage Elementary[4]	K-5	455	470	97%
Elko Jr. High	7, 8	952	600	159%
Elko Sr. High	9-12	1,606	1,200	134%
Carlin Combined	K-12	500	525	95%

Sources: [1] Elko County School District, enrollment figures at end of September, 1992.
[2] Building capacity figures from ENSR Socioeconomic Technical Background Report, 1991:2-17.
[3] Calculated by dividing September 1992 enrollments by building capacities.

Notes: [4] Sage Elementary consists entirely of mobile units (Elliott, pers. comm.)

Use of petroleum fuel products by IMC is conserved by busing employees from Elko to the mine site. The mine operations currently use the following petroleum products in daily operations: 400 gals./day gasoline; 15,000 gals./day diesel; 600 gals/day oil.

Other Communities in Elko County

Tuscarora is the only community in the Independence Valley. The Project area borders the east side of the valley, which lies about 50 miles north of Elko. Public facilities are minimal in this area, with the exception of one public school (K-8) on Nevada Highway 226. High school students from Tuscarora and the Independence Valley attend school in Elko (Elliott, pers. comm.). The population of Tuscarora has remained relatively stable over the past decade (Boucher, pers. comm.).

Mountain City is an unincorporated community of approximately 75 people located about 80 miles north of Elko on Nevada Highway 225. A mobile home park for 40 units is undeveloped (USDI, BLM 1989). Public facilities are minimal and students attend school in Owyhee on the Duck Valley Indian Reservation. Some high school students board with families in Elko to attend Elko High School (Elliott, pers. comm.).

The Duck Valley Indian Reservation is located on the Nevada/Idaho border. The town of Owyhee, Nevada, is the central community on the reservation. The reservation is under the jurisdiction of the Shoshone-Paiute Tribal Council which provides facilities and services, with technical assistance provided by the Bureau of Indian Affairs (McDade, pers. comm.).

Other major communities in Elko County which are not addressed in detail in this document include: Jackpot, Wells and West Wendover. It appears that these communities have not been affected directly by mining activities because of their distance from mining sites (in excess of 50 miles). As previously discussed, Elko and Carlin have experienced the most mining related growth over the last decade.

3.6 Visual Resources

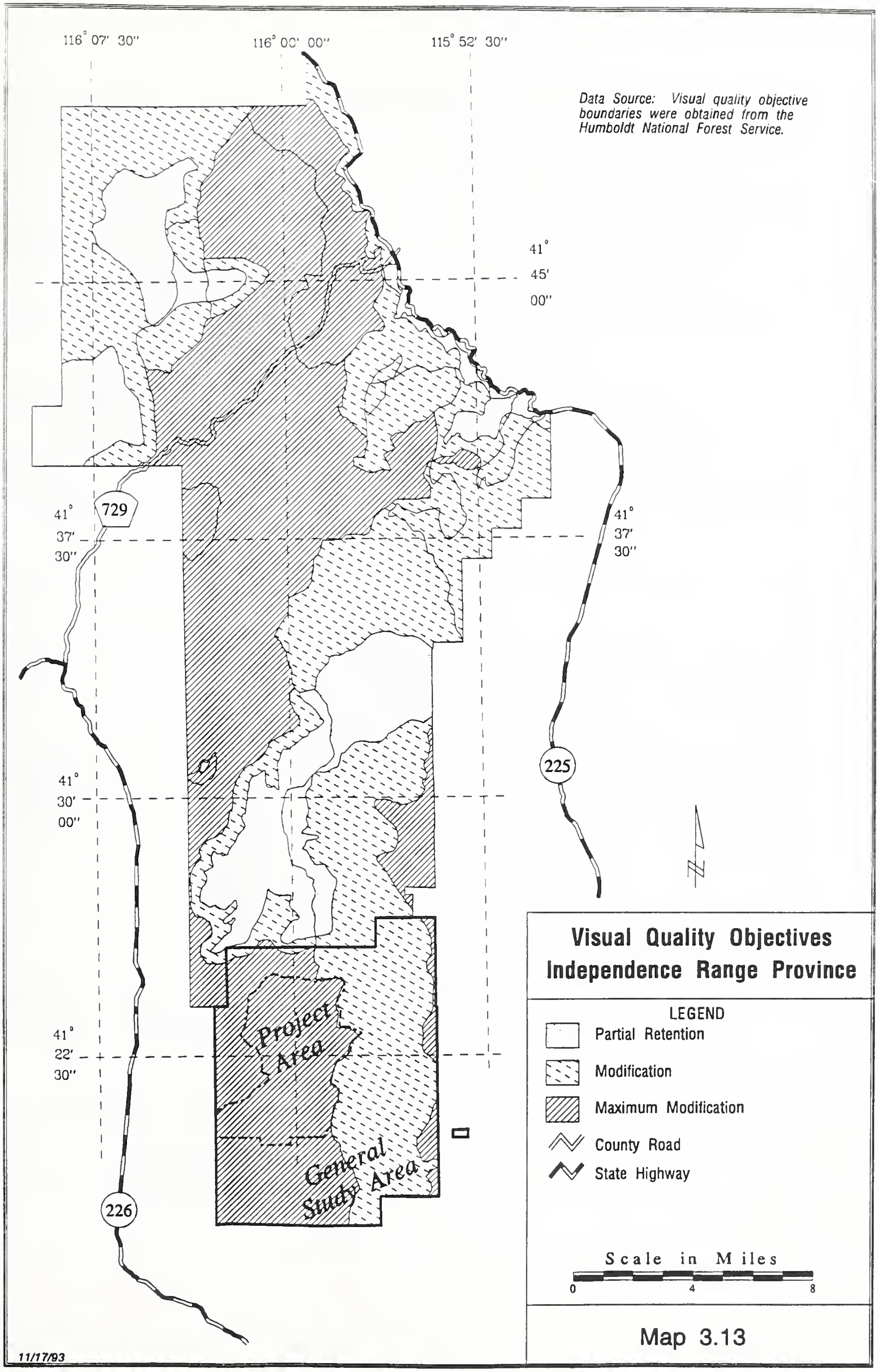
Visual resources were identified through public and agency scoping as an issue to be analyzed in this DEIS. The analysis area for visual quality is the Independence Range (See Map 3.13), which is the CEA province for cumulative effects analysis.

The southern portion of the Independence Range within the Mountain City Ranger District is relatively isolated. It is accessible via unimproved forest roads from Highway 225 to the east and Highway 226 to the west. Public use of the region is low with users falling into the following categories:

- IMC mine employees and individual miners and prospectors
- ranchers
- hunters
- fishermen
- wood cutters
- campers and picnickers

Undisturbed areas within the Project area include mountainous terrain from moderate rocky slopes to cliffs. Foothills and valleys on the west side of the Independence Range slope down to the nearly flat Independence Valley. The majority of the Project area consists of sagebrush and grasslands with small areas of aspen and willows. Overall, the Project area is not as visually diverse as the area to the north, which includes Jack's Peak with an elevation over 10,000 feet. The Jack's Peak area is displayed as a partial retention area on Map 3.13.

The visual resources of the Independence Mountain Range have been assessed by the USFS and Visual Quality Objectives (VQOs) have been established (Carlson, pers. comm.; USFS VQO map, March 1993). VQOs are designed to provide objectives for visual


116° 07' 30"
116° 00' 00"
115° 52' 30"
Data Source: Visual quality objective boundaries were obtained from the Humboldt National Forest Service.
41° 45' 00"
41° 37' 30"
41° 30' 00"
41° 22' 30"
729
225
226
Project Area
General Study Area
Visual Quality Objectives
Independence Range Province
LEGEND
Partial Retention
Modification
Maximum Modification
County Road
State Highway
Scale in Miles
0
4
8
Map 3.13
11/17/93

management of the land. The USFS visual management objectives for the Independence Range province and the Project area are displayed on Map 3.13 and in Table 3.21. These objectives can be defined as: Preservation, which allows ecological changes only; Retention, which provides for management activities which are not visually evident; Partial Retention, which provides for management activities subordinate of the characteristic landscape; Modification, which provides for management activities that visually dominate the original characteristic landscape; and Maximum Modification, which allows activities that alter the vegetation and landform and dominate the original characteristic landscape with some limitations. The TOC for visual quality is any change in retention and partial retention VQO classes. The Project area has been classified as an area with a maximum modification VQO (Map 3.13).

Table 3.21
Visual Quality Objectives in Independence Range and Project Area

	Independence Range (Acres)	Project Area (Acres)
Preservaton	0	0
Retention	0	0
Partial Retention	36,025	0
Modification	93,314	0
Maximum Modification	103,591	10,849
Total	**232,930**	**10,849**

Source: USFS 1993.

VQOs are based on several factors, including the public's concern for scenic quality (sensitivity levels), where the area is viewed from, and the diversity of natural features. The sensitivity level evaluation is based on the number of viewers an area has, their reason for being in a position to view the area, and the duration of their viewing.

The USFS had determined that the middleground and foreground views from Highway 225 on the east side of the Independence Range have a primary sensitivity rating. The Project area cannot be seen from Highway 225 because it is on the west side of the mountain ranges. Portions of the main haul road, the mill and tailings ponds can be seen from the highway.

Highway 226, on the west side of the mountain range, has less traffic and primarily serves ranchers and recreationists en route to the National Forest and BLM's Wilson Reservoir Special Recreation Management area. Highway 226 was rated as having secondary sensitivity (ERT 1979e). Portions of the Project area can be seen from Highway 226 and from other points in the Independence Valley, including residences and the town of Tuscarora. The north-south alignment of Highway 226 provides oblique views of the mountains.

Portions of the existing mining operations in Jerritt Canyon can be seen from the Independence Valley and from Highway 226. County road 734 from Tuscarora to Highway 226 provides a prolonged, but long distance view of portions of existing operations. The top ridge of the mountains in the Project area is approximately five miles from Highway 226 at the nearest point. Existing operations are apparent to the casual observer travelling south or north on Highway 226. Portions of existing operations are more easily distinguished as one travels north to south on Highway 226. These areas are seen as fill slopes, horizontal lines in the mountainous topography and color variations. Disturbed areas appear more distinct in the afternoon, when the sunlight is more direct on the western-facing slopes of the Project area.

3.7 Cultural Resources

Cultural resources, such as historical or archeological sites or areas with religious or cultural significance to Native Americans, were identified through public and agency scoping as concerns. The analysis area for cultural resources is the general study area with emphasis on the Project area. The province for analysis of cumulative impacts is the Independence Range but the archeological and cultural information for the Independence Range is primarily limited to the studies conducted for the general study area.

The general study area has been the subject of 57 archeological investigations since 1979 (Peterson et al. 1993). A total of 68 sites are recorded in the general study area, of which 11 sites are considered significant as defined by the National Historic Preservation Act (NHPA) and 16 are classified as unevaluated. Unevaluated sites are treated as significant until they are evaluated and determined to be insignificant. A total of 13 sites are recorded in the Project area. Three sites are considered significant and one site is unevaluated. Information gathered from the archeological field investigations indicates that the Project area and general study area have been occupied for at least 6,000 years (Peterson et al. 1993).

The general study area is within the extended seasonal range of the Tosawihi ("White Knife") subgroup of the Western Shoshone. It is also within the known or probable extended range of at least three other Shoshone subgroups. The proto-historic Western Shoshone were hunters and food collectors. In the second half of the nineteenth century, the United States government negotiated two treaties with the Tosawihi and other Western Shoshone people which resulted in relocation to various locations including the Duck Valley Indian Reservation north of the Independence Mountain Range. Today there are families and individuals on reservations and colonies, who trace their descent from the Tosawihi.

The persistence of traditional religious beliefs and practices among the Tosawihi descendants is evidenced by the importance they place on areas they hold to be particularly sacred. These areas include springs, mountain peaks or other prominent landforms and places where medicinal plants and minerals can be found (Peterson et al. 1993). USFS and religious leaders of descendants of the Tosawihi toured the Project area in the summer of 1993. Additional discussion and follow-up are being pursued, but initial information resulting from the tour indicates there are no religious or culturally significant Native American sites in the Project area.

Livestock production and mining are two additional major forces in the cultural history of the general study area since the 1850s. The general study area has been the site of both cattle and sheep grazing. Until the 1980s, precious metals mining in the general study area was limited in comparison to the gold and silver mining operations in Tuscarora. Gold placer deposits were discovered in what became Tuscarora in 1867. Just as placer deposits began to decline, significant lode silver deposits were discovered and the Tuscarora camp continued to prosper into the 1880s. Mining and related operations continued sporadically in Tuscarora from the late 1880s to the present (Peterson et al. 1993). Additional specific information on mining and grazing in the general study area and Project area is included in the section of this Chapter titled "Land Use".

Chapter 4

Environmental Consequences

Photo Description: Partial pit backfill and 3:1 slopes at Pattani (Summer 1993).

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This section analyzes and describes the potential consequences to the environment that could result from implementing the proposed Project and each of the alternatives that are described in Chapter 2. A comparison of impacts for all alternatives is also presented in Chapter 2.

The scope of impact analysis includes evaluation of potential impacts resulting from the proposed expansion. The existing disturbances addressed under the No Action Alternative provide a baseline against which the action alternatives can be compared. Anticipated environmental effects from implementing the various alternatives are quantified where possible. Where special conditions make quantification impracticable, efforts have been made to accurately describe differences in terms of significance, magnitude, or duration of environmental effects. Where appropriate, the descriptions distinguish which effects are direct, indirect, cumulative, long-term, short-term, irretrievable, and irreversible. Direct effects are those that occur at the same time and place as the proposed activity. Indirect effects occur later in time or are farther removed in distance. Cumulative impacts analysis includes the collective impacts of past, existing, proposed and reasonably foreseeable actions. Short-term effects are defined as those that would generally not last longer than the life of the Project, estimated at approximately ten years. Long-term effects are defined as those that persist beyond the life of the Project and, according to the CEA model, includes pits, angle of repose waste rock dump slopes, and haul roads. Irretrievable commitments of resources are those that are lost for a period of time. Irreversible commitments of resources are those that cannot be reversed except perhaps in the extreme long term. The mine pits and precious metal extraction would constitute irreversible commitments.

The discussion of effects is primarily directed to those issues and concerns raised throughout the course of the NEPA process and presented in Chapter 1. These include potential adverse environmental effects, technical and engineering considerations, and positive impacts. The process of prioritizing issues from public and agency comments is in accordance with the goals of NEPA and USFS Final Implementation Procedures require that an EIS be comprehensive, concise, issue-oriented, and understandable to the general public.

4.2 Physical Environment

Location and Topography

The Project area is the area of analysis for changes to topography. Changes in topography would occur under all action alternatives and would affect many of the resources addressed in this DEIS. The type of topographical change affects the total area of disturbance. For example, angle or repose slopes would impact a smaller area than the area that would be impacted by 3H:1V slopes.

Alternative A - No Action

Under the No Action Alternative, changes to topography would be the same as those for existing and approved operations. Permanent changes would be limited primarily to pits and waste rock dumps. Approximately 139 acres of the existing 720 acres of pits have partially backfilled. Under existing and approved operations, waste rock dumps comprise a total of 708 acres.

Effects Common to All Action Alternatives

The action alternatives for mine expansion would alter the existing topography in the Project area. The pits and dumps constitute the majority of permanent topographical change. Other permanent changes would include any remaining low grade ore stockpiles, road portions that are not fully recontoured or that are retained for public access, and any facilities that may remain on privately owned land after mining operations cease.

Pit shape is the same for all action alternatives with the exception of Alternative F, which does not include surface mining of New Deep. Pits comprise a total reasonably foreseeable development of 1332 acres for Alternatives B, C, D, E and G. Three pit operations are proposed: the New Deep, Saval and Steer, and Burns Basin expansion. If reasonably foreseeable development is realized, the pit shape would be that displayed on Map 2.2 in Chapter 2. It is probable that actual pit development and final size would be smaller than that displayed on Map 2.2. Under the reasonably foreseeable development, the New Deep pit would be 527 acres; the Saval and Steer pits would be 711 acres; and the Burns Basin expansion would comprise approximately 94 acres. Pit depth is anticipated to be 1,180 feet in New Deep, 820 feet for the Saval and Steer pits and 340 feet for Burns Basin. Partial pit backfill would be used wherever feasible under any alternative including in existing pits outside of the Project area.

Under all action alternatives, the waste rock dumps would result in changes to the steep, dissected topography. Existing slopes greater than 40 percent comprise more than half of the proposed disturbance area for waste rock dumps under any alternative. Once the waste rock dumps are complete, less than a quarter of the area would have slopes greater than 40% under any alternative. The majority of the waste rock dump area would consist of the relatively flat surface at the top of the waste rock dumps, however the proportion of flat surface to sloped surface varies among alternatives. Existing and post-mining slope areas for proposed waste rock dumps are displayed for each action alternative in Table 4.1. The height of the completed waste rock dumps would be virtually the same for all alternatives.

Table 4.1
Existing and Proposed Post-Mining Topography in Waste Rock Dump Area by Alternative (in Acres)

Percent Slopes	Alternative					
	B	C	E	E	F	G
0-10%						
Pre-Mining	34	33	24	22	16	35
Post-Mining	1,032	1,065	889	916	552	1,045
10-20%						
Pre-Mining	123	135	122	104	82	127
Post-Mining	0	0	0	0	0	0
20-40%						
Pre-Mining	410	428	466	421	262	415
Post-Mining	B	73	503	278	F	0
40-60%						
Pre-Mining	521	550	561	517	253	525
Post-Mining	0	26	0	26	0	0
60%						
Pre-Mining	220	242	241	234	117	221
Post-Mining	276	224	22	78	178	278

Source: USFS GIS data June 1993

Note:
relatively flat = 0-10%
3:1 slopes = 33%
2:1 slopes = 50%
angle of repose slopes = 77%

The waste rock dumps would cover some existing drainages. Specific impacts to water flow as a result of topographical changes are examined in the Surface Water section of Chapter 4.

Alternative F

Under Alternative F, there would be no surface mining of the New Deep deposit. Changes to topography associated with surface mining and waste rock dumps would be reduced under this alternative compared to all other action alternatives. There is a possibility of some surface subsidence from the underground mining proposed for the New Deep mine area. The area of subsidence is estimated at approximately 150 acres and would be a permanent change to the topography.

Topographic changes resulting from the Saval, Steer, and Burns Basin waste rock dumps would be similar to Alternative C.

Cumulative Impacts

Once reclamation is complete, cumulative changes to the topography would primarily be those associated with pits and dumps from the existing and proposed operations. Other cumulative changes would include portions of haul roads that are not fully recontoured, any remaining low grade ore stockpiles, and possible retention of facilities on private land. Any roads that are left open for public access purposes could also affect the post-mining topography.

Geology

Issues associated with the geology of the Project area include: 1) effects to mineral resources related to excavation and relocation of waste rock and ore; 2) potential for the waste rock dumps, pit walls, and ore stockpiles remaining after mining to release acidic waters or trace elements; and 3) physical stability of the waste rock dumps.

Mineral Resources

Effects to mineral resources include covering areas containing potential mineral resources with waste rock dumps or other project components and incomplete removal of the total resource as a result of only mining the economic portions of an ore body.

<u>Alternative A - No Action</u>

There would be no impacts on mineral resources in the No Action Alternative other than those analyzed in previous NEPA documents.

<u>Effects Common to Alternatives B, C, E and G</u>

Effects to mineral resources from Alternatives B, C, E and G include excavation and relocation of approximately 1,084 million tons of waste rock and 20 million tons of ore. The waste rock would be placed in waste rock dumps or used for partial pit backfill when operationally and economically feasible. Potential indirect effects to vegetation, wildlife, water quality and quantity, and other resources are addressed in the appropriate sections of this DEIS.

Alternative D

The configuration of waste rock dumps in this alternative would make it difficult or impossible to access identified mineral resources west of the New Deep pit in the future. Other direct and indirect effects would be the same as Alternatives B, C, E and G.

Alternative F

Potential impacts on mineral resources due to removal of waste rock for Alternative F would be less than the potential impacts for Alternatives B, C, E and G due to the smaller amount of waste rock that would be excavated and moved in the underground mining of the New Deep deposit. In addition, some of the mineral resources in the New Deep area would remain in the ground after mining as low grade ore that cannot be economically recovered. An area above the underground mine could subside. Potential impacts in the Saval/Steer and Burns Basin mine areas include the same pits and waste rock dumps as those discussed for Alternatives B, C, E and G.

Cumulative Effects

Cumulative effects for mineral resources include the creation of additional open pits, adits, underground workings, and waste piles as ore reserves are removed. Future exploration may identify additional deposits which may be mined by open pit or underground methods.

Geochemistry

The issues associated with geochemistry are the potential for waste rock, pit walls, and ore stockpiles remaining after mining to release acidic water and trace elements. Direct effects to surface and groundwater resources would result if acid were to be generated or if trace elements were released. Indirect effects to aquatic resources and vegetation would also occur if acid was formed or if trace elements were released.

Alternative A - No Action

If the No Action Alternative is selected, current mining and waste rock disposal activities would continue as currently permitted. The Saval, Steer, and New Deep deposits would not be mined and the corresponding waste rock dumps would not be constructed. Similarly, the Burns Basin pit would not be expanded as currently proposed. There would be no impacts to water and soil resources other than those associated with the geochemical properties of the waste rock material being mined under the existing and approved mining activities.

Effects Common to All Action Alternatives

The potential for waste rock in the Project area to generate acid was evaluated using NP/AP ratios. A 1:1 ratio was used to separate potentially acid forming rock (NP/AP less than 1:1) from those that fall into a "zone of uncertainty" (NP/AP greater than 1:1 and less than 3:1). Those with a NP/AP ratio greater than 3:1 are considered non-acid generating (see the geochemistry section in Chapter 3). For the purposes of this analysis, samples with an NP/AP value less than 3 are referred to as potentially acid-generating. AP values used in this analysis were calculated using the more conservative total sulfur values rather than pyritic sulfur values.

Geochemical analyses to date have shown that, based on the static test analysis results, most of the waste rock that would be generated under the action alternatives in the Saval, Steer, and Burns Basin mine areas has a low potential to generate acid. Static acid-base accounting results of intrusive rocks, that can locally have high pyrite contents, indicate that portions of these rocks may potentially generate acid. The intrusives make up less than one percent of the waste rock and would be mixed with the surrounding limestones and siltstones that make up the remainder of the dumps. Because the intrusives generally occur as narrow bands ranging from two to ten feet in thickness that are oriented in a near vertical position in the Burns Basin pit, dilution and mixing with the limestones and siltstone may be promoted. It is possible that sulfide oxidation could occur in isolated portions of the dump, but any acid produced should be neutralized by the surrounding waste rock that has high neutralizing potential.

Geochemical analyses from New Deep waste rock are not as conclusive. Evaluation of the acid-base accounting analyses by two methods of interpretation indicate that the Roberts Mountains and Hanson Creek Formations have a low potential to produce acid. Twenty-five percent of the samples from the Snow Canyon Formation and 31 percent of the samples from intrusive rocks fall into the category of potentially acid producing materials. Kinetic testing of these samples is underway to determine if these rocks will produce acid under simulated field conditions. Results of static and kinetic testing would be used to develop a waste rock evaluation program to guide additional sampling, handling and placement of materials that are determined to be acid-forming. Similar criteria would be used to evaluate any ore stockpiles that would be reclaimed in place. The effectiveness of this program may be improved if the pre-mining waste rock analysis can establish a relationship between sulfur content, lithology or alteration, or some other readily identified characteristic and net acid-generating potential. The actual waste rock testing and monitoring program that would be implemented during active mining would be described in the final POO.

Because the waste rock dumps would be constructed in stream channels and in some instances on top of seeps and springs, the potential exists for surface waters to contact waste rock material. The waste rock dumps would be subjected to meteoric water infiltration and runoff as a result of precipitation. Waste rock dump design would include under-dump drainage systems to permit surface water flow through the dumps. Surface water monitoring would continue at the existing stations that are located downgradient of the proposed waste rock dumps. The surface water monitoring results and a discussion of trends in water chemistry would continue to be submitted to the USFS in the Annual Work Plan in July of each year.

Effects Common to Alternatives B, C, D, E and G

Under alternatives B, C, D, E and G approximately 1,084 million tons of waste rock would be mined and deposited in waste rock disposal areas. The composition and distribution of rock types within the disposal areas is the same for Alternatives B, C, D, E and G. Disposal areas would include waste rock dumps and partial backfilling of existing and proposed open pits. The existing open pits to be backfilled would not impound water.

Alternatives F and G

Under these alternatives, mining and waste rock dump development in the Saval, Steer, and Burns Basin areas would be the same as the action alternatives discussed above, and the effects to geochemistry in these mine areas would be the same. However, underground mining of the New Deep ore body would result in a smaller quantity of material removed from the underground workings and placed in waste rock disposal areas. The composition of the New Deep waste rock dumps would not be the same as that which occurs under Alternatives B, C, D and E. The composition of the waste rock material to be removed from the New Deep underground workings would be approximately 50 percent Roberts Mountains Formation, 35 percent Hanson Creek Formation (all units combined), 15 percent Snow Canyon Formation and approximately one to two percent intrusives. Static test results indicate that some of the waste rock generated by underground mining is potentially acid generating. Samples of these rocks are being analyzed by kinetic testing. The results of static and kinetic testing, would be used to develop a waste rock evaluation program that would guide the handling and placement of the New Deep waste rock.

Cumulative Effects

Sampling of springs downgradient of two existing waste rock dumps does indicate that sulfate concentrations are greater than the drinking water standards. However, no baseline data were collected from these springs, therefore an increase in sulfate cannot be verified. Cumulative impacts to surface water quality associated with the action alternatives may be the same as the effects described for the existing operation.

Geotechnical Considerations

The primary geotechnical issue is waste rock dump stability. As indicated in the geology section in Chapter 3, the geotechnical considerations associated with dump stability include: 1) earthquake motions (seismicity); 2) the existence of unstable ground as evidenced by landslides or other movement features; 3) terrain steepness; 4) the clay content of foundation soils; 5) saturated foundation soils and springs; 6) dump slope steepness; 7) dump material properties; and 8) vegetation.

These geotechnical considerations are used in designing the dumps for seismic stability, mass stability, foundation stability, surface stability, long-term drainage control, and erosion control on waste rock dumps. From a geologic perspective, erosion and mass stability are naturally occurring phenomena; however, the design objective would be to take all practicable and feasible measures to control erosion and mass stability.

Dump stability was considered during the development of all of the action alternatives. Specific design measures responsive to the geotechnical considerations are discussed below.

Alternative A - No Action

Since no new dumps are involved, no new geotechnical considerations other than those previously analyzed would result from this alternative.

Effects Common to All Alternatives

This section discusses the probability and consequences of potential waste rock dump failures. Dump stability analyses indirectly indicate the probability of failure of a project component. The higher the factor of safety, the less potential for failure of the structure. A factor of safety equal to one implies that the structure has sufficient strength to carry the calculated load. Factors of safety less than one indicate that the structure will eventually fail, while factors of safety greater than one imply that the structure is more than strong enough to carry the calculated loads. Most structures are designed with a factor of safety greater than one to include a margin of safety against unknown factors that may affect the strength of the structure or the load it must carry. There is a potential that a designed waste rock dump may fail.

The consequences of failure of project components are addressed in this section as a means to evaluate alternative waste rock dump configurations. Although there are potential risks inherent in construction of waste rock dumps, based on the stability analyses conducted, they are not predicted to occur.

Factors of safety are calculated for two different conditions: static and pseudostatic. A static factor of safety measures the strength of the waste rock dumps under anticipated conditions. Pseudostatic safety factors relate to the ability of a dry waste rock dump to withstand an earthquake.

The consequences of failure of the project components are a function of the size and location of the structure. The effects to a waste rock dump face would vary with the size and nature of the failure. A small slump located on a dump face may affect the vegetation growing on the face but would have no other effects. A major failure, however, could potentially block the underdrain or result in sedimentation impacts downstream. The length to which the dump material would be transported downstream from the toe of the dump has not been calculated, but would vary with the height and slope of the dump face and the slope of the stream channel. Generally, the higher and steeper the dump face, the greater the distance the materials would be transported. Waste rock dump heights are similar for all of the action alternatives. The waste rock dumps for all of the action alternatives would initially be developed at angle of repose. Most of the dump slopes under Alternatives D and E would be reduced to 3H:1V after construction. Some dump slopes would be pushed to 3H:1V under Alternative C. Under Alternatives B, F and G the waste rock dump slopes would be left at angle of repose and be armored with coarse and durable rock. If a major failure were to occur, it would probably travel the farthest under these three alternatives.

During operations, dump failures would be controlled or remediated by IMC with the primary objectives of providing for the safety of equipment operators and minimizing environmental damage.

Seismicity

All waste rock dumps are designed to be stable for an earthquake with a 250 year occurrence interval.

Landslides

The hazard analysis did not reveal the presence of any natural landslides or related features such as debris flows or sinkholes within the area proposed for disturbance under any of the action alternatives. As a result, these potential foundation hazards would not be expected to effect the stability of the dumps under any of the alternatives.

Terrain Steepness

Upon completion of a dump, no unbuttressed angle of repose slope would have a toe foundation that is steeper than 30 percent. Slopes flatter than angle of repose would have a minimum safety factor for base sliding of 1.3 as calculated according to U.S. Forest Service Intermountain Region Guidelines (USDA, USFS 1991c). Appropriate engineering design and construction methods would be used to maintain stable dumps during operations. This is required for the safety of operators and equipment.

Foundation Soils

The majority of the soils are sandy and gravelly silts. The extent of soils with horizons dominated by clay are limited in extent and have only been mapped as a narrow band along Jerritt Creek. Therefore, the potential hazard is expected to be low due to the limited extent of clay. Development of toe berms would essentially eliminate any near surface high clay horizons at the downstream toe of the dumps in the drainage bottoms.

The critical portion of final slopes supported by clay would have a minimum stability safety factor that is acceptable to the USFS.

Saturated Foundation Soils and Springs

Design and construction measures would be taken to assure that there is no groundwater development in the dumps from the bottom up and that dumping would not occur on saturated foundations. Under-dump drainage systems or trench drains would be constructed in these areas to drain saturated foundation soils.

The waste rock dumps proposed under Alternatives B, D, E and G would cover four springs. Waste rock dumps for Alternative C would cover five springs and Alternative F would cover three springs. All of the action alternative waste rock dumps would cover two seeps.

The springs and seeps identified within the drainage bottoms would be covered by a drainage system that results from natural gravity sorting during dumping. Perennial springs located on hillsides outside of the drainage bottoms would be drained by preconstructed foundation trenches that extend to the nearest drainage bottom or beyond the dump perimeter.

Dump Slope Steepness

Erosion potential increases with both slope steepness and slope length. For the same dump height, flatter slopes have longer lengths. Because of differences in material characteristics, the erosion potential for the angle of repose dump slopes is expected to be higher than the natural pre-mining slopes that are steeper than 60 percent.

Erosional stability of the 3H:1V dump slopes would be achieved by revegetation that complies with a specified minimum cover density. Surface drainage and erosional stability of the 2H:1V and angle of repose dump slopes would be achieved by armoring with coarse and durable material. The total acres of post-mining slopes at angle of repose, 2H:1V, and 3H:1V are summarized in Table 4.1.

Dump Material Properties

Coarse and durable materials would be used to armor angle of repose slopes. As the particle sizes become coarser, the chances of erosion and shallow flow slides decrease. Durability provides assurance that the particle sizes would not become smaller in the near future. Coarseness and durability are also needed to maintain internal drainage to prevent saturated zones from developing in the vicinity of the slopes.

The tons of coarse and durable material and the percentage of total dump material that would be required for a 40-foot horizontally thick armor layer for the different mine areas and alternatives are indicated in Table 4.2.

Construction specifications that define suitable coarseness and durability in measurable terms for angle of repose armor layers and internal drainage systems, would be developed. Fine grained material that can cause differential settlement and disrupt

Table 4.2
Summary of Coarse and Durable Rock Volumes by Alternative

Alternative	Angle of Repose Slope Acreage	Total Waste Rock Mined (tons)	Coarse and Durable Rock Requirements (tons)	Percent of Total Waste Rock Volume
B	276	1,084,000,000	34,146,916	3.2
C	223	1,084,000,000	27,589,718	2.5
D	22	1,084,000,000	2,721,856	0.3
E	78	1,084,000,000	9,650,215	0.9
F	178	631,000,000	22,022,286	3.5
G	278	1,084,000,000	34,394,357	3.2

Source: IMC 1993

surface drainage would also be specified, and these materials would be placed at approved dump locations.

The selective placement of materials and minimum dumping heights would be implemented to ensure that particle size distributions would continually increase from the crest to the toe of dump slopes so that infiltration will not saturate the embankment from the top down.

The top of the finished dumps would be graded to offset potential settlement and maintain surface drainage away from the dump slopes.

Vegetation

Vegetation would not be removed from the majority of the waste rock dump sites due to the steepness of the natural slopes and the associated operational constraints and safety considerations. Clearing of vegetation would occur during development of the berms along the downstream toes of the lowermost dump levels. Aspen occurring in the drainage bottoms would be removed. Leaving vegetation within the remainder of the dumps would not be expected to adversely affect dump stability because the dominant vegetation type is sagebrush/grassland.

Cumulative Effects

If stability is controlled as expected, the geotechnical considerations alone would not result in any specific cumulative effects other than those related to the acreage of surface disturbance.

Soil Resources

Soil availability and suitability for use as growth medium are components of the reclamation potential focus issue. The availability of soil within the disturbance areas is related to thickness and natural slope steepness. Suitability for use as growth medium is based upon the physical and chemical characteristics of the soil. Application of growth medium to disturbed areas commonly enhances revegetation success.

Effects to soils are discussed in terms of changes in soil productivity. Soil productivity is related to the quality and quantity of growth medium applied to disturbed areas, as well as slope aspect and steepness.

Alternative A - No Action

No new impacts would occur to soils under this alternative, other than those analyzed in previous NEPA documents. Currently, there is a surplus of growth medium in stockpiles that would cover about 227 acres of disturbed land beyond that required for existing and approved disturbances. This surplus has not been included in the growth medium availability calculations discussed in the following sections for the action alternatives.

Effects Common to All Alternatives

Short-term losses of soil productivity would occur on disturbance areas to which growth medium would be applied during reclamation. The short-term losses of soil productivity are different for each alternative and would range from 957 acres under Alternative F to 1,691 acres under Alternative D. The short-term losses of soil productivity would exist until growth medium is redistributed and vegetation is established on the disturbed areas. A summary of short-term impacts expressed in terms of the acreage of surface disturbance to which growth medium would be applied and seeded using proven reclamation techniques is presented in Table 4.3.

Long-term losses of soil productivity would occur in disturbance areas which would not have growth medium applied during reclamation operations. The long-term losses of soil productivity vary by alternative and would range from 1,084 acres under Alternative F to 1,691 acres under Alternative G. Pit development would constitute about 803 acres (74 percent) of the long-term impacts for Alternative F and 1332 acres (79 percent) of those for Alternative G. A summary of the acreages that would not have growth medium applied and be revegetated using proven reclamation methods (long-term disturbance) is summarized in Table 4.3.

Table 4.3
Disturbance and Soil Redistribution Acreage Summary

	Alternative						
	A[1]	B	C	D	E	F	G
New Disturbance Area (Acres)	0	2,559	2,662	2,744	2,557	1,777	2,605
Total Disturbance Area[2] (Acres)	2,183	2,966	3,099	3,142	2,952	2,041	3,013
Long Term Disturbance[3] (Acres)	1,691	1,677	1,652	1,451	1,505	1,084	1,691
Cumulative Long Term Disturbance (Acres)	1,081	2,758	2,695	2,532	2,550	2,165	2,772
Short Term Disturbance[4] (Acres)	1,102	1,289	1,447	1,691	1,447	957	1,322
Cumulative Short Term Disturbance (Acres)	1,102	2,391	2,549	2,793	2,550	2,059	2,424
Growth Medium Required (CY)	1,339,012	1,227,535	1,396,775	1,656,237	1,404,950	757,121	1,257,651

Notes: Long term and short term Disturbances are not the same as CEA Long term and Short term Disturbance definitions.
[1] Exploration roads are not included in Alternative A disturbance and reclamation acreages.
[2] Total disturbance area includes overlap with existing disturbance.
[3] Long term Disturbance includes pits, angle of repose dump slopes, and 37.5 of haul road disturbance area.
[4] Short term Disturbance includes flat dump tope, 70% of pit backfills, 62.5% of haul roads, ore stockpiles, sediment traps, growth medium stockpiles.

Indirect effects to soils would be associated with the potential for erosion during mining and effects of waste rock dump stability. During mining and construction operations, dust suppression activities and revegetation would be used to control fugitive dust and wind erosion. Sediment control measures and revegetation of disturbed areas would be used to protect surface water and aquatic resources from the effects of soil erosion. Predicted sediment yields for each alternative compared to pre-mining conditions are described in the discussion of surface water quality. Due to the relatively shallow nature and the limited area of soils with high clay contents, effects of soils on dump stability are expected to be minor. Anticipated soils effects on waste rock dump stability are discussed under geotechnical considerations.

Cumulative short-term losses of soil productivity would vary by alternative and would range from about 2,059 acres under Alternative F to 2,793 acres under Alternative D. Long-term cumulative impacts to soil productivity would vary from about 2,165 acres under Alternative F to 2,772 acres under Alternative G. The existing and proposed pits represent between 1,523 acres (70 percent) under Alternative F and 2,052 acres (74 percent) under Alternative G of these long-term impacts to soil productivity. A summary of short-term and long-term cumulative impacts to soil productivity is presented in Table 4.3.

Growth Medium Availability and Suitability

Direct impacts as well as irreversible and irretrievable losses of soil productivity would be partially offset by recovering suitable materials for use as growth medium from those portions of the pits with slopes of 30 percent or less. The estimated quantity of suitable soils available within the pits is summarized in Table 4.4. These estimates are based on the area within the pits with slopes equal to or less than 30 percent, depth to bedrock for each soil series, and soil suitability for use as growth medium. The 1.8 million cubic yards of soil estimated to be available for use as growth medium is the same for Alternatives B, C, D, E and G, since the pit shapes do not change between these alternatives. Approximately 1.1 million cubic yards of growth medium would be salvaged under Alternative F, because the New Deep orebody would be mined using underground rather than open pit methods. Soil series with a poor suitability rating were not included in the calculations. The soils that would be used to develop the berms along the bottom of the waste rock dumps and haul road fill slopes were also excluded from the quantities presented in Table 4.4. It is anticipated that additional soils would be recovered during mining as pit benches are developed on steeper slopes. Recovery of soils from slopes steeper than 30 percent during pit development would focus on areas having deeper soils with a good suitability rating. The presence of aspen would be used as a visual guide to favorable soil conditions during pit development, because the aspen stands are normally associated with the thicker high quality soils.

The goal of the soil removal operations would be to salvage sufficient quantities to cover the acreages specified for each of the action alternatives. A sufficient quantity of suitable growth medium is available on slopes of 30 percent or gentler within the proposed pits to fulfill the growth medium redistribution goals for all of the action alternatives. Growth medium would be recovered from the steeper slopes within the pits, where feasible. The amount of growth medium needed to satisfy the goals for reclamation is summarized by alternative in Table 4.3.

Growth medium stockpile volumes at the existing Jerritt Canyon mining operations are monitored and the results reported to the USFS in the Annual Work Plan submitted by IMC each year. Future growth medium salvaging would be monitored and reported in the same manner. Suitability of growth medium would be based upon visual characteristics during removal and standard soil tests after redistribution.

Reclamation Potential

Reclamation objectives are to return areas disturbed by mining to a stable and/or productive condition. Reclamation activities would provide for physical stability (both mass stability and surface erosion) and revegetation. Reclamation would involve one or more of the following activities: removal of project facilities located on National Forest Service lands, grading of waste rock dump tops and/or slopes, armoring angle of repose waste rock dump slopes, application of growth medium, revegetation, and providing for public safety.

Table 4.4
Summary of Soils Available for Reclamation

Soil Association	Total Pit Area[1] (Acres)	Suitable Salvage Area[2] (Acres)	Depth to Bedrock (Inches)	Suitable Salvage Volume <=30% (CY)
New Deep Pit				
B	246.14	80.0	32.0	344,113
D	245.32	64.1	42.8	368,788
Subtotal	**491.46**	**144.1**		**712,901**
Saval/Steer Pit				
D	162.99	19.0	42.8	109,215
F	6.72	1.0	42.8	5,984
B	83.69	41.8	42.3	236,257
I	458.37	63.4	54.0	459,994
Subtotal	**711.77**	**125.2**		**811,450**
Burns Basin Pit				
B	19.92	5.8	32.0	24,867
G	20.61	15.9	42.3	89,895
I	42.53	16.2	54.0	117,902
K	2.6	2.6	58.4	20,414
Subtotal	**85.66**	**40.5**		**253,078**
GRAND TOTAL	**1,289.00**	**309.8**		**1,777,429**

Note: [1] Previously disturbed areas excluded from total pit acreages.
[2] Suitable salvage area corresponds to pit acreages with slopes less than 30 percent.

Mass stability of the waste rock dumps would be ensured by designing and constructing waste rock dumps with a minimum stability safety factor that is acceptable to the USFS. Mass stability may be further enhanced by reshaping some waste rock dumps slopes to an angle of 3H:1V. Surface stability would be accomplished through coarse and durable armoring of 2H:1V and angle of repose slopes and revegetation of gentler slopes. The section on geotechnical considerations discusses physical stability of the waste rock dumps.

Revegetation success is a function of several factors, such as, 1) slope steepness, 2) slope length, 3) physical and chemical characteristics of the seedbed, 4) aspect, and 5) climate. Factors 3 through 5 do not vary among alternatives. The differences in revegetated acres are primarily a function of dump slope steepness. The steepness of the final dump slopes is directly related to revegetation capabilities and was termed "reclamation potential" for the purposes of this analysis.

Waste rock dumps with slopes at an angle of 3H:1V or less can be revegetated using established reclamation methods. Growth medium application, seeding, and related activities can be done on the contour with construction or reclamation equipment. Alternatives C, D and E include 3H:1V dump slopes. Slopes at 2H:1V are too steep to be worked on the contour with machinery. Revegetation of these slopes depends on slope lengths short enough to use specialized techniques such as hand-seeding and hydro-seeding. For the purpose of this analysis, 2H:1V slopes are considered to be armored rather than revegetated. There are minor amounts of 2H:1V slopes under Alternatives C and E.

Conventional revegetation methods cannot be used on angle of repose slopes. Alternative revegetation methods such as hand-seeding and hydro-seeding would be used. Reclamation of angle of repose dump slopes would consist of applying coarse and durable rock to ensure surface stability by minimizing runoff and controlling erosion. Growth medium may be applied to the upper portions of the angle of repose waste rock dump slopes. Fine-textured growth medium applied directly to angle of repose slopes has the potential to erode. Revegetation of angle of repose slopes is not as predictable as it is for gentler slopes. Since the degree of revegetation success on angle of repose slopes treated with growth medium cannot be predicted, the total acreage of these slopes are included in the un-revegetated acreage (long term disturbance) in Table 4.3. Angle of repose dump slopes occur in Alternatives B, C, D, E, F and G.

The amount of disturbed land that would be reclaimed and revegetated to a productive state varies with the acreage of waste rock dump slopes in each slope category. The acreages presented in Table 2.1 for pits, angle of repose and 2H:1V slopes, and those portions of the haul road disturbances not expected to be covered with growth medium were used in calculating the long-term disturbance displayed in Table 4.3.

Alternative B

The waste rock dumps would be developed in a series of lifts that progress up the natural drainages. Locating the dumps in this fashion would consolidate the area of disturbance, utilize the natural topography to enhance stability, decrease dump heights, and reduce slope lengths. Angle of repose slopes would range from about 70 to 1,150 feet in length under this alternative.

A total of 2,966 acres (including existing and approved disturbance) would be disturbed under this alternative. Growth medium would be redistributed and revegetation would take place on approximately 1,289 acres under this alternative. In addition, approximately 138 acres (50 percent) to 166 acres (60 percent) of the angle of repose slopes would be covered with growth medium or fine textured waste rock materials and revegetated. This practice would only be used in those areas where surface erosion or surface failures would have no potential to affect the water quality of area streams. The purpose of this practice would be to encourage revegetation, although it is not possible to predict the degree of success. For this reason all angle of repose slopes, even those treated with growth medium, have been counted as unrevegetated acres (long-term disturbance) in Table 4.3. The majority of the remaining 1,677 acres of disturbance would be left in a stable condition but would not be revegetated.

The final shape of the waste rock dumps under this alternative would consist of approximately 1,032 acres (78 percent) of flat waste rock dumps tops with slopes of 0-10 percent and 276 acres (22 percent) with angle of repose slopes.

Alternative C

Under this alternative, 3H:1V slopes and terraces would be developed on some of the dumps. A total of 3,099 acres would be disturbed. Approximately 1,447 acres of disturbance would be revegetated. The majority of the remaining 1,652 acres of disturbance would be left in a stable condition but would not be revegetated.

The final shape of the waste rock dumps under this alternative would consist of 1,065 acres (76 percent) with slopes of 0-10 percent, 73 acres (5 percent) with slopes of 3H:1V, 26 acres (2 percent) with slopes of approximately 2H:1V, and 224 acres (16 percent) with angle of repose slopes. Angle of repose slopes would range from about 70 to 900 feet in length. The 3H:1V slopes would range from 205 to 900 feet in length.

Alternative D

This alternative was included to increase the area that could be revegetated by maximizing the area of 3H:1V slopes. Alternative D would require building the waste rock dumps in a series of lifts to allow the slopes to be reduced to 3H:1V. An extension of the under-dump drainage system would have to be constructed from the downstream toe of the waste rock dump to the final limit of the 3H:1V slopes under this alternative to permit water flow through the dumps.

A total of 3,142 acres would be disturbed under this alternative, of which approximately 1,691 acres would be revegetated. The remaining 1,451 acres would be left in a stable condition but would not be revegetated.

The final shape of the waste rock dumps under this alternative would consist of 889 acres (63 percent) with slopes of 0-10 percent, and 503 acres (36 percent) with slopes of approximately 3H:1V and 22 acres (1 percent) with angle of repose slopes. The 3H:1V slopes would range from 140 to 2580 feet in length.

Alternative E

This alternative is similar to Alternative D except angle of repose slopes would be developed on the upstream and downstream faces of the waste rock dumps to promote drainage through the dumps. A total of approximately 2,952 acres of disturbance would occur under this alternative, and approximately the same surface disturbance from waste rock dumps would occur when compared to Alternative B. About 1,447 acres would be revegetated under Alternative E. The majority of the remaining 1,505 acres would be left in a stable condition but would not be revegetated.

The final shape of the waste rock dumps would consist of approximately 916 acres (70 percent) with slopes of 0-10 percent, 278 acres (21 percent) with slopes of approximately 3H:1V, 26 acres (2 percent) with slopes of approximately 2H:1V, and approximately 78 acres (6 percent) with angle of repose slopes. Angle of repose slopes would range from about 440 to 1080 feet in length under this alternative. The 3H:1V slopes would range from 141 to 1265 feet in length.

Alternative F

This alternative was included to address the possibility of utilizing underground mining methods in the New Deep mine area. Total disturbance under this alternative would be approximately 2,041 acres, the least amount of total surface disturbance of all of the action alternatives. About 957 acres would be revegetated under this alternative. Most of the remaining 1,084 acres would be left in a stable condition but would not be revegetated.

The final shape of the waste rock dumps would consist of 552 acres (75 percent) with slopes of 0-10 percent, and 178 acres (24 percent) with angle of repose slopes. Angle of repose slopes would range from about 1.3:1 to 12.5:1. Angle of repose slopes would range from about 72 to 1,250 feet in length under this alternative. There would be no 3H:1V slopes under this alternative.

Alternative G

This alternative would include a combination of underground and open pit mining methods within the New Deep mine area. A total of 3,013 acres would be disturbed under this alternative. About 1,322 acres would be revegetated under this alternative. The majority of the remaining 1,691 acres would be left in a stable condition but would not be revegetated.

The final shape of the waste rock dumps would consist of 1,045 acres (79 percent) with slopes of 0-10 percent and approximately 278 acres (21 percent) with angle of repose slopes. Angle of repose slopes would range from about 72 to 1,150 feet in length under this alternative. There would be no 3H:1V slopes under this alternative.

Cumulative Effects

Cumulative short-term effects to soil resources would vary by alternative and would range from about 2,059 acres under Alternative F to 2,793 acres under Alternative D. Long-term cumulative impacts to soil productivity would vary from about 2,165 acres under Alternative F to 2,772 acres under Alternative G. The existing and proposed pits represent between 1,523 acres (70 percent) under Alternative F and 2,052 acres (74 percent) under Alternative G of these long-term impacts to soil productivity. A summary of short-term and long-term cumulative impacts to soil productivity is presented in Table 4.3.

Climatology and Air Quality

The area evaluated for detailed analysis of air resources is the Project area. For analysis of possible air quality impacts on PSD Class I areas, the area evaluated was expanded to include the nearest Class I area, which is the Jarbidge Wilderness area approximately 30 miles (50 kilometers) to the northeast of the Project area.

Impacts on air quality would be considered significant for this analysis if the mining activities would result in exceedences of any of the state or National Ambient Air Quality Standards, or if any of the activities would cause or contribute to an exceedence of any PSD increment. Past ambient air monitoring and dispersion modeling analyses have indicated no such impacts.

Effects Common to All Alternatives

The air pollutant emissions from mining, crushing, and construction activities within the Jerritt Canyon Project Expansion Area would primarily be total suspended particulates (TSP) and particulates of 10 microns diameter or smaller (PM_{10}). Minor emissions of sulfur dioxide (SO_2), oxides of nitrogen (NO_x), and carbon monoxide (CO) also result from these activities.

The mitigation measures (i.e. emissions controls, process rates, ore moisture, etc.) specified in the air quality permits required for these activities ensure that the pollutant emissions would be within acceptable limits and would not cause unacceptable impacts upon the air quality of the area. This means that there would be no exceedences of the State or National Ambient Air Quality Standards or of any PSD increment due to the mining activities. No mitigation measures beyond those required by the permits are proposed for any of the alternatives.

The only PSD Class I area within 60 miles (100 kilometers) of the study area is the Jarbidge Wilderness. The application of the mitigation measures previously discussed would ensure that no significant impact upon this Class I airshed would occur.

The existing air quality permits for the mine crushing and screening operations issued by NDEP may require modification with the implementation of an action alternative. These permits require monitoring and reporting of the moisture content of the ore being processed. This is intended to ensure that particulate emissions from the mine crushing and screening system would be properly controlled. No ambient monitoring would be required by NDEP. No additional monitoring requirements are proposed for any of the alternatives because past ambient monitoring indicated that the mining activities did not have a significant impact on ambient particulate concentrations. The surface disturbance permit for the Jerritt Canyon Project was amended and approved by NDEP in 1992 to include the mine expansion area.

Alternative A - No Action

If the proposed action were denied, IMC anticipates that the existing operations at the Jerritt Canyon Project would be expected to continue at current levels until 1994, after which time the operations would begin to decline. Operations would cease sometime before or during 1996 (IMC, 1993a). The pollutant emissions due to the current mining activities would decrease and end as the mining operation declines and ends. After the end of mining and the completion of reclamation activities, air quality in the area would be expected to return to pre-mining conditions.

Alternative B - Proposed Action

The new mining and construction activities outlined in the proposed action would result in continued particulate and gaseous emissions. Particulate emissions would result from drilling, blasting, excavation, loading, hauling, dumping of waste rock and ore, and from crushing, handling, and storage of ore. Particulate emissions from mining consist mostly of large suspended particles that would settle out of the atmosphere very near the emissions source. Gaseous emissions would result from the operation of mining equipment and of generators. Gaseous pollutants and fine particles may be transported downwind before they settle out or are washed out by precipitation.

Changes in timing of runoff due to snowmelt increase from surface dusting has been expressed as an issue. Fugitive dust could be generated by pit blasting, loading, hauling on mine roads, and dumping. Some dust may be available to coat snowpacks in a downwind direction. The amount and distribution is uncertain, but probably would be very localized. Surface dusting of snowpacks can reduce albedo (reflectivity) and slightly increase melt rates under certain conditions. However, there is extreme variability in weather conditions, color, physical properties of windborne materials, and probable distribution. Dusting has very little effect when the minimum daily air temperature is below freezing (Colbeck 1988). New snow layers can bury any dust, thus keeping the snow albedo high. As the season nears spring, the snow albedo decreases, especially when the snow is wetted, and the melt rate increases naturally. Too high a rate of dusting can actually insulate snowpacks and retard melting.

The limited dust generated will be grayish in color rather than black. For the majority of time snow is present, the air temperatures are low, keeping melting due to dusting negligible. Periodic storms will increase albedos. For these reasons, any fugitive dusting on snow is not expected to be significant in increasing melt rates.

Air quality monitoring conducted upwind and downwind of the mill site on the east side of the range does not indicate an increase in airborne particulate matter when compared to background conditions. Based upon the results of this monitoring, it is reasonable to conclude that dust accumulation on the snowpack from blasting and traffic on roads is localized and has a negligible effect on the timing of surface runoff.

Alternatives C - G

The effects on air quality of Alternatives C through G are expected to be similar to those of Alternative B. There would be some minor variations in the locations of emissions sources and the amount of pollutants emitted, due to the differing locations and extent of the surface disturbances for each of the various alternatives. In particular, Alternative F probably would result in somewhat lower emissions than the other alternatives, because underground mining is the only mining method proposed for New Deep in that alternative. However, as noted above in the Section entitled "Effects Common to All Alternatives," the air quality permits issued under any alternative would require mitigation measures to ensure that the permitted activities would not cause any substantial impact upon air quality.

Cumulative Effects

The cumulative effects on air quality in the study area would include elevated concentrations of TSP and PM_{10} particulates as mining and construction activities continue. Gaseous pollutants from operation of diesel-powered mining and construction equipment also would increase. Because of the air quality control measures, the cumulative effects of these activities on air quality in the study area are expected to be minimal. No irreversible and irretrievable commitment of air resources would result from the Proposed Action or alternatives. With cessation of mining and completion of reclamation activities, air quality would be expected to approach pre-mining conditions.

There are no other mining activities within 11 miles of the study area. Consequently, no measurable cumulative air quality impacts are expected due to mining activities outside of the study area.

Surface Water Resources

The Project Area is the area of analysis for surface water. The major water quality issues associated with the proposed action and the alternatives are: effects on surface water quantity, including discharge and timing of discharge and effects of disturbance on snow deposition; effects to stream channel characteristics; effects to surface water quality due to potential acid rock drainage and sedimentation; and the potential for water to be impounded by pits. The capability of the waste rock under-dump drainage systems to transport sediment and runoff associated with storm events has also been raised as an issue by the USFS, and is discussed below with effects to stream channel characteristics. These items are discussed in the following sections.

Surface Water Quantity

Potential impacts to water quantity in terms of seasonal runoff were evaluated by the Simulator for Water Resources in Rural Basins (SWRRBWQ) computer model (Condor 1993). Pre-mining runoff was calculated, based on surface conditions prior to mining, in order to provide a baseline for analysis of cumulative effects and comparison among alternatives.

Seasonal runoff that would occur under the final post-reclamation configuration of the waste rock dumps for each alternative was calculated using precipitation, drainage basin characteristics and runoff coefficients. Runoff calculations for this analysis consider all precipitation throughout the year, including snow, but did not include flow contributed by springs. Therefore, the estimated seasonal runoff volumes are likely lower than would be actually realized. Runoff calculations were performed for two locations within each basin. Calculated runoff volumes are summarized in Table 4.5.

Table 4.5
Change in Pre-Mining Condition
Runoff by Alternative

	Runoff in acre feet in excess (+) or below (-) pre-mining condition			
Alternative	**JC-X[1]**	**JC-3[2]**	**BC-2[3]**	**BC-3[4]**
A	-90	-90	-520	-510
A	-490	-360	-520	-530
C	-490	-360	-520	-530
D	-440	-320	-520	-530
E	-560	-420	-520	-530
E	-10	-10	-520	-530
G	-490	-360	-520	-530

Source: Jerritt Canyon Mine Expansion Hydrology and Sedimentology Technical File Report, July 1993.

Note: [1] Jerritt Creek Basin downstream of South Deep Dump sediment pond
[2] Jerritt Creek Basin at the border with the U.S. Forest Service (water quality measurement station JC-3)
[3] Burns Creek Basin downstream of Burns Basin Dump (water quality measurement station BC-2)
[4] Burns Creek Basin at the border with the U.S. Forest Service (water quality measurement station BC-3)

Although water quantity is expected to decrease as a result of the proposed mining operations, the timing of water flow would be somewhat regulated by the development of waste rock dumps. Waste rock dumps constructed in drainages within the Project area during the past 13 years of operation have been observed to absorb and slowly release water over an extended period of time later in the season. This phenomenon was documented below two existing waste rock dumps in the Snow Canyon drainage during the delineation of wetlands in August, 1992, after six consecutive years of drought (IME 1992). This phenomenon has not been observed in Burns Creek drainage.

Water is expected to infiltrate the proposed waste rock dumps more rapidly than the steep natural slopes, thereby reducing runoff volumes and evapotranspiration losses. Peak flows during flood events and spring snowmelt may be replaced by a more gradual release of water over a longer period of time than would occur in an undisturbed drainage.

The potential effects of the mining operations on snow deposition and snowmelt have been raised as an issue. Snowmelt does tend to occur more rapidly on the active haul roads as a result of heavy equipment traffic and snow removal operations. This is partially offset by the creation of snow piles that typically persist long after snow has melted from adjacent undisturbed areas. On inactive roads, snowmelt may occur earlier on the steeper cut and fill slopes. However, the safety berms constructed on these roads often cause snow drifts to form that typically melt more slowly than the snow on adjacent undisturbed ground. Dust produced by traffic on the roads during the winter and spring is typically minor, due to the high moisture contents within the road surface and base. The limited dust accumulation that does occur on the snowpack that results from blasting and road sanding is localized and is believed to have a negligible effect on the timing of runoff.

Alternative A

Under the No Action Alternative, existing operations would continue as analyzed and approved in previous NEPA documents and POOs. Compared to pre-mining conditions, existing operations would likely result in decreased water flow in Jerritt Creek as a result of interception of surface water flow by the existing pits in the headwaters of Jerritt Creek. Decreased flow may occur in Burns Creek after mining because the in-pit diversion would be breached and runoff allowed to drain into the pit.

Effects Common to All Action Alternatives

Jerritt Creek

The runoff calculations used to evaluate the effects on water quantity and the timing of discharge were based on the final configuration of the disturbed areas after reclamation under each alternative. Precipitation that falls within the pits and runoff that is captured by the pits would not contribute directly to downstream runoff and is the principal factor in the reduction of surface water runoff compared to pre-mining conditions. A limited amount of surface runoff would enter the Saval, Steer, and New Deep pits due to the location of these pits at or near the upper reaches of the watersheds. Most of the precipitation and runoff intercepted by the pits would recharge the local groundwater system by infiltration through the fractured rock in the bottom of the pits. This recharge may surface downstream of the pits as supplemental flow to streams, seeps and springs.

Compared to pre-mining conditions, impacts to surface water flow in Jerritt Creek at Station JC-X could vary from a loss of 10 acre feet under Alternative F to a potential loss of 560 acre feet under Alternative E. Alternatives B, C and G have the same potential impacts to runoff at approximately 490 acre feet below pre-mining conditions. Alternative D would result in a loss of approximately 440 acre feet at the same location compared to pre-mining conditions. This may affect downstream users of the water.

Burns Creek

Effects to Burns Creek surface water flow do not vary between Alternative B through G. The direct effect of the action alternatives would be the reduction of runoff downstream of the pit by approximately 20 acre feet as a result of pit enlargement, compared to pre-mining conditions.

Over 95 percent of the cumulative impacts to runoff in Burns Creek are the result of the existing approved operations. At the completion of existing operations, the Burns Basin in-pit diversion ditch would be breached. The natural drainage upstream of the pit would be reestablished so that runoff enters the pit at the low point of the pit rim. Water entering the pit would be expected to evaporate or infiltrate into the fractured rock and karst system underneath the pit. Under the No Action Alternative, cumulative impacts could be an approximate loss of 520 acre feet at Point BC-2 and 510 acre feet at Point BC-3, compared to pre-mining conditions. Under the action alternatives, the cumulative impact could be a potential loss of approximately 520 acre feet at Point BC-2 and 530 acre feet at Point BC-3 compared to pre-mining conditions affecting downstream users.

Cumulative Effects

The cumulative effects to surface water quantity in Jerritt Creek and Burns Creek would be reduction in flow at the Forest boundary under current operations and all of the action alternatives. The greatest flow reduction in Jerritt Creek would occur under Alternative E and the least under Alternative F.

Stream Channel Characteristics

Stream channel characteristics would be modified by the construction of waste rock dumps in drainages and conveyance of stream flow through the base of the dumps. The capability of the waste rock under-dump drainage systems to transport sediment and runoff associated with storm events and effects to stream channel characteristics are discussed in the following section.

Alternative A - No Action

Under this alternative, no new disturbance would be approved and the existing operations would continue until completed. Existing operations have resulted in the disturbance of about 3.3 acres of ephemeral and intermittent stream channels. Diversion ditches have been developed in some areas to route surface runoff around disturbed areas such as the Winters Creek pit and the Burns Basin dump. Cross-valley waste rock dumps with under-dump drainage systems in Mill Creek and Burns Creek convey runoff and stream flow through these dumps. Head-of-valley dumps in Snow Canyon gradually release water to the surface water system (IME 1992).

<u>Effects Common to All Action Alternatives</u>

<u>Jerritt Creek</u>

All of the action alternatives would result in changes to stream channel characteristics. These changes would occur primarily in Jerritt, Saval and Steer Canyons, where 3.0 to 7.2 acres of stream channels would be excavated by pits or covered under the waste rock dumps by the underdump drainage systems. Sediment control structures such as ponds and traps would also be constructed in various locations under each action alternative. Changes in Burns Creek would be primarily associated with pit enlargement, which would affect a few hundred additional feet of an ephemeral stream channel.

Effects to watersheds are sometimes evaluated in terms of the percentage of disturbance to the watershed for timber and range management programs. A summary of the percent of each watershed which has been or would be disturbed within the general study area is provided in Table 4.6.

Under all action alternatives, the South Deep waste rock dump would be developed in the Jerritt Canyon drainage. This dump would be constructed with a gravity-sorted under-dump drainage system capable of conveying flow underneath the dump. Rock sizes in the South Deep under-dump drainage system are expected to be larger than the rocks found in existing waste rock dumps due to the greater distance between blast holes and the increased bench heights in the New Deep pit. There would be measurable standards for the underdrain construction in the approved plan.

Runoff would enter the South Deep under-dump drainage system via Jerritt Creek or its tributaries. Some runoff would be intercepted by pits. The height of the dump at the main inflow point in Jerritt Creek varies between the action alternatives. This could slightly affect inlet conveyance capacity, the magnitude of upstream ponding, and timing of flow.

Peripheral ditches would be developed along portions of the dump perimeter in order to collect runoff and convey it to the base of the dump or enhance infiltration. The peripheral ditches would be developed along the contact with natural topography.

The underdump drainage system for the South Deep dump was analyzed for its capability to pass flood waters from a 100 year, 24-hour precipitation event using the HEC-1 computer model developed by the Corps of Engineers (Condor 1993). The model used runoff coefficients, (or CN values), for the various subbasins based on soil and cover types, dump inlet discharge capacity, frictional resistance to flow in the underdrain channel, and peak flows for the 100 year event. The analyses indicate that the underdrain would have a much

Table 4.6
Proposed & Cumulative Disturbance by Watershed
(as percent of total watershed)

	Jerritt Creek	Burns Creek	Mill Creek	Snow Canyon
Alternative A				
Proposed	0%	0%	0%	0%
Cumulative	17.5%	12.5%	19.6%	3.1%
Alternative B				
Proposed	28.0%	7.1%	0%	0%
Cumulative	45.6%	19.5%	19.6%	3.1%
Alternative C				
Proposed	28.9%	7.8%	0%	0%
Cumulative	46.5%	20.3%	19.6%	3.1%
Alternative D				
Proposed	30.3%	7.2%	0%	0%
Cumulative	47.8%	19.6%	19.6%	3.1%
Alternative E				
Proposed	28.0%	7.0%	0%	0%
Cumulative	45.6%	19.5%	19.6%	3.1%
Alternative F				
Proposed	18.1%	7.7%	0%	0%
Cumulative	36.7%	20.2%	19.6%	3.1%
Alternative G				
Proposed	28.6%	7.1%	0%	0%
Cumulative	46.1%	19.5%	19.6%	3.1%

Source: USFS GIS Data Base

Note: [1] Includes area of subsidence in Jerritt Creek watershed as a proposed disturbance.

greater capacity than would be required to pass the flow that would result from a 100-year, 24-hour precipitation event. Peak flow at the dump exit was computed to be 385 cfs and the full capacity of the underdrain was computed to be a minimum of 13,000 cfs.

The capability of the South Deep under-dump drainage system to pass the predicted sediment load in Jerritt Creek without clogging was also analyzed. The drainage system was determined to have an average flow velocity well in excess of the minimum velocity required to keep sediments in suspension. The average flow velocity of approximately 1.41 fps and the minimum flow velocity of approximately 0.77 fps near the downstream end are well in excess of the velocity of 0.25 fps needed to keep sediments in suspension. Overall, the underdrain void volume of 92,000,000 ft^3 is more than 3,000 times the average annual sediment yield of 30,000 ft^3 per year from the contributing watershed. This would indicate that most of the sediment would pass through the underdrain, although some could settle out and be deposited locally in areas of lower velocity, most likely in the upstream portion of the drain and in back eddies within the underdrain.

Ongoing reclamation in the upper basin above the Jerritt Creek under-dump drainage system should reduce the amount of sediment delivered to the inlet of the South Deep dump.

Burns Creek

Effects to drainage and stream channel morphology in Burns Creek as a result of pit expansion do not vary between action alternatives. Under Alternatives B and G, the expansion of the existing waste rock dump would impact a portion of the stream channel that flows into Burns Creek from the south. A portion of the diversion ditch around the existing waste rock dump would also be covered under these two alternatives.

Cumulative Effects

The cumulative effects to stream channels would increase from the current 3.3 acres to between 6.3 and 10.5 acres. The percentage of disturbance to the Jerritt Canyon and Burns Basin watersheds would also increase under each of the action alternatives.

Surface Water Quality

Concerns about water quality identified in Chapter 1 focus on two issues: 1) the potential for acid generation and resultant acid drainage from waste rock, ore stockpiles or pits and the introduction of these contaminants into waterways, and 2) potential increases in sedimentation resulting from roads, pits and waste rock dumps.

Acid Rock Drainage Potential

The potential for contaminants or acid leachate to be released from waste rock, ore stockpiles, or pits and introduced into surface waters was evaluated for the proposed project and is discussed under geochemistry in the geology sections of Chapters 3 and 4. The acid-base accounting analysis results indicate that there is a low potential for acid rock drainage from waste rock derived from the Saval and Steer pits and expansion of the Burns Basin pit. The acid-base accounting analysis results for the New Deep waste rock indicate that there is a low to moderate potential for acid generation. A small percent of the waste rock samples from the New Deep mine area are potentially acid-producing and kinetic testing is currently underway to better define the potential for acid rock drainage. Results of the static and kinetic testing would be used to develop a waste rock evaluation program to guide additional sampling, handling and placement of materials that are determined to be acid-forming. With successful implementation of any special handling techniques that may possibly be required, the action alternatives would meet NDEP water quality standards. In the event that monitoring reveals a problem with acid generation or leaching of trace elements in the dumps, appropriate remedial action would be taken.

Sedimentation

Sediment yield is dependent upon soils, vegetation, topography, and climatic factors such as storm frequency, rainfall intensity, snow accumulation, and snowmelt. The sediment yield for the various alternatives was analyzed using the USDA's SWRRBWQ computer program. The major components of SWRRBWQ are surface runoff, percolation, return flow, evapotranspiration, transmission losses, sedimentation and plant growth (Condor 1993). Runoff volumes are predicted using the SCS curve number that is a function of soil moisture content, soils, and vegetation cover. Watershed dimensions, average slopes and slope lengths are also used in the model. Precipitation from Tuscarora, the nearest weather station, was corrected for elevation and temperature. Soil characteristics included in the program include the soil erodability parameter (K factor) and runoff parameter. The results of the analysis are shown in Table 4.7 as total annual sediment yield in tons. Sediment yield calculations were based on final configurations of disturbed areas after completion of reclamation.

Table 4.7
Potential Change in Sediment Yield by Alternative

	Total Annual Sediment Yield in Metric Tons in excess (+) or below (-) pre-mining condition			
Alternative	**JC-X[1]**	**JC-3[2]**	**BC-2[3]**	**BC-3[4]**
A	+400	+160	-260	-160
B	-1,040	-910	-260	-160
C	-1,040	-910	-200	-130
D	-730	-480	-200	-130
E	-1,000	-820	-200	-130
E	-50	-120	-200	-130
G	-1,040	-910	-260	-160

Source: Jerritt Canyon Mine Expansion Hydrology and Sedimentology Technical File Report, July 1993.

Note:
[1] Jerritt Creek downstream of South Deep Dump sediment pond
[2] Jerritt Creek at the border with the U.S. Forest Service
[3] Burns Creek downstream of Burns Basin Dump (water quality measurement station BC-2)
[4] Burns Creek at the border with the U.S. Forest Service (water quality measurement station BC-3)

The action alternatives would result in a short-term increase in sediment yield as a result of surface disturbance during pit development, haul road and waste rock dump construction. Until pits are deep enough to function as sediment traps, sedimentation would likely increase over existing conditions, but would be mitigated by construction of sediment control structures. Alternatives that have waste rock dump slopes at 2:1 or 3:1 would require regrading upon project completion that would not be required where angle of repose slopes are retained. Additional earth-moving required to create the flatter slopes could also increase the potential for sedimentation during the reclamation phase. Upon completion of reclamation, sediment yields would be reduced to below pre-mining conditions for all alternatives as described below for the Jerritt Creek and Burns Creek watersheds.

Jerritt Creek

Pre-mining conditions in Jerritt Creek indicate a sediment yield of about 3,970 tons at the proposed sediment pond and 4,520 tons at the USFS boundary. With the exception of Alternative A, all the alternatives would result in less sediment yield after final reclamation than the pre-mining condition. This would be primarily due to the presence of pits which would serve as sediment traps. Alternative A would have higher sediment yields than the other alternatives primarily due to the smaller size of the existing pits relative to the disturbance associated with other mine facilities, primarily haul roads.

Burns Creek

Pre-mining conditions in Burns Creek indicate sediment yield of 1,100 tons at the sediment pond downstream of the dump and about 1,990 tons at the USFS border. Sediment yields after reclamation for all alternatives, including Alternative A, are less than for pre-mining conditions. This is primarily due to the fact that all water and associated sediment upstream of the pit drain to the pit.

Other potential impacts to water quality include impacts from accidental spills of petroleum products. In response to the risk associated with the transportation and storage of petroleum products, IMC has developed a SPCCP. All oil storage tanks are equipped with berms that serve as secondary containment and are of sufficient volume to contain the entire contents of the tank, plus precipitation events. The SPCCP addresses the need to minimize the potential for accidental spills and environmental contamination by discussing the steps that would be taken to contain and clean up such spills. Implementation of the SPCCP would significantly reduce the potential for accidental spills that may affect water quality.

Cumulative Effects

Under all action alternatives, a short-term increase in sediment yields may occur in the Jerritt Canyon watershed during the initial stages of mining. This would be mitigated by constructing sediment control structures. The cumulative effects to surface water quality due to sedimentation in Jerritt Creek and Burns Creek would be a reduction in the total annual sediment yields under all of the action alternatives after reclamation, when compared to Alternative A and baseline conditions. Potential cumulative effects to surface water quality due to generation of acid waters is discussed under geochemistry in the geology section of Chapter 4.

Groundwater Resources

The focus issue associated with groundwater resources is the potential for acid mine drainage to affect groundwater quality. Other issues associated with groundwater are the potential for groundwater to be impounded in the pits and potential effects to the flow of Niagara and Van Norman Springs. Effects to groundwater are discussed in terms of quantity and quality.

Groundwater Quantity

The mine expansion operations would affect groundwater quantity by mining below the estimated water table in the New Deep pit; removing or covering springs and seeps in New Deep, Saval and Steer; and altering runoff, recharge, and discharge characteristics within disturbed areas. The anticipated magnitude and longevity of these impacts are discussed in the following sections.

Alternative A - No Action

There would be no impacts to groundwater quantity in the No Action Alternative other than those analyzed in previous NEPA documents.

Effects Common to Alternatives B, C, D, E and G

The final elevation of the proposed New Deep pit bottom would be 5,960 feet, or approximately 140 feet below the estimated regional groundwater surface elevation in the New Deep mine area, as summarized in Table 4.8. The regional groundwater system is assumed to encompass the western slopes of the Independence Mountain Range from the drainage divide between Jerritt Canyon and Snow Canyon on the north to Burns Creek on the south and extending into the Independence Valley on the west. Mining in the New Deep pit would occur below the estimated water table elevation of 6,100 feet for approximately the last three years of pit development, as presently planned, and groundwater would be expected to flow into the pit.

Preliminary estimates of potential groundwater inflow rates for the New Deep pit range from 100 to 300 gpm (HCI 1993). These estimated rates of inflow are based on a transmissivity value of 1,000 gallons per day per foot obtained from airlift recovery tests of monitoring wells. This calculation assumed a storativity of 0.02, which is believed to be representative of water table conditions in fractured rock. The wide range of pit inflow values is due to the variability of groundwater flow characteristics which are expected in a fracture controlled, bedrock groundwater system such as occurs in the New Deep area. The extent to which water would collect in the pit during mining is not fully known, because this depends on the rate of water inflow and the extent to which the water evaporates or

Table 4.8
Proposed Pit Bottom Elevations and Regional Groundwater Elevations

Pit	Pit Bottom Elevation After Expansion	Estimated Regional Groundwater Elevation
New Deep	5,960 feet	6,100 feet
Saval	6,560 feet	6,382 feet
Steer	7,280 feet	6,382 feet
Burns Basin	6,860 feet	6,500 feet

Source: Westec 1993

infiltrates into the fractured rock in the bottom of the pit. Water that would collect in this pit would be routed to in-pit sumps. If sufficient quantities are available, it would be stored in sumps, ponds or tanks and used for dust suppression or in other facets of the mining operations. The availability of water at New Deep would decrease the amount that is currently pumped over six miles to the mine site for use in mine operations and exploration drilling. Active dewatering of the New Deep pit area prior to mining is currently not anticipated. If active dewatering were necessary, the water would be routed to storage ponds or tanks and would be utilized for dust suppression or in other facets of mine operations. In the event that there was excess water beyond that required for the mining operations, IMC would obtain the required permits for surface discharge or underground injection.

Excavation of the New Deep pit would create a "cone of depression" (an area of lowered groundwater levels adjacent to the pit) during mining as a result of removal of water from the pit. The radius of the cone of depression is not known, but it would likely be less than three miles from the deepest point in the pit, given the low transmissivity of the rocks, numerous faults and fractures in the area and low flow rates expected. No water supply wells occur within a three miles radius of the pit, but developed and undeveloped springs in this area could potentially be affected, as discussed in the next section. Perched groundwater outside of the pit would not be affected, as the source of the perched groundwater is from precipitation, snow melt, and infiltrating surface water.

After mining is completed, groundwater may flow into the New Deep pit and stabilize at or near the pre-mining static water level of approximately 6,100 feet. Water impounded in the pit may reach a maximum depth of 140 feet and may have a surface area as large as 19 acres (HCI 1993).

Mining of the Saval and Steer pits and the expansion of the Burns Basin pit is not expected to intersect the regional groundwater table, but would intersect perched aquifers occurring at various elevations. Perched groundwater may flow into the pits but would be expected to either evaporate or infiltrate into fractured rock in the pit bottom, as has been observed in the past at the Jerritt Canyon mine. As a result, impoundment of groundwater in the Saval, Steer, and Burns Basin pits is not expected.

Alternative F

Direct effects to groundwater quantity for Alternative F would be less than the other action alternatives due to underground mining of the New Deep deposit. The New Deep underground mine would reach a maximum depth of 5,950 feet and inflow of regional groundwater would be expected to occur below approximately 6,100 feet. Sustained groundwater inflows into the New Deep underground workings were estimated to be 100 to 150 gpm (HydroGeo 1993). A maximum inflow of 250 gpm at any given time was predicted for the underground operations (HydroGeo 1993). Water utilized or encountered during underground mining would be directed to sumps located inside the underground workings and near the portal sites. Active dewatering prior to underground mining using wells and pumps is currently not anticipated. If active dewatering were necessary, the water would be routed to storage ponds or tanks and utilized for dust suppression or in other facets of the mining operations. In the event there was excess water beyond that required for the mining operations, IMC would obtain the required permits for surface discharge or underground injection.

The areal extent of the cone of depression that would form would be less than that for an open pit, due to the smaller size of the underground workings and because inflows to underground workings would be controlled using concrete, shotcrete, grout or other standard methods. Water would be impounded in the underground workings after mining but would not flow out of the portals to surface waters because the adits would be constructed as declines that intersect the surface at elevations considerably higher than the static groundwater level.

Alternative G

Under Alternative G, both underground and surface mining of the New Deep orebody would occur. The effects to groundwater in the New Deep mine area would be a combination of those described for underground mining under Alternative F and those described for open pit mining under Alternatives B, C, D, and E. The cone of depression associated with this alternative may be slightly larger than that which would form under Alternatives B, C, D, and E, as the underground workings extend approximately 10 feet below the depth of the open pit proposed under those alternatives.

Effects to Springs and Seeps

Direct effects to as many as five springs and two seeps could occur as a result of physical disturbance due to covering of springs and seeps by waste rock dumps or from pit excavation. As many as two springs would potentially be indirectly affected by flow reduction due to excavation of the New Deep pit and depression of the water table in this area. The effects to springs and seeps under the action alternatives are summarized in Table 4.9. A short term reduction in spring flow could potentially occur at Niagara Spring and spring GDSP-25, both of which probably emanate from the regional groundwater aquifer and are within the estimated area of the cone of depression that could form. Effects to Niagara Spring are of particular concern as it is presently used as a source of irrigation water for a nearby ranching operation. No reduction in flow from Van Norman Spring is expected to occur as a result of mining the New Deep pit, because it is located nearly four miles away in a completely different watershed. This spring is located over two miles from the Saval/Steer mine area and Burns Basin pit expansion area. Since these pits are not expected to penetrate the regional groundwater table, flow reductions are not anticipated at Van Norman Spring.

Table 4.9
Summary of Impacts to Springs and Seeps by Alternative

	Springs				SEEPS		
Alternative	Number Present in Area	Number Affected by Pits	Number Affected by Dumps	Number with Potential Effects to Flow[1]	Number Present in Area	Number Affected by Pits	Number Affected by Dumps
A	23	0	0	0	8	0	0
B	23	1	4	2	8	2	1
C	23	1	5	2	8	2	1
D	23	1	4	2	8	2	1
E	23	1	4	2	8	2	1
F	23	1	3	2	8	2	0
G	23	1	4	2	8	2	1

Note: [1] Potential effects to spring flow may occur if pit dewatering is required and a cone of depression in the water table is formed that has a three mile radius

Over the past ten years, flows from Niagara Spring have varied between 300 and 8,620 gpm, averaging 3,599 gpm. The degree of hydraulic connection between the New Deep pit area and Niagara Spring is not known due to complex faulting and poor exposure of the rock units in the area between the pit and Niagara Spring. Geologic data indicates that there are faults between the two sites that may act as flow barriers that would limit the hydraulic connection. If the New Deep pit and Niagara Spring were directly connected, the estimated inflows of 100 to 300 gpm represent only about three to eight percent of the average flow from this spring. Niagara Spring would continue to be monitored by IMC during implementation of any of the action alternatives. If a reduction of flow occurs that impairs the use of this spring and is attributable to mining, appropriate mitigation measures would be implemented. After mining, reduced spring flows would probably recover fully. Perched springs and seeps outside the pits and dumps would not be affected.

Indirect effects to other resources that result from reduction of flows and/or covering of springs and seeps may include reduced availability of water for wildlife and livestock, localized changes in vegetation, and waste rock dump stability issues related to foundation conditions. Reductions in water availability and vegetation changes outside of the proposed disturbance areas that may result from removing water from the New Deep pit would be temporary in nature. Surface expression of springs that are covered by dumps would be relocated to the outlet of the underdump drainage system. Waste rock dump stability would be enhanced as a result of maintaining the dumps in an unsaturated condition. This would be accomplished by allowing surface runoff and flows from springs and seeps located in the bottom of natural drainages to pass through the waste rock dumps. No springs or seeps on hillsides have been identified within the waste rock dump sites. If springs are discovered on hillsides and/or located within the waste rock dump sites, a trench drain would be developed that would allow flows to reach the under-dump drainage system or beyond the dump perimeter. Fine textured materials that may impede flows would not be placed in these areas.

Effects to Recharge and Discharge

Effects Common to all Action Alternatives

Excavation of pits above the water table would increase infiltration to groundwater by capturing precipitation, temporarily ponding water, and enhancing recharge through the fractured bedrock in the bottom of the pits, during mining and after reclamation. If inflows are of sufficient quantity below the water table in the New Deep pit to require removal and use or discharge, then recharge to the groundwater system would be reduced during mining. Recharge would be expected to equal or exceed natural conditions after mining is completed. Mine dumps would enhance recharge to groundwater and decrease surface water runoff as a result of creation of relatively flat dump surfaces on steep natural terrain. Road construction would increase runoff and decrease infiltration. The overall effect of the action alternatives would be to decrease runoff and slightly increase groundwater recharge during mining and after reclamation. These effects would be less for Alternative F than the other action alternatives because a pit would not be created in the New Deep mine area. Surface water runoff to other parts of the basin would decrease due to increased infiltration in the mine area.

Cumulative Effects

Existing mining operations have not encountered groundwater, other than minor seeps along pit highwalls that flow in response to snowmelt and precipitation. No future actions other than the proposed action or the action alternatives are foreseen for this groundwater system. Therefore, there are no past, present or future actions which would result in cumulative impacts to groundwater resources beyond those discussed for direct impacts.

Groundwater Quality

Alternative A -- No Action

There would be no impacts to water quality under the No Action Alternative other than those resulting from actions analyzed in previous NEPA documents.

Effects Common to All Action Alternatives

Groundwater quality may be directly affected if generation of acid rock drainage and subsequent mobilization of trace metals and other compounds from waste rock and pits were to occur. The potential for acid rock drainage and trace metal mobilization to occur in the project area has been evaluated during geochemical waste rock characterization studies, described in detail in Chapter 3. Results of these analyses are discussed in the geochemistry section in Chapter 4.

Effects Common to Alternatives B,C,D,E and G

If impoundment of water occurs in the New Deep pit, the potential also exists for changes in water quality as a result of interaction with rocks in the pit walls. Pit water would be expected to meet state water quality standards or baseline groundwater conditions. If the water does not meet state water quality standards, the water would be treated to meet state standards.

Spring and seep water quality may potentially be affected by contact with waste rock in areas where the springs and seeps have been covered by waste rock dumps, where dumps are located upstream, or by contact with pit walls following excavation of the pits. These waters would be impacted only if weathering of the waste rock by contact with the water and air generates poor water quality.

Water that collects in the New Deep pit would be monitored on a regular basis after mining is completed. The monitoring program would be developed and incorporated into the final POO.

Cumulative Effects

The proposed action, when combined with past and existing mining activities, would cumulatively increase the area which could be affected by weathering of pit wall rock, waste rock dumps, and ore stockpiles. The high TDS and sulfate concentrations recorded for springs GDSP-10 and MCDS-10 may indicate either groundwater in equilibrium with ore deposits or the oxidation of sulfides in adjacent and upgradient waste rock dumps. No baseline data were collected for these springs, and therefore the source of sulfate is unknown. Other than effects to groundwater that result from the proposed action and the action alternatives, no future actions are foreseen that would affect groundwater quality. Cumulative effects to groundwater resources would be a combination of the effects due to existing operations and proposed operations.

Wetlands

The potential for loss of wetlands was identified through public scoping as an issue. In order to provide a comprehensive evaluation of potential impacts to the proposed action and alternatives, the following analysis examines potential impacts to waters of the United States including wetlands. Mitigation is typically used to offset unavoidable adverse impacts which would occur after all appropriate and practical measures have been taken to minimize wetland impacts. The area of analysis is the Project area.

Alternative A - No Action

Under Alternative A, there would be no new impacts to existing waters or wetlands other than those already identified and authorized for existing and approved operations.

Effects Common to All Action Alternatives

There would be some direct and unavoidable disturbance to waters of the U.S. including wetlands under all of the action alternatives, as displayed in Table 4.10. Potential impacts to wetlands categorized according to habitat type are summarized in Table 4.11. Maps of potential impact areas for the proposed action have been submitted to the Corps and are included in Appendix C. Under any action alternative, affected wetlands would be less than a total of four acres. A finalized analysis of affected wetlands would be conducted by the Corps and be based on the ROD issued by the USFS for the FEIS. Wetland impacts associated with the alternative selected by the USFS would not be expected to exceed the range indicated in Table 4.10. Section 404 (b) (1) guidelines require that measures be taken to first avoid and second to minimize impacts to wetlands. The following sections summarize the avoidance, minimization, and mitigation strategies considered and incorporated into the alternatives.

<u>Avoidance</u>

As described in Chapter 2, various alternatives were considered by an IDT to address issues raised during scoping, including potential impacts to waters of the U.S. and wetlands. Mining pits were not subject to the alternatives analysis because pit locations and configurations are defined by the presence and depth of economic gold mineralization. As a result, impacts to waters and wetlands in the pits are considered unavoidable. Locations of waste rock dumps, haul roads, and sediment control structures were evaluated under several criteria such as stability factors. Sidehill type waste rock dumps were initially evaluated for the Saval, Steer, and New Deep mine areas as a means of avoiding waters and wetlands. This type of dump construction would not provide the required storage capacity and would fail to meet stability criteria. Due to these factors, alternatives incorporating sidehill type dumps that did not cross drainage bottoms were eliminated from further analysis, as described in Chapter 2. Haul road locations were selected to minimize the number of stream crossings and avoid wetlands to the extent possible. Sediment control measures would be installed in the drainage bottoms to maximize the effectiveness of these structures in intercepting runoff from fill related activities and to protect downstream

Table 4.10
Summary of Impacts to Waters and Wetlands of the U.S. by Alternative

Description	Impacts (Acres)						
	Alternative A (Existing Approved Disturbance)	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
Waters	3.30	5.90	6.48	7.20	6.18	3.04	6.04
Wetlands	3.57	3.40	3.67	3.82	3.64	2.89	3.40
Total	**6.87**	**9.30**	**10.15**	**11.02**	**9.81**	**5.93**	**9.44**
Cumulative Total	6.87	16.17	17.02	17.89	16.68	12.80	16.31

Source: IMC August 1993.

Table 4.11
Impacts to Wetland Habitat Types by Alternative (Acres)

Alternative	Riparian Wetlands	Riparian Spring & Seep Wetlands	Isolated Spring & Seep Wetlands	Total Wetland Impact	Cumulative Wetland Impact
A	2.35	0.17	1.05	3.57	3.57
B	1.13	2.03	0.24	3.40	6.97
E	1.22	2.21	0.24	3.67	7.24
D	1.27	2.31	0.24	3.82	7.39
E	1.21	2.19	0.24	3.64	7.21
E	0.96	1.69	0.24	2.89	6.46
G	1.13	2.03	0.24	3.40	6.97

Source: IMC August 1993.

waters and wetlands resources. The alternatives being examined in this DEIS result in unavoidable impacts to waters and wetlands that would be minimized as described in the next section.

Minimization

Guidelines in 40 CFR 230.10 (d) state that no discharge of dredged or fill material shall be permitted unless appropriate and practical steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem. Minimization of impacts to waters and wetlands was incorporated into the design of Alternatives B, C, E, F, and G waste rock dumps. This was accomplished by designing the lower levels of the waste rock dumps under these alternatives as cross-valley fills with angle of repose slopes. Developing the waste rock dumps in this manner utilizes the natural topography to maximize storage capacity and reduce the area of disturbance.

Several alternative dump sites at greater distances from the pits were evaluated as a means of minimizing impacts to waters and wetlands, as described in Chapter 2. The alternative dump site locations were eliminated from further consideration because of unfavorable haulage distances and the need to construct additional haul roads using deep fills across drainages. The stability of the road fills across the drainages was a factor considered by IMC in the development of their proposed action. Sediment traps, catchment basins, dumps, silt fences, hay bale check dams, and other effective methods would continue to be installed in appropriate locations before or during construction to intercept runoff and sediment from fill-related activities.

Mitigation and Monitoring

A mitigation and monitoring plan would be developed in coordination with appropriate resource agencies and a final plan would be approved by the Corps. The final mitigation plan would include, but not be limited to, the following: 1) identify the size and location of the mitigation area, 2) water sources to maintain the area, 3) revegetation plans, 4) a five year maintenance and monitoring plan including performance standards to determine mitigation success, 5) the parties ultimately responsible for the plan's success, and 6) contingency plans to be enacted if the plan fails.

IMC proposes to mitigate any unavoidable wetland losses by creation of new wetlands. IMC is currently implementing a wetland mitigation program designed to compensate for wetland impacts incurred from existing, approved operations.

Initially, the intent of this mitigation program was to create new wetlands as near as possible to the impacted areas. It became apparent, however, that there are several inherent disadvantages to this approach. In order to create new wetlands, a reliable water source is necessary. A reliable groundwater source is not available near the proposed areas of impact, so the mitigation would need to take advantage of available surface water. The problem with this is that areas with available surface water are, quite often, those with higher habitat values. It would be counterproductive to disturb areas with high existing habitat values to create wetlands. The greater total gain in habitat value would result from creating wetlands in areas with relatively low existing values.

Another disadvantage of creating wetlands as close as possible to the impacted area is that their proximity to existing mine operations and ore deposits could result in their being located in the path of future mine expansion. Mitigation should be designed so that the possibility for conflicts between mine operations and wetlands could be reduced, not increased.

Because of the above factors, the area for potential mitigation sites was extended. Eventually a site was located which had the potential not only for mitigating existing and approved impacts but also impacts which could result from future expansion such as the proposed action and the alternatives examined in this DEIS. This mitigation area is located at the site of an old gravel pit at the eastern flanks of the Independence Mountain Range, approximately seven miles from the proposed disturbance area. The habitat has been altered by past borrow activities and although it is not currently a wetland, the groundwater is near enough to the surface that wetland hydrology conditions can be achieved by excavation. This conclusion is based on groundwater monitoring conducted in the spring and early summer 1993.

The mitigation area for existing and approved impacts is being constructed in a two-year, phased program. Initially, the land will be excavated to the approximate target elevations based on projected spring and early summer groundwater levels. The water level within the excavated area would then be monitored through one growing season. The contours would be adjusted as dictated by the monitoring and then application of top soil, seeding, and sprigging would be completed. The wetlands are being designed as a diverse aquatic system including riparian shrub, shallow water marsh, deep water marsh, aquatic bed, and upland nesting islands.

The area of wetlands being developed exceeds that required to mitigate previously incurred impacts. The wetlands being created could also compensate for impacts which would result from the proposed expansion. The ratio of wetlands created to wetlands impacted by the proposed action or alternatives would approach 2:1 regardless of the alternative selected. It is anticipated that full functional replacement of wetland values would be achieved under any alternative given the design factors of the mitigation area and the amount of wetlands created per acres impacted.

The excavation or filling of wetlands could indirectly impact wildlife as a result of habitat disturbance at a particular location. The proposed operations would not jeopardize continued existence of any TES species, or impact any identified cultural resources sites that are eligible for the National Register of Historic Places (NRHP). None of the alternatives are expected to significantly affect aquatic habitat or water quality. The reader is referred to the analysis for TES, cultural resources, aquatic resources, and water quality in Chapter 4 for more information.

Cumulative Impacts

Cumulative impacts from existing approved operations and the proposed action alternatives are displayed in Table 4.10. Cumulative impacts are greatest under Alternative D and least under Alternative F.

4.3 Biological Environment

Aquatic Resources and Fisheries

The issues associated with aquatic resources are primarily related to surface water and, to a lesser extent, groundwater. Related issues include effects to any threatened, endangered, sensitive, or candidate fish species.

Alternative A - No Action

There would be no impacts to aquatic resources under Alternative A other than those analyzed under previous NEPA documents.

Effects Common to All Action Alternatives

The effects of the action alternatives to surface water resources are discussed in detail in the surface water resources section of Chapter 4 of this DEIS. Surface water impacts that would directly affect aquatic resources include decreases in water quantity, timing of flow, and effects to water quality due to changes in sediment yields or generation of acid mine drainage.

Water quantity is expected to decrease below pre-mining levels as a result of the proposed mining operations as water is trapped in the pits. This decrease in water runoff volumes would be greater for the Jerritt Creek watershed because runoff in the Burns Basin watershed has already been affected by development of the Burns Basin pit. Burns Creek is the only stream known to have reproducing fish populations within the Project area. These decreases in water flow may negatively affect the aquatic resources present downstream of the mining operations. However, the timing of water flow would be somewhat regulated by the development of waste rock dumps. The projected decreases in stream flow may also be partially offset by increases in stream flow as water in the pits recharges springs located downstream from the mine area.

The action alternatives could result in a short-term increase in sediment yield as a result of surface disturbance during pit development and waste rock dump construction. Until pits are deep enough to function as sediment traps, sedimentation would likely increase over existing conditions, and would have a short term negative impact to water quality and aquatic resources. After reclamation and revegetation of the proposed mining activities, sediment yields are expected to be reduced to below pre-mining conditions for all alternatives in the Jerritt Creek and Burns Creek watersheds.

Vegetation

The issues associated with the vegetation resources of the project area include: 1) the potential for threatened, endangered, candidate, or sensitive plant species to be affected; 2) effects to vegetative diversity; and 3) the potential for aspen habitat to be fragmented. Related issues include effects to wildlife habitat, range resources and wetlands. The reclamation potential focus issue as it relates to vegetation is also discussed in this section.

Alternative A - No Action

Under Alternative A there would be no additional impacts to vegetation beyond those resulting from approved and existing operations. These effects have been analyzed in previous NEPA documents.

Threatened, Endangered, Candidate, and Sensitive Species

As discussed in Chapter 3, no threatened or endangered plant species or their habitat occur in the Project area. Potential habitat for three USFWS candidate plant species which are also classified as sensitive by the USFS occurs or may occur within the project area. These three species are Lewis' buckwheat, meadow pussytoes and Howell dimersia. None of these species were found during intensive field surveys of the Project area and no negative effects are expected. Grimes vetchling is currently classified as a candidate species and has been petitioned for listing as an endangered species. Potential habitat for Grimes vetchling is not likely to occur in the Project area and none of these plants was found during field surveys.

Cumulative Effects

No cumulative effects to threatened, endangered, candidate or sensitive plant species are expected because none have been observed within the existing and proposed mine areas.

Vegetative Diversity

As discussed in the vegetation section of Chapter 3, there are 74 vegetation types in the Independence Mountains that have been grouped into ten community types. A summary of the effects of the project alternatives to these community types is presented in Table 4.12 and are discussed below.

Direct effects to vegetative diversity would occur from disturbance to vegetative cover during development and operation of the proposed project or the action alternatives. Most of the disturbance would occur within the sagebrush/grassland community type, with lesser amounts of disturbance to the mature aspen and north-facing brush community types, both of which provide habitat for mule deer and other wildlife species. Alternative F would have the least impact (1,777 acres) to existing vegetation resources and Alternative D would have the greatest impact (2,744 acres) to existing vegetation resources.

Table 4.12
Vegetation Community Type Disturbed by Alternative (Acres)

Vegetation Community Type	Alternative						
	A[1]	B	C	D	E	F	G
Sagebrush/Grasslands	0	1,555	1,620	1,608	1,472	919	1,593
Aspen							
Mature Aspen	0	623	648	641	627	613	623
Snowbank Aspen	0	14	14	15	14	10	14
North-Facing Mountain Brush	0	223	225	272	263	91	223
Sagebrush/Snowberry	0	90	100	145	130	[illegible]	98
Low Sagebrush/Grasslands	0	41	41	42	41	41	41
South-Facing Mountain Brush	0	<1	41	<1	<1	0	<1
Herbaceous Meadow	0	9	10	16	9	10	9
Riparian	0	4	0	[illegible]	1	0	4
Snowbank Forb	0	0	0	0	0	0	0
Subalpine Fir/Pine	0	0	0	0	0	0	0
Total Additional Net Disturbance by Community (Acres)	**0**	**2,559**	**2,662**	**2,744**	**2,557**	**1,777**	**2,605**

Source: USFS GIS data base, June 24, 1993.

Note: [1]Under Alternative A, the No Action Alternative, there would be no new additional disturbance.

All action alternatives would have direct and indirect effects on vegetative diversity in terms of abundance and distribution of vegetation. During the life of the project, including reclamation activities, there would be a modification in plant composition, age, heights, and canopy densities within disturbed areas. Once reclamation activities are completed and vegetation becomes re-established, new community types consisting of a mixture of native and introduced grasses, forbs and shrubs would develop. The reclaimed sites would contain early successional stages as a result of concurrent reclamation. This would form a vegetation mosaic within the Project area in the short term. Over time, the first generation plantings of aspens and shrubs would mature and reproduce, invasion by plant species from the adjacent undisturbed lands would occur, and eventually the diversity of the vegetative cover in disturbed areas would be expected to be similar to that of adjacent undisturbed areas.

Cumulative Effects

The time frame for the cumulative effects analysis is assumed to be the life of the proposed project plus the time required for establishment of vegetation on disturbed areas. The life of the proposed project is estimated to be approximately ten years, including reclamation. Table 4.13 presents new and cumulative impacts in relation to pre-mining (baseline) vegetation for the study area. Assuming that the effects to vegetative diversity are directly related to the acreage disturbed, Alternative A, the No Action Alternative, would have the least cumulative impact to vegetative diversity. Alternative D would have the largest cumulative impact to vegetative diversity.

Table 4.13
Cumulative Impacts to Vegetation Resources in the General Study Area by Alternative

Vegetation Community	Baseline	Alternative						
		A	B	C	D	E	F	G
Sagebrush/Grasslands	22,151	1,727	3,282	3,347	3,335	3,199	2,646	3,320
Aspen								
Mature Aspen	6,525	559	1,182	1,207	1,207	1,186	1,172	1,182
Snowbank Aspen	552	24	38	38	39	38	38	38
North-Facing Mountain Brush	3,169	257	480	482	529	520	348	480
Sagebrush/Snowberry	7,279	425	515	525	570	555	514	523
Low Sagebrush/Grasslands	3,354	102	143	143	144	143	143	143
South-Facing Mountain Brush	241	7	[illegible]	7	7	7	7	[illegible]
Herbaceous Meadow	45	4	13	14	20	13	14	13
Riparian	300	14	18	18	16	15	14	18
Snowbank Forb	45	2	2	2	2	2	2	2
Sub-Alpine Fir/Pine	6	4	0	0	0	0	0	0
Rock/Talus	300	16	16	16	16	16	16	16
USFS Administrative Area	82	0	0	7	0	0	0	0
TOTAL	**44,054[1]**	**3,137[1]**	**5,696[1]**	**5,799[1]**	**5,881[1]**	**5,694[1]**	**4,914[1]**	**5,742[1]**

Source: USFS GIS data base, June 24, 1993.

Note: [1]Includes 954 acres of existing USFS and exploration roads that is carried forward cumulatively across all alternatives.

Aspen Habitat Fragmentation

Attempts were made to analyze effects to aspen habitat fragmentation in terms of the distance between aspen stands and stand size. However, the GIS technology available was not adequate to perform the detailed spatial analysis required (Anderson, pers. comm., 1993). Effects to aspen fragmentation are therefore analyzed in terms of the acreage of direct removal, as shown in Table 4.12.

The spatial distribution of mature and snowbank aspen community types relative to Alternative C is shown on Map 4.1. Most of the aspen communities that would be disturbed under any action alternative are located in the Saval and Steer mine areas, and all action alternatives have very similar disturbances in this area. Therefore, the amount of aspen disturbed does not vary substantively between action alternatives, and ranges from 627 acres under Alternative F to 662 acres under Alternative C (Table 4.12). Projected estimated disturbance of existing aspen in the Project area would range from 39 percent under Alternative F to 42 percent under Alternative C. Disturbance in the Jerritt Canyon watershed would range from 541 acres (53 percent) under Alternative F to 597 acres (65 percent) under Alternative D. Disturbance in the Burns Creek watershed would range from 140 acres (10 percent) under Alternative E to 162 acres (13 percent) under Alternative C. For the general study area, the projected disturbance would range from approximately 9.6 percent under Alternative F to 10.1 percent under Alternative C.

Several large contiguous aspen stands that occur on north-facing slopes in Saval and Steer Canyons would be disturbed under all action alternatives. Small isolated islands of aspen habitat would remain after project implementation, and these islands may be selectively utilized by some plant and animal species.

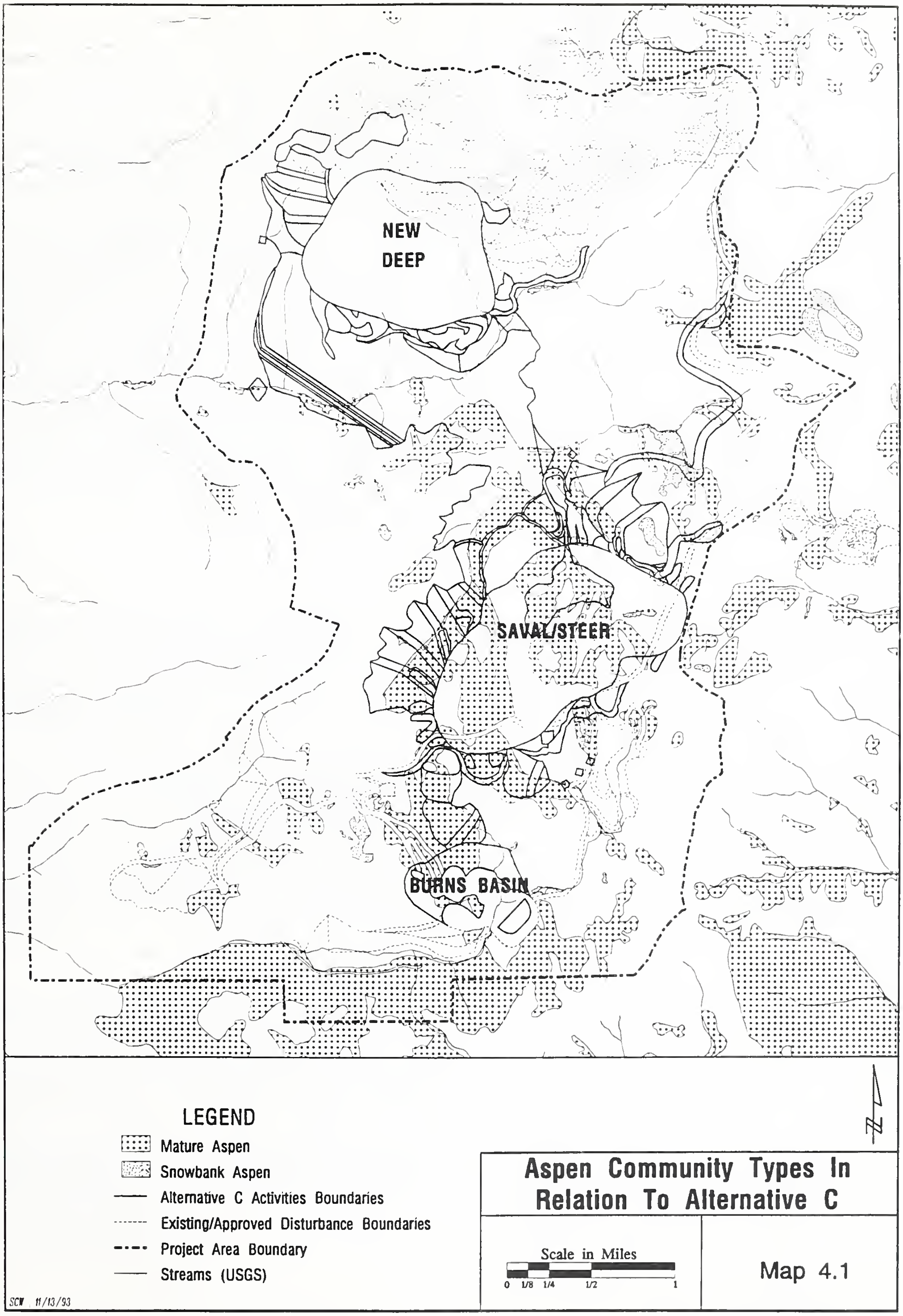
<u>Cumulative Effects</u>

Cumulative effects to aspen habitat fragmentation are summarized in Table 4.13. As discussed above, differences in the magnitude of cumulative effects between the action alternatives are minimal due to the location of aspen stands relative to proposed disturbance in the Saval and Steer mine area.

Other Issues Related to Vegetation

<u>Wetlands</u>

There would be some unavoidable disturbance to wetlands that are included within the riparian and herbaceous meadow community types under all action alternatives. Wetlands are not distinguished as a community type under the ECODATA mapping system. The wetlands in the Project area were delineated and approved in accordance with Corps guidelines. Effects to wetlands would be avoided or minimized to the extent practicable. Unavoidable effects would be mitigated through the enhancement and/or creation of wetlands, as discussed under the wetlands section of Chapter 4.



Aspen Community Types In Relation To Alternative C

Map 4.1

Wildlife Habitat and Range Resources

All action alternatives would have direct and indirect effects on the abundance and distribution of wildlife habitat and range resources. Existing vegetative cover provides habitat for a variety of wildlife species and forage for livestock. During the life of the project, including reclamation activities, changes in vegetation would result in a temporary loss of habitat, which would displace some animals to neighboring areas, provided those areas were capable of supporting additional animals. Once reclamation activities are completed and vegetation becomes re-established on suitable sites, wildlife and livestock would likely return to the previously disturbed areas. Wildlife habitat and livestock forage would be enhanced as a result of inclusion of species utilized by wildlife and livestock in the seed mixtures. Habitat potential for wildlife would initially favor species that prefer early vegetative seral stages. Over time, with the progression of secondary succession, more age classes would become established, structural diversity would be reestablished, and wildlife species requiring older successional stages would be expected to return. Disturbance areas which would not be revegetated represent an irreversible loss of habitat for some wildlife species and livestock forage, modification of existing wildlife habitat for some species, and creation of wildlife habitat for other species. Wildlife resources are discussed in more detail below in the wildlife section in Chapter 4.

Reclamation Potential

Reclamation activities proposed under all action alternatives would mitigate to varying degrees the effects to vegetative diversity and aspen habitat fragmentation in the Project area. The acreage anticipated to be revegetated under each alternative is displayed in Table 2.2. The goal of the revegetation efforts would be to re-establish a productive vegetation cover within two to five years after mining and reclamation activities cease, although some revegetation would occur earlier through concurrent reclamation that would be ongoing during project implementation. Growth medium application and revegetation would occur on relatively flat waste rock dump surfaces, 3:1 dump slopes, accessible pit bottoms, new facilities sites, low grade ore stockpiles abandoned at closure, benches and portions of the angle of repose slopes. Appropriate areas in the bottoms of pits would be revegetated to establish a protective ground cover, wetlands or aspen habitat. Areas within the pits that would be revegetated cannot be determined until the pit is completed, and therefore they have not been included in Table 2.2.

Seed mixtures used to reclaim disturbed areas would be approved by the USFS and would include a variety of grasses, forbs, and shrubs that are adapted to the regional climate and site conditions. Some of the species in the seed mixture are not native to the area. Several of the introduced grass and forb species in the seed mixtures are selected for their ability to stabilize disturbed sites and control erosion. Species selection is based on adaptability, diversity, and potential for succession enhancement. Native and introduced plant species that are utilized by wildlife or livestock are also included in the seed mixtures. The re-established vegetation would not be an exact duplicate of the original community types. However, invasion by plant species from the adjacent undisturbed lands would gradually occur. Over time, the diversity of the vegetative cover in disturbed areas is expected to be similar to that of adjacent undisturbed areas.

Reclamation activities would involve re-establishing aspen by planting seedlings on north-facing slopes or other appropriate locations where reclaimable disturbance has occurred. Regeneration of mature aspen stands from seedlings, root cuttings, and natural invasion would be expected to require decades.

Short term cumulative effects to vegetation include impacts resulting from existing and ongoing disturbance that has not been revegetated as well as effects due to implementation of an action alternative. These effects would decrease as reclamation activities and revegetation take place. Some disturbed areas such as portions of pit bottoms and walls, portions of haul roads, and angle of repose waste rock dump slopes would not be revegetated resulting in long term cumulative effects to vegetation resources. Any areas that do not become revegetated through reclamation activities or by natural processes would result in an irreversible and irretrievable commitment of vegetation resources. The total acreage of disturbances that would and would not be expected to be revegetated under each alternative is provided in Table 2.2.

Wildlife

The primary issues associated with wildlife include potential effects to the following: 1) endangered, threatened, candidate, or sensitive species, 2) goshawk habitat, 3) mule deer habitat, 4) sage grouse brooding habitat, 5) golden eagles, and 6) upland game birds, furbearers, and trout. Related issues include effects to other wildlife species and aspen habitat fragmentation.

The analysis areas for direct, indirect, and cumulative impacts to wildlife resources are third order watersheds within the Independence Mountains, unless noted otherwise in the following sections. Thresholds of concern (TOCs) have been established for some wildlife species or their habitats to facilitate analysis of direct and cumulative impacts. The level of disturbance that results in a TOC being exceeded generally warrants additional mitigation. The TOCs for wildlife were determined through a process documented in the draft CEA Technical Guide (USDA, USFS 1992a).

A direct loss of wildlife habitat would occur upon implementation of any of the action alternatives analyzed in this DEIS. The number of acres and potential quality of wildlife habitat disturbed varies by alternative. "Islands" of undisturbed habitat were analyzed as short term disturbance under CEA guidelines. Indirect impacts to wildlife in the form of temporary displacement would also result from project implementation.

A direct loss of approximately 2,559 acres of wildlife habitat, primarily sagebrush/grassland and mature aspen vegetation, would occur under the proposed action (Alternative B). Direct disturbance varies with the other action alternatives from a low of approximately 1,777 acres under Alternative F to as much as approximately 2,744 acres under Alternative D. In addition, 344 acres (Alternative F) to 419 acres (Alternative D) of "islands" of undisturbed habitat that were analyzed as short term disturbance to wildlife resources using CEA guidelines would be indirectly affected. The duration of disturbance is determined by the type of disturbance. For example, relatively flat dump surfaces are considered short term disturbance and pits, haul roads, and angle of repose slopes are considered long term disturbance.

Direct, indirect, and cumulative effects vary according to the particular wildlife related issue being considered. For this reason, each of the wildlife issues are discussed separately.

Alternative A - No Action

There would be no direct, indirect, or cumulative impacts to wildlife resources under the No Action Alternative other than those that may result from existing and approved operations. These impacts have been analyzed in previous NEPA documents.

Endangered, Threatened, Candidate, and Sensitive Species

Field surveys conducted by JBR in 1992 and WESTEC biologists in 1993 determined the extent of endangered, threatened, candidate, and sensitive animal species occurring or potentially occurring in the Project area. These surveys, combined with information obtained from a literature review and previous surveys, were used to analyze potential impacts to endangered, threatened, candidate, and sensitive species.

Endangered Species

Impacts to bald eagles, which may occasionally migrate through the Project area annually, and peregrine falcons that may rarely pass through the area would be negligible. Neither of these species would be adversely affected by loss of habitat or altered distribution of forage under any of the action alternatives.

Threatened Species

There would be no additional impacts to Lahontan cutthroat trout as a result of any action alternative. Prolonged use of the haul road that was analyzed in previous documents would occur under all action alternatives. Potential impacts to Lahontan cutthroat trout under the no action alternative have been analyzed in previous NEPA documents, including the FEIS for the original Jerritt Canyon Project and subsequent EAs and POO modifications.

Candidate Species

Potential habitat for the Preble's shrew, pygmy rabbit, western big-eared bat, and spotted bat exists within the Project area, but none of these mammals was observed during the field surveys for the mine expansion. Because of the widespread distribution of these species, no significant impacts are expected for any of these species or their habitats as a result of project implementation. The two bat species rely heavily on water sources for both watering and food, but mist net surveys of the only two ponds within the Project area that contained water in 1992 did not reveal the presence of either species. Since none of the ponds within the Project area would be eliminated as a result of implementation of any action alternative, there would be no adverse impact to these ponds as potential bat habitat. Existing roosting habitat may be disturbed or displaced under any action alternative, but some habitat may also be created as a result of mining. Spotted bat habitat may be created by the exposure of pit walls having cracks and crevices that would serve as potential spotted bat roosting sites. Current highwalls in the Jerritt area do not appear to have cracks suitable for roosting habitat (Warder, pers. comm.). Mine shafts and adits created by underground mining, as proposed in Alternatives F and G, could possibly create western big-eared bat roosting habitat depending upon the final closure methods utilized.

Sierra Nevada red fox and lynx were not observed during field surveys of the Project area. As described in Chapter 3, these species are not expected to occur in the Independence Mountains or the Project area. No adverse impacts on these two species are expected to result from the mine expansion operations.

Of the two Category 2 bird species described in Chapter 3 under Candidate Species that have the potential to occur within the Project area, only habitat for the loggerhead shrike exists. Neither of the two candidate bird species was observed in the Project area during the field surveys for the mine expansion. Loggerhead shrikes have been observed at lower elevations near the Project area. Because of the widespread distribution of loggerhead shrikes and the fact that the Category 2 listing is primarily the result of concerns for this species in the eastern U.S., this species is not expected to be adversely affected by any of the action alternatives.

Redband trout is the only Category 2 fish species that has the potential to occur in the vicinity of the Project area. NDOW has identified Burns Creek as potential habitat for this species. The trout species in Burns Creek has not been genetically tested, but NDOW considers them redband trout. Burns Creek changes from ephemeral to intermittent below the existing mining operations until it is within about one mile of the western Forest boundary, where perennial flows may be encountered. The unstable streambed and banks limit the value of Burns Creek as a fishery. Sediment yields and flows in the long-term are expected to decrease in Burns Creek due to the pit expansion, as discussed in the surface water resources section of Chapter 4. Decreased flows and short-term increases in sedimentation could have some adverse effects, but in the long-term this may be partially offset by the potential for more gradual release of water from the waste rock dumps, and reductions in peak flows from flood events, which may reduce sediment flows that occur during high runoff periods.

Spotted frogs have the potential to occur within the Project area. Although potential habitat exists for this species, no spotted frogs were observed during the 1992 and 1993 field surveys of the Project area. Although riparian habitat would be lost, the spotted frog is not expected to be adversely affected by any of the action alternatives.

Although Mattoni's blue butterfly has the potential to occur within the Project area, no Mattoni's butterflies were observed during the 1992 and 1993 field surveys. The presence of this species in the Project area is considered unlikely and no impacts would be expected under any action alternatives.

Sensitive Species

The flammulated owl is the only USFS sensitive animal species that is not also classified as Category 2 or an MIS that has the potential to occur within the Project area. Habitat for this species is likely present within the Project area, but no flammulated owls were observed during the field surveys. Potential flammulated owl habitat within the Project area would be reduced by implementation of any of the action alternatives. Proposed removal of mature aspen varies from approximately 614 acres in Alternative F to 648 acres in Alternative C. Though reclamation activities may re-establish some aspen, tree size would be too small for nest cavities for several decades. Consequently, long term loss of potential flammulated owl habitat exists under all action alternatives.

Cumulative Effects

With the exception of northern goshawk habitat, the existing mining operations have not impacted any endangered, threatened, candidate, or sensitive species. Therefore, the cumulative effects would be the same as those described for direct effects.

Management Indicator Species

Northern goshawk, mule deer, sage grouse, and trout have been identified as management indicator species (MIS) for the Humboldt National Forest. Direct, indirect and cumulative effects are presented for each species in the following sections.

Northern Goshawk

Northern goshawk are present within the Project area between March and October of each year. The goshawk is considered to be an indicator of the condition and trend of old growth cottonwood-aspen stands that occur in riparian areas.

The CEA technical guide has established TOCs for goshawks based on disturbance within the 1.75 mile radius that defines the home range for each nest site. The CEA analysis for goshawks emphasizes evaluation of nesting habitat (aspen stands), which is considered to be an important factor in the continued viability of the species in northeastern Nevada. The short and long term TOCs are direct removal of 20 and 10 percent, respectively, of the home range. Results of CEA analysis for the home ranges that would be affected by the action alternatives are presented in Tables 4.14 through 4.20.

Goshawk nests have been grouped into nesting territories by the USFS. Goshawk nests within the same nesting territory are considered to be alternate nests, with only one

Table 4.14 Impacts to Goshawk Home Range Habitat Nest 027					
		Cumulative Impacts			
		Short Term[1]		Long Term	
Alternative	Direct (Acres)	(Acres)	(%)	(Acres)	(%)
A	0	426.7	7.0	173.4	2.8
B	296.0	722.7	11.8	425.4	6.9
C	316.5	743.2	12.1	432.3	7.1
D	301.3	728.0	11.8	420.3	6.9
F	296.0	722.7	11.8	425.4	6.9
F	315.3	742.0	12.1	436.3	7.1
G	296.0	722.7	11.8	425.4	6.9

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.15 Impacts to Goshawk Home Range Habitat Nest 037					
		Cumulative Impacts			
		Short Term[1]		Long Term	
Alternative	Direct (Acres)	(Acres)	(%)	(Acres)	(%)
A	0	390.1	6.4	191.6	3.1
B	0.1	390.2	6.4	191.7	3.1
C	0.1	390.2	6.4	191.7	3.1
D	0.1	390.2	6.4	191.7	3.1
E	0.1	390.2	6.4	191.7	3.1
F	0.1	390.2	6.4	191.7	3.1
G	0.1	390.2	6.4	191.7	3.1

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.16
Impacts to Goshawk Home Range Habitat
Nest 074

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	762.9	12.5	302.3	4.9
B	1,813.6	2,576.5	42.1	1,330.6	21.7
C	1,889.6	2,652.5	43.3	1,320.1	21.6
D	2,010.5	2,773.4	45.3	1,186.8	19.4
E	1,969.0	2,731.9	44.6	1,208.0	19.7
F	1,665.5	2,428.4	39.7	1,355.6	22.1
G	1,813.6	2,576.5	42.1	1,330.6	21.7

Note: [1] Short term cumulative impacts include long term cumulative impact averges.

Table 4.17
Impacts to Goshawk Home Range Habitat
Nest 127

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	804.4	13.1	281.8	4.9
A	2,618.6	3,423.6	55.9	1,787.2	29.2
C	2,679.1	2,483.5	55.9	1,773.6	29.0
D	2,771.2	3,575.6	58.4	1,629.9	29.6
D	2,605.9	3,410.3	55.7	1,617.1	29.0
F	1,848.1	3,652.5	43.3	1,341.8	21.9
G	2,648.5	3,452.9	56.4	1,816.2	29.7

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.18 Impacts to Goshawk Home Range Habitat Nest 128					
		Cumulative Impacts			
		Short Term[1]		Long Term	
Alternative	Direct (Acres)	(Acres)	(%)	(Acres)	(%)
A	0	987.7	16.1	394.4	6.4
B	2,548.5	3,536.2	57.7	1,836.5	30.0
C	2,608.4	3,596.1	58.7	1,817.9	29.7
D	2,731.6	3,719.3	60.7	1,673.2	27.3
E	2,535.8	3,523.5	57.5	1,660.1	27.1
F	1,743.8	2,731.5	44.6	1,381.3	22.6
G	2,588.2	3,575.9	58.4	1,870.4	30.5

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.19 Impacts to Goshawk Home Range Habitat Nest 134					
		Cumulative Impacts			
		Short Term[1]		Long Term	
Alternative	Direct (Acres)	(Acres)	(%)	(Acres)	(%)
A	0	669.1	10.9	315.1	5.1
B	520.7	1,189.8	19.4	722.2	11.8
C	551.7	1,220.8	19.9	723.8	11.8
D	524.3	1,193.4	19.5	706.5	11.5
E	519.0	1,188.1	19.4	711.6	11.6
F	545.4	1,214.5	19.8	740.1	12.1
G	520.7	1,189.8	19.4	722.2	11.8

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.20 Impacts to Goshawk Home Range Habitat Nest 136						
		Cumulative Impacts				
		Short Term[1]		Long Term		
Alternative	Direct (Acres)	(Acres)	(%)	(Acres)	(%)
A	0	672.6	11.0	334.8	5.5
B	382.1	1,054.7	17.2	608.6	9.9
C	413.0	1,085.6	17.7	610.1	10.0
D	385.7	1,058.3	17.3	597.5	9.8
E	380.3	1,052.9	17.2	602.6	9.8
F	403.8	1,079.4	17.6	626.5	10.2
G	382.1	1,054.7	17.2	608.6	9.9

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

of the nests being used during a particular year. This analysis considers effects to home ranges grouped according to the nests that are within a particular nesting territory.

The three historic goshawk nests (074, 127, and 128) that occur within the Project area would be disturbed by all of the action alternatives. These three nests represent one nesting territory. Nest 074 would be removed by the Steer pit and nests 127 and 128 would be covered by the South Deep waste rock dump. New direct home range disturbance would be the least for nest 074 under Alternative F at 1665 acres (27 percent of home range area impacted) and greatest for nest 128 under Alternative D at 2732 acres (44 percent). The cumulative short-term and long-term TOCs would be exceeded for all three of these historic goshawk nests, but portions of their home ranges would not be disturbed.

Goshawk nests 026 and 027 are outside of the Project area in the same nesting territory. The home ranges for these two nests extend into the Project area. No new disturbance would occur within the home range of nest 026 under any of the action alternatives. Additional home range disturbance for nest 027 would not differ much between alternatives. New home range disturbance would vary from 296 acres (5 percent) under Alternatives B, E, and G to 316 acres (5 percent) under Alternative C. The cumulative short-term and long-term TOCs would not be exceeded for nest 027 under any of the action alternatives.

Nests 037, 039, and 143 are not in the Project area and are in different nesting territories. The home ranges for these three nests extend into the Project area. No new disturbance would occur within the home range for these three goshawk nests under any of the action alternatives.

Goshawk nests 134 and 136 are located in the same nesting territory near the Burns Basin mine area. Nest 134 is within about 300 feet of the existing Burns Basin pit. Both of these nests have been occupied in recent years in close proximity to active mining operations. Nest 134 was occupied in 1991 and produced three young. Nest 136 was occupied and produced three young in 1992, and two young in 1993 during mining (Younk pers. comm, 1993). New home range disturbance does not differ significantly between alternatives for both of these nests. Direct disturbance to nest 134 home range would vary from 519 acres (8 percent) under Alternative E to 552 acres (9 percent) under Alternative C. All of the action alternatives would result in the long-term TOC being exceeded for nest 134. Additional disturbance to nest 136 home range would be between 380 acres (6 percent) under Alternative E to 413 acres (7 percent) under Alternative C. None of the action alternatives would result in short-term TOCs being exceeded for nest 136. The long-term TOC for nest 136 would be exceeded under Alternative F.

The occupancy data for goshawk nests 134 and 136 indicate that the established TOCs for goshawk based on direct removal of home range acreage does not adequately evaluate actual impacts to goshawks. The relative effects of the project alternatives on goshawks can also be determined by the proximity, timing, and duration of activity in relation to post-fledging areas (PFAs) (USDA, USFS 1993a). PFAs are delineated to include 600 acres of mature aspen habitat around nest sites. A small portion of the Burns Basin PFA would be affected by expansion of the existing waste rock dump under Alternatives B and G. Expansion of the Burns Basin waste rock dump into this PFA would not reduce the current 300 foot distance between Nest 134 and proposed disturbance.

<u>Mule Deer</u>

Direct and cumulative impacts to mule deer habitat were analyzed in relation to winter and summer range, as well as fawning habitat. The province for mule deer analyzed in this document varies with the type of range or habitat.

<u>*Winter Range*</u>

The province for mule deer winter range is defined in the CEA technical guide as the area utilized by the Management Area 6 deer herd in the winter on USFS lands in the Independence Mountains. That area of high and moderate RVR encompasses approximately 16,204 acres. Direct impacts on high to moderate value mule deer winter range would vary from a low of approximately 1,790 acres (11 percent) under Alternative F to a high of approximately 2,854 acres (17.6 percent) under Alternative D.

Cumulative short term impacts, including "islands" of undisturbed habitat, on high to moderate RVR lands of this habitat type would vary from approximately 3,623 acres (22.4 percent) under Alternative F to 4,687 acres (28.9 percent) under Alternative D. Long term cumulative impacts would be approximately 1,857 acres (11.5 percent) under Alternative F to 2,346 acres (14.5 percent) under Alternative G, as shown in Table 4.21.

Table 4.21
Impacts to Mule Deer Winter Range

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	1,833	11.3	846	5.2
B	2,627	4,459	27.5	2,312	14.3
C	2,698	4,530	28.0	2,303	14.2
D	2,854	4,687	28.9	2,156	13.3
E	2,618	4,451	27.5	2,132	13.2
F	1,790	3,623	22.4	1,857	11.5
G	2,666	4,499	27.8	2,346	14.5

Note: [1] Short term cumulative impacts include long term cumulative impact averages and "islands" of undisturbed habitat. Province for mule deer winter range used for this analysis is approximately 16,204 acres in size, the area of high and moderate RVR value winter range in the Independence Mountain Range.

Since the TOC for mule deer winter range is defined in the CEA as any disturbance of habitat with a high to moderate RVR, all action alternatives would exceed the TOC. The majority of the direct and cumulative impacts would occur on areas classified by the CEA as moderate RVR mule deer winter range under all action alternatives.

Summer Range

The province for mule deer summer range is defined in the CEA technical guide as the high and moderate RVR areas in watersheds within the Independence Mountains. Direct impacts to potential mule deer summer range in the Jerritt Canyon watershed would be between approximately 253 acres (43 percent) under Alternative F to 319 acres (54 percent) under Alternative D. All action alternatives would result in less than one acre of additional disturbance to potential mule deer summer range in the Burns Creek watershed.

Cumulative short term impacts to potential mule deer summer range, including "islands" of undisturbed habitat, would be approximately 308 acres (52 percent) in the Jerritt Canyon watershed under Alternative F to 374 acres (63 percent) under Alternative D. Long term cumulative impacts to potential mule deer summer range in the Jerritt Canyon watershed would range from approximately 152 acres (26 percent) under

Alternative F to 219 acres (37 percent) for Alternative C (Table 4.22). Short term and long term cumulative impacts to potential mule deer summer range in the Burns Creek watershed would be the same for all action alternatives, with disturbance of about three acres and one acre, respectively.

Table 4.22
Impacts to Jerritt Canyon Watershed Mule Deer Potential Summer Range

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	55	9	1	0.2
B	300	355	60	219	37
C	301	356	60	219	37
D	319	374	63	194	33
E	305	360	61	194	33
F	253	308	52	152	26
G	300	355	60	218	37

Note: [1] Short term cumulative impacts include long term cumulative impact averages.
Province for potential mule deer summer range in the 8,106 acre Jerritt Canyon watershed is about 591 acres in size.

The TOCs for mule deer summer range are the short term disturbance of more than 20 percent of the habitat with a high to moderate RVR or more than 10 percent long term disturbance of these RVR areas. All of the action alternatives would exceed the short term and long term TOCs for mule deer summer range in the Jerritt Canyon watershed. None of the action alternatives would exceed the TOCs for mule deer summer range in the Burns Creek watershed.

Fawning Habitat

The province for mule deer fawning habitat is also the high and moderate RVR areas within watersheds in the Independence Mountains. Direct impacts to potential mule deer fawning habitat in the Jerritt Canyon watershed would be between approximately 216 acres (51 percent) under Alternative F and 241 acres (57 percent) under Alternative D. Alternatives B, C, F, and G would result in about six acres (6 percent) of additional disturbance to potential mule deer fawning habitat in the Burns Creek watershed, while Alternatives D and E would result in approximately four acres (4 percent) of new impacts.

Cumulative short term impacts, including undisturbed "islands" of potential mule deer fawning habitat in the Jerritt Canyon watershed would be between about 260 acres (62 percent) under Alternative F and 285 acres (68 percent) for Alternative D. Long term cumulative impacts in the Jerritt Canyon watershed would range from approximately 117 acres (28 percent) under Alternative D to 158 acres (38 percent) for Alternative F. Long term impacts are greatest under Alternative F because the angle of repose dump face (considered a long term disturbance) on the shortened and smaller South Deep dump is located in a high and moderate RVR area. The other action alternatives would result in direct and cumulative impacts on potential mule deer fawning habitat in the Jerritt Canyon watershed as shown in Tables 4.23 and 4.24.

Short term cumulative impacts to mule deer fawning habitat in the Burns Creek watershed would be about 11 acres (12 percent) for Alternatives D and E to about 13 acres (14 percent) for Alternatives B, C, F, and G. Long term cumulative impacts would be about 7 acres (8 percent) for all action alternatives in the Burns Creek watershed.

The CEA defines the TOC for mule deer fawning habitat as the short term disturbance of more than 20 percent of the habitat with a high to moderate RVR or more than 10 percent long term disturbance of these RVR areas. All action alternatives would exceed the short term and long term TOCs for mule deer fawning habitat in the Jerritt Canyon watershed. None of the action alternatives would exceed the TOCs for this habitat in the Burns Creek watershed.

Indirect impacts of the proposed mining activities have the potential to affect mule deer over a larger area than indicated for direct effects. Temporary displacement of mule deer has the potential to increase foraging pressure on adjacent areas. However, mule deer are frequently observed in active mining areas and are known to utilize reclaimed areas, so displacement would not be complete. No studies are available to indicate what percentage of the mule deer population would normally occupy active mining and reclamation areas. The carrying capacity of the habitat adjacent to the project area has not been determined, so the magnitude of any indirect impacts from temporary displacement cannot be quantified. Competition for forage with domestic livestock also has the potential to indirectly affect mule deer that may be temporarily displaced. Forage preferences are most similar between mule deer, sheep, and goats. Closure of the Jerritt Canyon Sheep and Goat Allotment by the USFS in December 1992 is expected to leave more available forage for mule deer. Mule deer mortality attributable to heavy equipment and light vehicle traffic has been very low to date at the existing Jerritt Canyon Mine and is not expected to increase as a result of the proposed mine expansion. Closure of the active mining areas to public access since 1980 would continue to provide a "refuge" for mule deer during the hunting season.

Impacts to mule deer have been addressed and mitigation is provided for in a Memorandum of Understanding (MOU) between IMC, USFS, and NDOW, signed March 31,

Table 4.23
Impacts to Mule Deer Fawning Habitat
Jerritt Creek Watershed

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	44.5	10.6	2.3	0.6
E	231.8	276.3	65.7	141.5	33.7
C	233.3	277.8	66.1	143.4	34.1
D	240.5	285.0	67.8	116.9	27.8
E	235.2	279.7	66.6	117.3	27.9
E	215.4	259.9	61.9	158.0	37.6
G	231.8	276.3	65.7	141.5	33.7

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.24
Impacts to Mule Deer Fawning Habitat
Burns Basin Watershed

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	7.4	8.2	4.0	4.5
B	5.6	13.0	14.5	6.7	7.5
C	5.6	13.0	14.5	6.8	7.6
D	3.4	10.8	12.0	6.8	7.6
E	3.4	10.8	12.0	6.8	7.6
F	5.6	13.0	14.5	6.8	7.6
G	5.6	13.0	14.5	6.7	7.5

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

1993 and a subsequent Habitat Improvement Plan (See Appendix D). This agreement identifies funds IMC has and will continue to contribute to NDOW to fund certain deer habitat management activities. This action mitigates for all past, present, and future impacts to mule deer habitat (up to 5,500 acres of long term impacts to mule deer habitat) in the Independence analysis area. In addition, IMC continues to work with the USFS and NDOW to utilize reclamation practices and plant species in areas to be revegetated that will benefit and support mule deer on mined areas after reclamation.

Sage Grouse

The CEA province for sage grouse is third order watersheds in the Independence Mountain Range. Habitat determined to be important to sage grouse was brooding habitat, which is the limiting factor for the species in this area.

Direct impacts to potential sage grouse brooding habitat in the Jerritt Creek watershed range from approximately 611 acres (16 percent) with Alternative F to 1,115 acres (29 percent) for Alternative D. Direct impacts to potential sage grouse habitat in the Burns Creek watershed vary from 113 acres (9 percent) under Alternatives B and G to 119 acres (10 percent) for Alternative C.

Short term cumulative impacts to potential sage grouse brooding habitat in the Jerritt Creek watershed range from approximately 873 acres (22 percent) under Alternative F to 1377 acres (36 percent) for Alternative D. Long term cumulative impacts in the Jerritt Creek watershed range from 336 acres (9 percent) under Alternative F to approximately 542 acres (14 percent) under Alternative G. Short term cumulative impacts to potential sage grouse brooding habitat in the Burns Creek watershed range from approximately 297 acres (23 percent) under Alternatives B and G to 303 acres (24 percent) for Alternative C. Long term cumulative impacts in the Burns Creek watershed range from 163 acres (13 percent) under Alternative D to approximately 171 acres (13 percent) under Alternative F. A summary of the direct and cumulative impacts to potential sage grouse brooding habitat is provided in Tables 4.25 and 4.26.

All alternatives exceed the 20 percent high to moderate short term cumulative impact TOC and all alternatives except Alternative F exceed the 10 percent long term cumulative impact TOC to potential sage grouse brooding habitat in the Jerritt Creek watershed. All alternatives exceed both short and long term TOCs for potential sage grouse brooding habitat in the Burns Creek watershed. Consequently, IMC has proposed off-site sage grouse brooding habitat mitigation. Similar to the actions described in a sage grouse brooding habitat mitigation document, IMC, USFS, NDOW, and BLM would identity sites in which sage grouse brooding habitat can be improved or developed to mitigate the long term loss of potential brooding habitat caused by implementation of any action alternative in this DEIS. A system has been established and would be maintained by the USFS, NDOW, and IMC, to document the number of acres mitigated versus the number of acres disturbed. Acres in excess of the number necessary to mitigate for a particular project would be set into a reserve of mitigated acres to be applied to other projects the company proposes. This concept is termed "banking" of mitigated acres.

Table 4.25
Impacts to Jerritt Creek Watershed Potential Sage Grouse Brooding Habitat

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	262	7	116	3
B	1,036	1,298	34	521	14
[illegible]	1,077	1,339	35	509	13
D	1,115	1,377	36	445	12
[illegible]	934	1,196	31	418	11
[illegible]	611	873	23	336	9
G	1,065	1,327	34	542	14

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.26
Impacts to Burns Creek Watershed RVR Potential Sage Grouse Brooding Habitat

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	185	15	91	7
B	113	297	23	168	13
C	119	303	24	166	13
D	118	303	24	163	13
E	117	301	24	165	13
F	118	302	24	171	13
G	113	297	23	168	13

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Trout

Trout provide an indication of water quality and of the condition and trend of riparian zones. Sediment yields and flows are expected to decrease in the long-term as a result of pit development in the Jerritt Creek and Burns Creek watersheds. In the short-term, increases in sediment may be observed. The timing of flows in these two streams would be somewhat regulated by the waste rock dumps, which have been observed to release water over a longer period of time than undisturbed drainages. Burns Creek is ephemeral in the upper reaches and perennial at the lower elevations outside of the Project area. This is the only stream that is known to have reproducing fish populations within the Project area. Effects to surface water quantity and quality are discussed in greater detail under surface water resources in Chapter 4. During a study conducted in 1985, a tracer injected in the vicinity of the Burns Basin pit was recovered at a spring in Burns Creek about one-half mile inside the western Project area boundary. This suggests that the spring drains the karst system in the Burns Basin mine area, which may partially offset the predicted reductions in flow within Burns Creek. The spring is located within the segment of Burns Creek known to have trout. Additional information pertaining to the tracer study is provided in the Chapter 3, groundwater resources section.

As indicated in the surface water resources section in Chapter 4, approximately 95 percent of the effects to surface water quality and quantity in Burns Creek are related to the existing operations. A similar relationship would be expected to apply to trout. Cumulative impacts of reduced flow and sedimentation may affect trout.

Golden Eagles and Other Raptors

All action alternatives would disturb habitat in the vicinity of three golden eagle nests that represent two nesting territories within the Jerritt Canyon drainage. Two of these nest were active in both 1992 and 1993 (JBR 1993c). Golden eagle nest 01, commonly referred to as the pinnacle nest, has not been occupied in the past several years and will most likely not be utilized while mining activities are taking place in close proximity. The other Jerritt Canyon nest inside the Project area is farther from proposed mining operations and would probably remain active since new disturbances would not get any closer. The disturbances for all of the action alternatives would impact areas closer to the golden eagle nest just west of the Project area than the existing operations. This nest may continue to be occupied during project implementation since exploration activities and use of a nearby road have not affected use of this nest in the past.

The pinnacle nest would be covered by a waste rock dump under Alternative B and G. However, the removal of this nest would probably be of little or no consequence to golden eagles nesting in the Jerritt Canyon drainage because: (1) the nest has apparently not been utilized since 1977, three years before mining activity began in this area, and (2) other nest-sites both up and down the canyon from this site have been occupied by golden eagles on a regular basis.

Alternatives C, D, E and F would avoid direct impacts to the "pinnacle" nest. By placement of the eastern portion of the South Deep waste rock dump in a more westerly location in these alternatives, impacts to this nest would only be the indirect effects of noise and other proposed mining disturbances. Impacts to the other two golden eagle nests within the Jerritt Canyon drainage would be approximately the same for all action alternatives, except Alternative F. Alternative F would have considerably less indirect impacts to all golden eagle nests due to the greatly reduced surface disturbance in the Jerritt Creek drainage in the nest-site areas. Overall, Alternative F has the least likelihood of directly and indirectly affecting golden eagle nests within the Project area.

Cooper's hawk nests 071 and 072 would be covered by the waste rock dumps developed for the Saval and Steer mine areas under all of the action alternatives. A third Cooper's hawk nest identified as 073 would be removed during the development of 3:1 slopes on one of the Alternative D waste rock dumps.

Ledge-nesting raptor species such as golden eagles, red-tailed hawks, and prairie falcons may gain alternative nesting habitat, as they are known to nest in pit highwalls (Albrechtsen 1987, Fala 1979, Steele 1981). In addition, some increase or decrease in prey or prey availability may be experienced by raptors during and after mining activities. Disturbances from mining could affect up to 2,744 acres under Alternative D, which include habitat areas for raptor prey. Rodent species often inhabit mine areas in spite of the increased disturbance. Also, availability of prey for capture by raptors may be enhanced by lower vegetative cover in active mine areas or on rocky pit walls, pit bottoms, and dump slopes. Some individual raptors or raptor species in the area may be affected by the loss of nest sites and prey base as a result of any of the action alternatives. Lack of vegetative cover in some areas during operations could result in some reduction of prey in specific areas. Once mining operations cease, the majority of the area would be revegetated.

Cumulative impacts to most raptor species would be negligible, as raptors are wide-ranging and commonly seen in and around active and inactive mining areas in Nevada, including the existing Jerritt Canyon mining operations. Long term effects of mining operations on raptors have not been quantifiably documented. Raptor species may adjust in population numbers due to changes in habitat. Some raptor species, such as forest dwellers, may decrease in population and others such as open area foragers may experience population increases.

Upland Game Birds

Upland game birds including chukar, mourning dove, and gray partridge could also potentially be directly impacted by any of the action alternatives. Some potential chukar habitat, blue grouse habitat and possibly, gray partridge habitat would be lost. These losses would be minor compared with the availability of higher quality habitat for these species outside of the Project area. Mourning doves would not likely be affected by the loss of habitat associated with any of the action alternatives.

Indirect effects on upland game birds may include displacement as a result of equipment noise or other mining related activities. Some upland game birds may not be able to avoid vehicles or construction activities. Other birds would be protected from hunting within the Project area.

Furbearers and Predators

Furbearer habitat is not addressed in the CEA technical guide, except for beavers. Short term reductions in available potential habitat for furbearers would occur during implementation of any of the action alternatives. Direct mortality may occur in situations where animals could not escape vehicular traffic or waste rock dumping.

Carnivores in the Project area including coyotes, weasels, raccoons, skunks, and badgers, would be minimally impacted. Some would be unable to avoid vehicles and construction activities or would not find alternate suitable habitat. The remainder would be displaced into adjacent undisturbed areas.

Direct impacts to beavers would be negligible under any of the action alternatives because proposed activities occur upstream of perennial flowing streams and would not change downstream water flows to the point of adversely affecting beaver populations.

Indirect impacts such as noise disturbance from mining activities, including blasting and vehicular traffic, may cause avoidance of active areas by furbearers. Interim and post-mining reclamation activities would re-establish a portion of the furbearer habitat areas, thereby reducing long term impacts. Cumulative impacts would include long term loss of furbearer habitat in areas made uninhabitable due to mining, including portions of some pits that would not be reclaimed and roads that would remain in use after mining.

Mountain lions are not addressed in the CEA technical guide. A limited amount of potential mountain lion habitat would be impacted directly by any of the action alternatives. Though no direct mortality would be expected to occur to lions, there would be some direct loss of habitat due to construction of roads, pits, waste rock dumps, growth medium stockpiles, and other facilities associated with the mine expansion.

Mountain lions may move away from active construction areas, but would continue to make use of other mountainous habitats in the area, with concentration of activity in areas with mule deer. The removal of mule deer habitat may indirectly effect mountain lions by changing the nature of their hunting territory and forcing them to use other areas.

Cumulative impacts would be slightly higher than direct impacts for all action alternatives with regard to mountain lions due to displacement and habitat loss already occurring within the existing mining areas.

After mining and reclamation, conditions may be suitable for mountain lions to return to mined areas. Reclaimed areas could provide habitat for prey species, and benches, highwalls and other rocky areas created by mining could become potential habitat. Deer are the primary prey species for mountain lions and the long term presence of lions in the Project area would be related to deer densities in the Independence Range.

Other Species

Habitat for most small mammals is not addressed in the CEA technical guide. Small mammals such as shrews would be impacted by a direct loss of available habitat. Existing habitat for bats may be removed, but bats may also be positively affected by an increase in available habitat due to the creation of cracks and holes or exposure of solution cavities in the pit walls as the result of any of the action alternatives. Current highwalls in the Jerritt area do not appear to have cracks suitable for roosting habitat (Warder, pers. comm.). Bats that utilize forested habitat may be negatively impacted by loss of aspen stands.

Rodent species, including chipmunks, ground squirrels, marmots, mice, rats, gophers, voles, and porcupine would also be affected by a direct loss of available habitat. The habitat required for these species is prevalent throughout the Project area. Consequently, short term and long term impacts would be minimal, as many of these species would re-inhabit some of the mined areas during and after reclamation.

Cottontails, black-tailed jackrabbits, and white-tailed jackrabbits are common throughout the Project area. Direct loss of habitat in the form of forage and shelter would occur and some rabbits would perish as surface disturbance occurs. Other rabbits would flee the disturbance areas and some of these would fall prey to predators. Some of the displaced rabbits would find new niches to occupy and others would not.

The proposed action would be implemented after the cyclic peak of the rabbit population in Elko County that was noted by NDOW Region II biologists during 1992-1993. Population declines may occur in the short-term due to habitat loss. As interim and final reclamation occur, rabbit populations would be expected to increase due to increases in forage and cover. Cumulative impacts would include long term loss of wildlife habitat in areas made uninhabitable due to mining, including portions of proposed pits that would not be reclaimed and roads that would remain in use after mining.

The CEA province for cavity nesters is third order watersheds in the Independence Mountain Range. Direct impacts to potential cavity nester habitat in the Jerritt Creek watershed would range from about 519 acres (59 percent) in Alternative F to 573 acres (65 percent) under Alternative D. In the Burns Creek watershed, direct impacts would vary from about 140 acres (10 percent) under Alternative E to 171 acres (13 percent) under Alternative C.

Short and long term effects were analyzed according to the CEA model, which defines duration by type of disturbance. Regardless of CEA definitions for short term and long term, it could take several decades for newly planted trees to be used for cavity nesting. Short term cumulative impacts to potential cavity nester habitat in the Jerritt Creek watershed would range from approximately 645 acres (73 percent) under Alternative F to 699 acres (79 percent) for Alternative D. Long term cumulative impacts in the Jerritt Creek watershed would range from 333 acres (38 percent) under Alternative D to approximately 394 acres (45 percent) under Alternative F. Short term cumulative impacts to potential cavity nester habitat in the Burns Creek watershed would range from approximately 330 acres (24 percent) under Alternative E to 361 acres (27 percent) for Alternative C. Long term cumulative impacts in the Burns Creek watershed would range from 211 acres (15 percent) under Alternative D to approximately 230 acres (17 percent) under Alternative F. A summary of direct and cumulative impacts to potential cavity nester habitat is provided in Tables 4.27 and 4.28.

All action alternatives exceed the 20 percent short term cumulative impact TOC and the 10 percent long term cumulative impact TOC to potential cavity nester habitat in both the Jerritt Creek and Burns Creek watersheds. Long term impacts above the TOC would be partially mitigated by planting aspen as indicated in the preliminary POO and by creating artificial snags for interim nesting. Results of aspen planting in the Independence Range are inconclusive.

The habitat of neotropical migrant bird species is not addressed in the CEA technical guide, and TOCs or RVRs have not been established for these species. As discussed in Chapter 3, neotropical migrant bird species, including songbirds, are numerous and diverse within the Project and general study areas. Those species most likely to be affected by project implementation are those that require specific habitat characteristics for nesting and/or foraging. Canopy-nesting species associated with mature aspen communities would be most affected by project implementation, and include warbling vireos (*Vireo gilvus*), hermit thrush (*Hylocichla guttata*), and western tanagers (*Piranga ludoviciana*). Birds associated with the subcanopy layer of willow and chokecherry, including yellow warblers (*Dendroica petechia*), lazuli buntings (*Passerina amoena*) and rufous-sided towhees (*Pipilo erythrophthalmus*) would also be affected by impacts to aspen communities. Generalistic species and those associated with more abundant and widely distributed plant communities would not be appreciably affected.

4.4 Land Use

Land use within the Project area would shift temporarily to mining operations under all action alternatives. Areas surrounding active operations and inactive or reclaimed mining areas would serve as wildlife habitat during project operations.

Post-mining land use objectives include providing for wildlife habitat, livestock grazing, recreational opportunities, public access, watershed stability, and visual quality consistent with established classifications. These post-mining land use objectives would be accomplished using a variety of reclamation and final closure methods that vary by alternative.

With the exception of the pits and some angle of repose slopes on waste rock dumps, the area would be revegetated for use as livestock range and wildlife habitat. Use by livestock would be enhanced by creation of flatter slopes on the surfaces of the waste rock dumps.

Table 4.27
Impacts to Jerritt Creek Watershed RVR Potential Cavity Nesters Habitat

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	126	14	28	3
B	548	674	77	383	44
C	550	686	77	384	44
D	573	699	78	333	38
E	560	686	78	347	39
F	519	645	73	394	45
G	548	674	77	383	44

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Table 4.28
Impacts to Burns Creek Watershed RVR Potential Cavity Nesters Habitat

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term[1]		Long Term	
		(Acres)	(%)	(Acres)	(%)
A	0	190	14	141	16
B	147	337	25	223	16
C	171	361	27	214	16
D	143	333	24	214	15
C	140	337	24	214	16
F	190	356	26	230	17
G	147	337	25	223	16

Note: [1] Short term cumulative impacts include long term cumulative impact averages.

Rock piles would be placed on the undulating dump surfaces as potential wildlife habitat. The outer edges of coarse and durable waste rock used to cover the angle of repose slopes adjacent to forage may serve as habitat for rodents, which are prey for mammalian and avian predators. Ledge-nesting raptors such as golden eagles, red-tailed hawks, and prairie falcons may utilize the pit benches and highwalls for nesting. Solution cavities and cracks exposed by the mining operations could provide roosting habitat for bats and nesting sites for cliff-dwelling bird species. The mitigation measures described for all of the action alternatives in Chapter 2 would provide for additional wildlife habitat and livestock range.

Reclamation and final closure operations would re-establish public access into portions of the disturbance areas under all of the action alternatives. This is described in greater detail in the section on public access. This would result in re-establishment of the major recreational use of the area, hunting. The relatively flat dump surfaces may also promote use of the area by campers or other recreational users. Public access would be restricted around the pits and any underground openings for safety reasons.

An anticipated stable watershed would exist after mining and reclamation. This would be accomplished through proper dump construction, development of adequate under-dump drainage systems or trench drains, armoring angle of repose slopes with coarse and durable waste rock, growth medium redistribution and revegetation. Best management practices would be used to meet baseline conditions and/or applicable state and federal water quality standards.

The Forest Service visual quality objective for the area disturbed by mining is maximum modification. All of the alternatives would meet this objective.

Land Use Planning and Management

NEPA regulations require discussion of possible conflicts with federal, regional, state, and local land use plans. All alternatives would be consistent with the Humboldt National Forest LRMP, which provides for multiple land uses. Alternative A may be in possible conflict with Elko County's draft policy that mining on federal lands should remain open and free to the public. If Alternatives D and E were not implementable by IMC because of associated costs of development, these alternatives may also be in conflict with Elko County's stated land use policy.

Mining

Direct and indirect effects to mining would be similar for all action alternatives. Mining would be the predominant land use within the Project area during the life of the Project. The amount of ore mined would be similar under all action alternatives except for Alternative F, which would result in less ore production. A more detailed discussion of ore production and geologic resources is included in the geology section of Chapter 4. Under Alternative A, mining operations would cease and no additional ore would be produced from this area in the near future.

Livestock Grazing

The analysis areas for direct, indirect, and cumulative impacts to forage resources are the individual grazing allotments within the Humboldt National Forest in the Independence Range. Direct and cumulative impacts are analyzed in terms of the removal of forage classified as high and moderate resource value ratings (RVRs) for the type of livestock permitted on an allotment. High and moderate RVR areas for cattle and horses are defined as areas having slopes of 30 percent or less with plants that have a medium to high forage value that are less than one mile from a water source.

Alternative A - No Action

There would be no impacts to livestock grazing under the No Action Alternative other than those analyzed in previous NEPA documents.

Effects Common to All Action Alternatives

Two cattle and horse allotments, Schmitt Creek and Jerritt Canyon, would be affected by implementation of any of the action alternatives. A portion of the Mill Creek allotment was closed and the remainder was incorporated into the Jerritt Canyon cattle allotment by the USFS during 1993. Closure of the Jerritt Canyon Sheep allotment by USFS in December 1992 results in no effects by any action alternative.

The direct impact to high and moderate RVR forage on the Schmitt Creek allotment would range from five percent of total allotment area (132 acres) for Alternative E to six percent of the total allotment area (164 acres) for Alternative C. Short term cumulative impacts to high to moderate RVR forage would range from sixteen percent (436 acres) for Alternative E to seventeen percent (468 acres) for Alternative C. Long term cumulative impacts would range from nine percent (251 acres) under Alternative D to ten percent (272 acres) under Alternative F (Table 4.29). There would be no reductions in Animal Unit Months (AUMs) under any action alternative. Reductions were previously made in anticipation of the mine's expansion and existing operations.

The direct impact to high to moderate RVR forage on the Jerritt Canyon cattle and horse allotment would range from 17 percent (151 acres) for Alternative F to 28 percent (245 acres) for Alternative D. Short term cumulative impacts to high to moderate RVR forage would range from 20 percent (183 acres) for Alternative F to 31 percent (277 acres) for Alternative D. Long term cumulative impacts would range from six percent (56 acres) under Alternative D to nine percent (82 acres) under Alternative C (Table 4.30). Under any of the action alternatives, the closure of one unit could be anticipated for this allotment, representing a 50 percent reduction of AUMs from 750 to 375.

The impact to forage resources under all action alternatives would be below the short term cumulative impact threshold of concern (TOC) of 20 percent and the long term cumulative impact of 10 percent for the Schmitt Creek Allotment (Table 4.29). Impacts

Table 4.29
Impacts to Schmitt Creek Cattle and Horse Allotment High and Moderate RVR Potential Forage

Alternative	Direct (Acres)	Cumulative Impacts			
		Short Term		Long Term	
		Acres	%	Acres	%
A	0	304	11	179	6
B	139	443	16	260	9
C	164	468	17	261	9
D	139	439	16	251	9
E	132	436	16	254	9
F	159	463	17	272	10
G	139	443	16	260	9

Table 4.30
Impacts to Jerritt Canyon Cattle and Horse Allotment High and Moderate RVR Potential Forage

Allotment	Direct (Acres)	Cumulative Impacts			
		Short Term		Long Term	
		Acres	%	Acres	%
A	0	32	3	3	0.4
B	205	237	26	81	9
[illegible]	227	239	27	82	9
D	245	277	31	56	[illegible]
E	227	259	29	61	7
E	151	183	20	74	7
G	205	237	26	81	9

from all action alternatives exceed the 20 percent short term cumulative impact TOC for the Jerritt Canyon Allotment. However, the 10 percent long term cumulative impact TOC would not be exceeded (Table 4.30).

Some areas, such as mine pits, would be permanently lost to livestock grazing because they would not be revegetated. Some steep slopes remaining after reclamation would experience little or no use by livestock. The majority of the waste rock dump disturbance areas would consist of relatively flat surfaces after reclamation, as described in Section 4.2. Flat dump surfaces are expected to have the highest revegetation potential of all the disturbance areas. The greatest area of relatively flat dump surface would be created under Alternative C. This alternative would result in up to 1,065 acres of relatively flat dump surface. Of the open pit mining alternatives, the smallest area of flat dump surface would be created under Alternative D resulting in the development of up to 889 acres of relatively flat dump surface. The 503 acres of 3H:1V dump slopes created under Alternative D would not qualify as high to moderate RVR forage areas after revegetation because of the 30 percent slope restriction on these areas. Overall, Alternative F would have the least acreage of flat dump surface because the South Deep dump would be eliminated. This dump represents about 76 percent of the total dump disturbance area.

The other allotments (East Independence, Snow Canyon, Foreman Creek) within the general study area would not be measurably impacted by any of the action alternatives. Stocking rates for these allotments would not change to absorb any AUMs lost on the Jerritt Canyon cattle and horse allotment.

IMC has agreed to maintain about 23 miles of allotment boundary and pasture fences surrounding the existing mining operations to assist in range management and to prevent livestock from entering the mine areas for safety reasons. The seed mixes utilized during revegetation operations would include plants which are used by livestock to mitigate for impacts to forage resources.

Recreation and Public Access

Recreation

The area of analysis for recreation is the Independence Range, with emphasis on the general study area. Potential effects on hunting and fishing were raised as issues during public scoping and are the focus of the analysis of proposed mining expansion impacts on recreational resources. Also addressed are the TOC for cumulative effects as defined by the CEA model.

Alternative A - No Action

Existing mining operations have resulted in the closure of certain areas for public safety. These areas are described in the "Public Access" section of Chapters 3 and 4. Portions of the closed area were formerly accessed for hunting purposes. Due to the ephemeral nature of the streams and drainages, there has been no impact to recreational fishing in the existing closure area. These conditions would be expected to continue under this alternative until mining has ceased and the area is reopened for public access.

Effects Common to All Action Alternatives

Existing hunting opportunities in the Independence Mountain Range would not be substantively impacted by the proposed mining expansion under any alternative. The existing closure area would be expanded to the west for safety purposes, and hunting access would thus be restricted in this area. Hunting opportunities would still be possible outside of the closed area. Hunters would still be able to access portions of the general study area via numerous FS-administered roads, including Jerritt Creek (USFS #875), China Creek (USFS #136), Snow Canyon Creek (#368), and Gance Creek (#868). Mining operations may temporarily require wildlife, including deer, to seek habitat outside of the proposed disturbance areas. Many areas within the proposed closed area would be undisturbed and deer have been observed adjacent to active pits, waste rock dumps, and haul roads. No studies are available to indicate what percentage of the population would normally occupy such an area during mine activity. The protection from hunting afforded wildlife in the closure areas may attract game animals during the hunting season, thereby reducing hunting opportunities. Hunting opportunities exist throughout the Independence Range.

There would be no direct impacts to recreational fishing as a result of the proposed mining expansion. No mining operations or closures are proposed for areas which currently support reproducing fish populations. Other impacts to fish are described in the aquatic resources section of Chapter 4.

Cumulative Effects

The CEA province for cumulative effects is the Independence Range. The TOC for recreational opportunity is any reduction in primitive and semi-primitive nonmotorized opportunity classes. There are no areas classified for recreational opportunity as primitive or semi-primitive non-motorized in the Project area. The TOC for recreational use is where demand is expected to exceed supply. Additional population growth in Elko County is possible as a result of various in-migration factors (See Socioeconomics-Population, Chapter 4) and could result in additional demand for recreational opportunities. As described in Chapter 3, the Independence Range is one of many public recreation areas in Elko County. Overall demand for recreational use is not expected to exceed supply in the Independence Range during Project operations.

Once mining operations have ceased and public access is reopened, recreational opportunities should resume in most of the area that was closed for public safety. Some pit areas may continue to be closed for safety reasons.

Public Access

The availability of access to public lands is directly related to the public's ability to recreate on those lands. The detailed analysis area for project impacts is the proposed

Project area. The Independence Range is the CEA province for analysis of cumulative effects. The following criteria were used to identify effects to public access: (1) change in public access on existing roads, (2) project-related changes that affect duration, quantity, and type of impact to public access, and (3) loss of USFS Public Access Class 1 or 2 areas.

Alternative A - No Action

Under the No Action Alternative the existing area closed to public access would remain closed until final reclamation of the existing mine operations is completed and existing public access restrictions are lifted by the USFS.

Effects Common to All Action Alternatives

In the interest of public safety, the existing closure area would be expanded to the west to restrict access to the New Deep, Saval and Steer mine areas under all action alternatives. The existing gate on the Jerritt Creek Road (#875) would be temporarily relocated approximately one and a half miles downstream and the Arana road gate would be relocated less than one quarter mile to the west (See Map 2.4).

Under all action alternatives the mining expansion would result in an estimated additional 2,695 acres of Class 4 area, the Public Access class for areas totally closed for public safety. With the exception of the one and a half miles of the Jerritt Creek Road and a quarter mile of Arana Road, there are no other roads open to the public within the Project area. The majority of the Project area is therefore not readily accessible under existing conditions. The primary project-related change in quantity of access would therefore fall within a narrow corridor along the additional one and half miles proposed for closure on the Jerritt Creek road and the quarter mile of Arana Road.

After mining operations cease and final reclamation is completed, the area would be reopened to public access. Vehicular access would be restricted in portions of the area that cannot be practically made safe by means of earthen berms or other methods.

At the discretion of the USFS, portions of haul roads and/or exploration and other roads may be left in place after reclamation, specifically to provide access within the former mining area. These roads would provide access to the flat surfaces of dumps. Where possible, these roads would provide continuous routes that connect with other USFS roads outside the former mining area.

Under Alternatives B and G, the proposed dump in the Burns Basin area could potentially impact an access road kept open during operations for grazing allotment purposes, but not for general public access. IMC would make adjustments as necessary to keep this road or an alternate route open.

Cumulative Effects

Jerritt Mining Operations Area

Past and current mining operations have resulted in an existing closure area of 7,347 acres. Prior to mining, the area had been open to access in a manner similar to Class 2 - generally open access with no easements (Whalen, pers. comm.). Roads provided vehicular access from the west up Jerritt Creek and Burns Creek to a north-south route that generally followed the divide with access routes to the east along Sheep Creek and California Creek. Many of these roads were not Forest Development Roads and therefore not maintained by the USFS. The Forest Transportation Plan allows closure of these roads if there are significant conflicts with other resources. A rough four-wheel drive trail also provided access up Mill Creek to the Steer Canyon drainage divide (Clarke, pers.comm.) Portions of the roads on the western side of the divide became inaccessible when the area was closed for safety purposes. The north-south route from California Creek to Gance Creek formed the southeastern boundary of the closed area and remained open until 1993, when a portion of the road was temporarily closed for the California Mountain mining operations. The portion of the route closed for the California Mountain operations is scheduled to reopen by 1995-1996, when the project is completed.

The roads described above have historically been used by the public. Much of the area that has been or would be temporarily closed for past mining and proposed expansion operations has had limited access via maintained or mapped roads. There were no roads to the north of Jerritt Creek in sections 28, 29, 31, 32 and 33 of T41N, R53E, or between Jerritt Creek and Mill Creek in sections 8, 9, and most of sections 16, 17 and section 21 of T40N, R53E (Forest Visitor/Travel Map, Mountain City and Jarbidge Ranger Districts, 1990 and Clarke, pers. comm.).

Once reclamation is completed for mining-related projects in the area, the closed area would be re-opened with some safety restrictions. Portions of mining operation roads would be left to provide access to flat portions of dumps and to other roads with access over to the Independence Mountain divide. Final access road configurations would be subject to review by the USFS, but the potential exists for access to be improved over existing and pre-mining conditions by the addition of these routes. The short-term closure of portions of pre-mining roads would be an irretrievable loss of use for that period, but access would be restored in the long-term.

Access to the USFS boundary from Highways 225 and 226 is another factor that may cumulatively affect use of public roads on National Forest System land. Access to the Project area requires use of private roads across private lands. By definition, the Class 2 area is "generally open access with no easements". Typically this means that although a road has no public easements, the landowner has historically allowed access to the USFS boundary. In many cases, landowners can refuse access in areas where they previously allowed it (Keister, pers. comm.).

Independence Mountain Range

The CEA province for cumulative effects to access is the Independence Range. The TOC is any loss of Class 1 or 2 areas. A total of 8,463 acres is currently closed in the Independence Range. An estimated additional 2,695 acres of existing Class 2 area would be closed, resulting in a cumulative closure area of 11,158 acres.

4.5 Socioeconomic Environment

Socioeconomic impacts are closely related to the mine economics issue identified during public scoping. Actions or decisions which influence the economic feasibility of the mining operations would also be reflected in the socioeconomic environment. Mine economics were raised as an issue by the public because of the effect that mine economics have on employment levels, property tax payments, net proceeds of mining tax revenues, and local purchases by IMC. All alternatives are assumed to be economically feasible to implement for analysis purposes throughout this DEIS. IMC is currently evaluating the technical feasibility of Alternatives F and G, as discussed in Chapter 2. As with all of the preceding sections, Alternatives F and G are considered feasible to implement for the purposes of this analysis. A comparison of the total estimated costs by alternative is displayed in Table 4.31. A base level of $0 was assigned to Alternative B to evaluate the added costs of implementing Alternatives C, D, E, F and G.

The costs of implementing Alternatives D and E are significant from a mine economics perspective, as shown in Table 4.31. It is estimated that Alternative D would add approximately $35 million and Alternative E would add approximately $17 million in costs over those incurred with implementation of Alternative B to produce an equivalent amount of gold. Alternative C is estimated to cost slightly more than Alternative B to implement. The high costs of implementing Alternatives D and E may be prohibitive to implementation of the proposed mine expansion under current gold prices.

This section evaluates potential changes to existing social and economic conditions that may result from the proposed action or the alternatives. Expansion of the Jerritt Canyon mine would allow operations to continue for a minimum of another nine to ten years (2001 to 2002) based on current (1993) mine economics. Implementation of the proposed action alternative would result in sustained employment along with increased employment opportunities, further diversification of the local economy, and continued payments of local, state and federal taxes by IMC and its employees. Local government fiscal conditions are particularly dependent on sustained economic activity and continued revenues from sales and use taxes, property taxes and net proceeds of mine taxes. Without the proposed expansion, IMC anticipates mining operations would begin to decline in 1994 and would cease sometime before or during 1996 (IMC 1993a). This would result in the lay-off of about 600 employees, the loss of revenues from property taxes, and a reduction in the payment of other taxes and the local purchase of goods and services.

Direct and indirect effects resulting from the proposed action have been analyzed, taking into account recent trends in Elko County. Cumulative effects have been evaluated

Table 4.31
Relative Costs by Alternative

	Alt-B[1] Base Level ($MM)	Alt-C ($MM)	Alt-D ($MM)	Alt-E ($MM)	Alt-F ($MM)	Alt-G ($MM)
Steer & Burns						
Dumps						
Hauling	$0.00	$0.49	$15.18	$15.18	$0.00	$0.00
Dozing 3:1	$0.00	$0.81	$0.81	$0.80	$0.00	$0.00
Reclamation	$0.00	$0.30	$0.49	$0.33	$0.02	$0.20
Road Reclamation	$0.00	$0.01	$0.02	$0.0[illegible]	$0.00	$0.00
Total	**$0.00**	**$1.61**	**$16.50**	**$16.32**	**$0.02**	**$0.00**
Saval						
Dumps						
Hauling	$0.00	$0.00	$4.85	$0.25	$0.00	$0.00
Dozing 3:1	$0.00	$0.00	$0.54	$0.27	$0.00	$0.00
Reclamation	$0.00	$0.01	$0.01	$0.03	$0.00	$0.00
Road reclamation	$0.00	$0.00	$0.01	$0.00	$0.00	$0.00
Total	**$0.00**	**$0.00**	**$5.84**	**$0.55**	**$0.00**	**$0.00**
New Deep						
Dumps						
Hauling	$0.00	$0.00	$6.39	$0.00	$0.00	$0.00
Dozing 3:1	$0.00	$0.25	$1.00	$0.61	$0.00	$0.00
Reclamation	$0.00	$0.27	$0.82	$0.26	$0.00	$0.00
Road reclamation	$0.00	$0.00	$0.12	$0.00	$0.[illegible]	$0.20
Total	**$0.00**	**$0.52**	**$8.33**	**$0.87**	**$0.39**	**$0.20**
Additional Equipment	$0.00	$0.00	$4.46	$0.00	$0.00	$0.00
TOTAL COSTS (in millions)	**$0.00**	**$2.13**	**$35.13**	**$17.74**	**$0.41**	**$0.20**

Source: IMC July 1993.

Note: [1] Costs for Alterntive B were assumed to be $0 for purposes of comparison.

utilizing the best available information regarding other project proposals, other than the Jerritt Canyon expansion, which have potential impacts in Elko County.

Key socioeconomic issues identified in the scoping process include: potential effects on employment; effects on Elko County; potential effects to tax structure and revenues to the county; and community stability, including the length of operations. Timing and duration of mining operations and effects on the economy and employment are discussed under Economy and Employment. Effects to Elko County are discussed under the following sections: Population; Housing; and Public Facilities and Services (including schools). Impacts to tax structure and revenues to the county are discussed under Financial Resources. Other topics analyzed include power, communications, transportation and energy.

Analysis methodologies are based on traditional planning practices and include observations of trends and patterns in the study area, State of Nevada population projections, information from economic impact studies conducted by the University of Nevada-Reno, and information from other local, state and federal agencies (Appendix 4-A, Technical File).

The analysis area for evaluating socioeconomic impacts is Elko County. It is expected that the City of Elko and the unincorporated Spring Creek community would be the areas most impacted by the proposed action. However, many facets of the entire County's economic base are reliant on the revenues generated by the Jerritt Canyon project. In addition to the proposed expansion, there are seven other major projects proposed or planned in Elko County and surrounding counties which are expected to affect the socioeconomic environment in Elko County in the reasonably foreseeable future. Other than the proposed action, only Barrick's proposed Meikle project would be located in Elko County. It is assumed that many new employees at projects that would be located in Eureka and Lander counties would choose to live in Elko, Carlin and Spring Creek where housing, goods, services and public facilities are available. These projects include: Placer Dome, U.S.'s Pipeline Project; Santa Fe Gold's Mule Canyon Mine; Newmont's Roaster Plant and Gold Quarry Expansion; and Dee Gold's Expansion and Underground Projects. Combined duration of these projects is anticipated to extend from 1993 to 2011, with all projects expected to begin construction activities or come on line from 1993 to 1997. Cumulative effects of these projects are discussed under the appropriate sections.

Population

Elko County population would not change significantly upon implementation of the proposed action. A maximum increase of less than two percent over the 1993 estimated population of 39,000 could be expected from in-migration related to new project-related mining employment and secondary support and service industry job opportunities. It is estimated that approximately 43 percent of the new employees required for the project would be hired locally.

Growth rates for Elko County are expected to continue at a moderate increase, peaking in 1993-94 at 3.8%, then slowing to less than 2% per annum through 1998. Table 4.32 indicates that the total percent growth in the county over the next five years, 1993 to

1998, would be 11.8% at an average annual rate of 2.3% based on these projections (Nevada State Demographer 1993).

Table 4.32
State Demographer's Population Estimates and Forecasts 1992-1998

	Elko County	City of Elko[1]	City of Carlin[1]	Eureka County	State of Nevada
1992	37,740	16,580	2,270	1,580	1,343,930
% >[2] 92-93	3.3			0.6	3.3
1993	39,000			1,590	1,388,630
% > 93-94	3.8			0.6	3.6
1994	40,470			1,590	1,438,560
% > 94-95	2.5			0.6	3.3
1995	41,480			1,590	1,485,720
% > 95-96	1.7			0.0	3.5
1996	42,190			1,600	1,536,980
% > 96-97	1.6			0.0	3.2
1997	42,870			1,600	1,586,280
% > 97-98	1.8			0.0	3.4
1998	43,640			1,600	1,640,390
% > 93-98	11.8			0.0	18.1

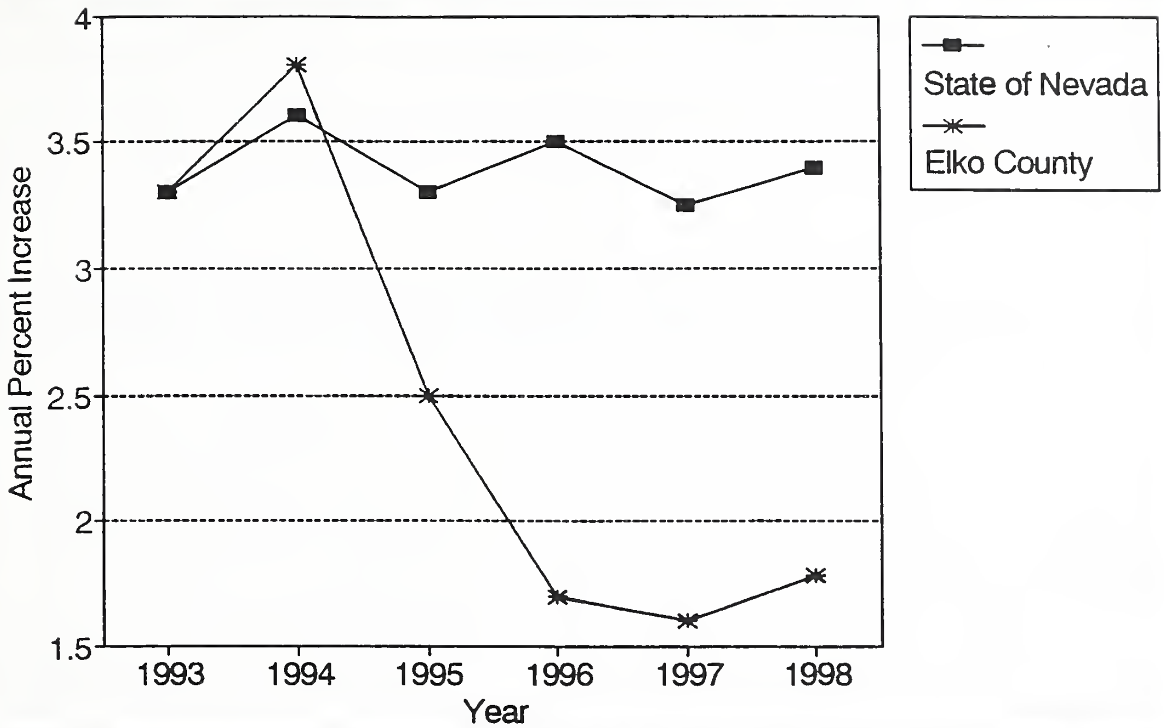
Source: Nevada State Demographer 1993. Bureau of Business & Economic Research, College of Business Administration, University of Nevada, Reno.

Note: Forecasts and estimates for July 1 of each year.
[1] The State Demographer does not project population for these cities.
[2] > means increase.

The five-year forecast for 1993 to 1998 suggests that a stabilizing trend is developing in Elko County, with annual growth rates subsiding to less than those forecast for the state as a whole for this period (See Figure 4.1). This trend corroborates the predictions of economist John Dobra, PhD, who suggested in 1991 that growth rates in the Elko County area would begin to decline into the foreseeable future as mining industry production in the region reached a plateau (USDI, BLM 1991b).

Projected direct and indirect population increases which may be expected upon implementation of the proposed action are displayed in Table 4.33. Direct population is associated with new mining jobs and is calculated as one household per in-migrating mining

Figure 4.1
County and State Population Forecast
1993 to 1998



employee times the average Elko County household size of 2.79 (US Bureau of the Census 1990). Indirect population is associated with new secondary service and supply industry jobs induced by new mining industry jobs. It is assumed that 70 percent of indirect jobs would be filled by second persons in primary job households or by current residents of Elko County (ENSR 1991).

Alternative A - No Action

No population growth from in-migration associated with expansion of the Jerritt Canyon Mine would occur under this alternative. If the proposed action were denied, or an economically infeasible alternative selected, IMC anticipates that production and employment would begin to decline in 1994 and cease sometime before or during 1996 based on current mine economics (IMC 1993a). The loss of 600 direct mining jobs could cause lay-offs and job losses affecting up to 750 employees in secondary support and service industries. Some of the affected workers could possibly migrate out of the county if other employment were not locally available.

Table 4.33
Summary of Project-Related Impacts
Employment, Population, Schools
For Alternatives B, C, D, E, F, and G[1]

	Direct Mining & Construction				Indirect Service & Support				Total Direct and Indirect			
Alternative[2]	B & C	D & E	F	G	B & C	D & E	F	G	B & C	D & E	F	G
New Employment												
Temporary[3]	30	30	30	30	19	19	19	49	49	49	49	49
Permanent[4]	175	200	155	270	122	140	109	190	297	340	264	460
Subtotal	**205**	**230**	**185**	**300**	**141**	**159**	**128**	**209**	**346**	**389**	**313**	**509**
New Households												
Temporary	16	16	16	16	6	6	6	6	22	22	22	22
Permanent	99	113	88	153	37	42	32	57	136	155	121	210
Subtotal	**115**	**144**	**104**	**169**	**43**	**48**	**38**	**63**	**158**	**177**	**143**	**232**
New Residents												
Temporary	19	19	19	19	17	17	17	17	36	36	36	36
Permanent	276	315	245	427	103	17	92	190	340	432	337	586
Subtotal	**295**	**334**	**264**	**446**	**120**	**134**	**109**	**176**	**415**	**468**	**373**	**622**
New School-Age												
Temporary	2	2	2	2	7	7	7	7	9	9	9	9
Permanent	124	141	110	191	46	53	41	71	170	194	151	262
Subtotal	**126**	**143**	**112**	**193**	**53**	**60**	**48**	**78**	**179**	**203**	**160**	**271**

Source: IMC, August 1993. New direct employment projections. GeoResearch, Inc., September 1993. Indirect employment, new households, new residents, new school-age projections.

Notes:
1. Under Alternative A there would be no new employment, households, residents, or school-age children, based on IMC employment projections.
2. Actual employment levels, households, residents and school-age children would be dependent upon the economic feasibility of Alternatives D and E, as well as the technical logistics and economic feasibility of Alternatives F and G.
3. Temporary Positions (less than one year); construction workers.
4. Permanent Positions (one year or more); mining operations workers; projected peak employment levels for the various alternatives are displayed here and were used as the basis for indirect industry employment, new households, new residents, and new school-age projections.

Alternative B - Proposed Action & Alternative C

Alternatives B and C would result in the creation of 175 new permanent job opportunities at IMC. The total population increase in Elko County related to in-migration associated with expanded mining industry jobs and indirect service sector job opportunities under these alternatives would be approximately 415. Direct mining employment-related population would be 295 with an indirect increase of 120 occurring as a result of new secondary employment. Based on a 1993 estimated county population of 39,000 (Nevada State Demographer 1993), a one percent increase would result from direct and indirect employment-related in-migration. It is assumed that new residents would live primarily in Elko and Spring Creek where most available housing is likely to be located.

Alternatives D & E

The creation of up to 200 new permanent mining jobs at IMC under Alternatives D and E would result in about 140 indirect employment opportunities. County population would rise by a total of about 432 permanent residents, which is an increase of approximately one percent over the estimated 1993 population.

Alternative F

The addition of 155 permanent mining jobs at IMC under this alternative would result in a total population increase of 373 in the county. Direct and indirect increases would be 264 and 109, respectively. An increase of less than one percent over 1993 population would result.

Alternative G

A total of 270 new permanent job opportunities at IMC would be created under this alternative. The greatest potential for population growth would result from this alternative, with a possible increase of 1.6 percent over the 1993 level. A total of 622 new residents, 446 direct employment-related and 176 indirect employment-related, could migrate into the county to take advantage of new job opportunities.

Cumulative Effects

Summaries of reasonably foreseeable impacts to employment, population and schools which may result from projects other than the Jerritt Canyon Expansion are displayed in Table 4.34.

In addition to the in-migration expected to result from the proposed action, a total of 2,097 new permanent residents could settle in Elko County over the next five years (1993 to 1998) as a result of expanded direct and indirect job opportunities related to the projects listed under on Table 4.34. Another 2,556 people (construction-related workers and their families) could reside temporarily in Elko County during construction seasons from 1993 to 1998. Maximum construction work force estimates were used for impacts analysis which

Table 4.34
Summary Of Reasonably Foreseeable Impacts Other than Jerritt Canyon Expansion Employment, Population and Schools

DIRECT IMPACTS

	Regional Employment[1]		New Elko Co. Households[2]		New Elko Co. Residents[2]		New School-age Residents[2]	
Company/Project	Temp.	Perm.	Temp.	Perm.	Temp.	Perm.	Temp.	Perm.
Placer Dome, U.S./ Pipeline Project	285	265	40	185	236	516	25	261
Santa Fe Gold/ Mule Canyon Mine	500	350	250	175	295	488	31	219
Barrick/ Meikle Project	250	220	137	209	181	583	14	261
Newmont/ Gold Quarry Exp.	760	0	418	0	493	0	50	0
Newmont/ Roaster Plant	10	0	110	0	130	0	14	0
Dee Gold/ Expansion	500	30	38	28	45	78	5	35
Dee Gold/ Underground	30	0	14	0	14	0	2	0
Total Direct	**2,095**	**865**	**1,169**	**597**	**1,379**	**1,464**	**146**	**746**

INDIRECT IMPACTS[3]

	New Elko Co. Employment		New Elko Co. Households		New Elko Co. Residents		New School-age Residents	
Company/Project	Temp.	Perm.	Temp.	Perm.	Temp.	Perm.	Temp.	Perm.
Placer Dome, U.S./ Pipeline Project	240	229	72	69	201	192	90	86
Santa Fe Gold/ Mule Canyon Mine	300	217	[illegible]	65	251	181	112	81
Barrick/ Meikle Project	250	220	137	209	161	583	17	261
Newmont/ Gold Quarry Exp.	502	0	151	0	421	0	189	0
Newmont/ Roaster Plant	137	0	40	0	112	0	50	0
Dee Gold/ Expansion	46	37	14	11	31	31	17	14
Dee Gold/ Underground	19	0	6	0	583	0	7	0
Total Indirect	**1,403**	**758**	**422**	**227**	**1,177**	**633**	**526**	**283**
Grand Total	**3,498**	**1,621**	**1,591**	**824**	**2,556**	**2,097**	**672**	**1,029**

Sources: [1] BLM, 1993. Best available information regarding proposed/planned projects expected to impact Elko County (Davis, pers. comm.). (IMC provided employment figures for Jerritt Canyon Expansion.)
[2] GeoResearch, Inc. 1993 (new households, residents, school age).
[3] GeoResearch, Inc. 1993

presents an overstated projection for temporary population influxes. However, it is expected that the temporary labor pool would migrate from project to project as work is available, therefore cumulative effects would likely be less than the potential impacts displayed in Table 4.34. Peak influxes of temporary residents would probably occur between 1993 and 1995, when most construction would be scheduled. The resultant total percent population increase would be seven percent over the 1993 estimated population of 39,000. This seven percent increase would occur incrementally over the 1993 to 1998 period as proposed projects come on line.

Economy and Employment

The local economy would be further stimulated and diversified by creation of new mining sector jobs. Studies of the economic impacts of Nevada's mineral industry revealed that for every mining job, an additional 0.74 jobs were created in the local economy and 0.5 jobs were created in the urban economies of the state which serve as supply centers (Dobra 1989). For analysis purposes, Elko is considered a supply center and it is assumed that 1.24 additional jobs would result from each new permanent mining job.

The local economy would also be stimulated by increased purchases of goods and services by IMC, its employees and by indirect employment workers. A healthy local economy is critical to the financial well-being of local governments, particularly in Nevada, where economic volume drives the tax base (Chapman, pers. comm., June 3, 1993).

Projected employment levels and duration of operations by alternative are presented in Table 4.35. Under Alternatives B, C, D, E, F and G, thirty construction workers would be required to build new mine facilities for a duration of approximately six months beginning in the summer of 1994. At an average 1991 state construction industry wage of $28,709 per year, 30 construction workers would be paid $430,635 over a six month period. No new mining operations or construction workers would be employed under Alternative A. Reclamation and final closure activities that would be undertaken after the mining operations end would require fifty employees for a period of two years under Alternative A and three years for Alternatives B, C, F and G. Reclamation and final closure would require 90 and 75 employees, respectively, for Alternatives D and E from 2003 to 2005, dropping to 50 and 25 in 2006. Employment duration of one year or more is considered to be permanent for purposes of this analysis. Employment duration of less than one year is considered to be temporary.

Alternative A - No Action

The potential loss of 600 direct mining jobs, and up to 750 indirect support and service sector jobs, as a consequence of closure of the Jerritt Canyon operations could result in the loss of $39.2 million per year in personal income to Elko County workers, thereby having a substantial negative effect on the local economy. Local businesses could be impacted by reduced purchases of goods and services by IMC, its employees and affected indirect businesses and their employees. Unemployment rates could rise and demands on social services could increase if other employment were not locally available. The local

Table 4.35
Jerritt Canyon Mine Expansion
Employment Levels By Alternative
(fiscal years)

Year	Alternative						
	A	B	C	D[1]	E[1]	F[2]	G[2]
1993	600	600	660	600	635	600	600
1994	600	775	775	775	775	710	870
1995	300	775	775	800	800	755	870
1996	800	660	660	685	685	755	755
1997	50	660	660	685	685	755	755
1998	50	485	485	500	500	465	565
1999	0	395	395	410	410	285	395
2000	0	395	395	410	410	110	395
2001	0	200	200	220	210	110	200
2002	0	100	100	140	125	50	100
2003	0	50	50	90	75	50	50
2004	0	50	50	90	75	50	50
2005	0	50	50	90	75	0	50
2006	0	0	0	50	25	0	0
2007	0	0	0	0	0	0	0

Source: Independence Mining Company August 1993.

Note: [1] Alternatives D and E are assumed to be economically feasible for this analysis.
[2] Alternatives F and F are currently being evaluated for economic and technical feasibility.

economy would be further depressed by a decline in property values and the tax base would be eroded by reductions in revenues from property taxes and sales taxes. Community stability would be disrupted under this alternative.

Alternative B - Proposed Action & Alternative C

At an average annual wage of $38,700 (IMC 1993b), creation of 175 new mining operations jobs under these alternatives would result in a direct payroll increase of $6.8 million per annum in 1994 and 1995. The mine work force would gradually be reduced from 1996 through 2002 when operations are anticipated to cease. At the 1991 state average annual wage of $21,504 for service sector jobs (US Department of Labor 1992), another $3.0 million in wages would be paid annually to secondary or indirect service sector workers. The combined mining and service sector annual payrolls of $9.8 million would contribute to the local economy through purchases of goods and services. In addition, an estimated $2.8 million would be paid in Federal income taxes on these wages.

Alternatives D & E

The new jobs assumed to be created under these alternatives would result in a total direct payroll increase of $6.8 million in 1994, $7.7 million in 1995, and $3.3 million in 1996 and 1997. Indirect payroll increases of about $2.6 million, $3.0 million, and $1.3 million would occur for these same periods if the indirect employment opportunities specified in Table 4.33 were created.

Alternative F

The addition of 110 new mining jobs in 1994, increasing to 155 in 1995 under this alternative, would result in a direct annual payroll increase of $4.2 million in 1994 and $5.9 million in 1995 through 1997. The addition of an indirect service sector annual payroll of $2.6 million could result in a total increase of $6.8 million to $8.5 million in personal income per year for Elko County workers during this period. Mine employment levels would begin to decline gradually in 1998 until operations cease in 2001.

Alternative G

Mining operations under this alternative would require 240 additional employees in 1994, increasing to 270 additional workers in 1995. Employment would then stabilize at 755 (155 over the 1993 level of 600) for the years 1996 and 1997. Employment would then gradually decline until operations cease in 2002. The payroll increase could exceed $10 million annually during peak employment years. Wages paid to indirect service sector employees could be as much as $4.9 million annually during the 1994 to 2002 period.

Cumulative Effects

Moderate growth which is projected for the mining industry of the region would continue to stimulate the local economy in Elko County resulting in further diversification and sustainability over the next two decades. On a broader scale, the long term economic growth and diversification of the state economy through the location of firms supplying goods and services to the minerals industry would be further enhanced and the quality of the state's labor force and infrastructure would continue to be upgraded (Dobra 1989).

A total of 2,095 temporary construction jobs and 865 permanent jobs would be created in the region by the seven mining projects (other than the Jerritt Canyon Expansion) proposed to start-up between 1993 and 1997. These new primary industry jobs would create an additional 1,403 temporary and 756 permanent service and support sector jobs in Elko

County. During peak employment periods, yearly direct and indirect construction wages paid could exceed $90 million based on 1991 average construction and service sector wages for the state (US Department of Labor 1992). Yearly direct mining wages paid to new operations workers would be $31.1 million and yearly indirect wages would be $16.2 million based on 1991 average state wages. The total annual cumulative payroll associated with the seven proposed projects could be as much as $137.7 million depending on the number of construction and operations workers employed during a given year. Combined duration of these projects is estimated to be nearly two decades (1993 to 2011). As some projects come off line, employment possibilities would occur at other projects if the reasonably foreseeable operations are realized.

Housing

Historically, housing has been relatively limited throughout the county. Vacancy rates were very low prior to the resurgence of gold mining activity in the region (USDA, USFS 1980). It is likely that some units may need to be added to the available housing stock as a result of in-migrating families associated with the proposed expansion and other projects proposed to come on line in the reasonably foreseeable future. Past trends indicate that new housing construction correlates closely with market demand. It is anticipated that this trend would continue in the future. Housing costs tend to reflect market demand and it is assumed that prices would continue to rise concurrently with increased demand and would stabilize when supply is adequate to meet demand.

Temporary housing needs associated with the proposed expansion would have a negligible effect on existing supply. The cumulative demand on temporary housing (RV sites, hotels/motels, apartments) resulting from other projects could exceed available units during peak construction phases.

A summary of project-related and cumulative housing requirements associated with known proposed projects is displayed in Table 4.36. Temporary housing is considered to have a maximum of one-year occupancy for purposes of this analysis. Permanent housing is that which would be occupied for more than one year. Estimates of the types of housing which may be required are based on 1990 Census information.

Alternative A - No Action

Additional housing units would not be required in Elko county under this alternative. Property values could potentially be depressed if the Jerritt Canyon project shuts down before or during 1996 and out-migrating displaced homeowners put their homes on the market simultaneously.

Alternative B - Proposed Action & Alternative C

An estimated total of 15 temporary housing units could be required as a result of in-migration. An estimated total of 136 permanent units could also be required. Of these, 99 would be for mine workers and their families, and 37 would be for service and support

Table 4.36
Housing Requirement Summary

Project-Related[1]

	Direct					Indirect					Total Direct and Indirect				
	Temporary	Permanent				Temporary	Permanent				Temporary	Permanent			
Alternative	**B, C, D, E, F & G**	**B & C**	**D & E**	**F**	**G**	**B, C, D, E, F & G**	**B & C**	**D & E**	**F**	**G**	**B, C, D, E, F & G**	**B & C**	**D & C**	**F**	**G**
Housing Type[2]															
Single-family	4	44	51	40	69	1	14	19	15	26	2	61	70	55	95
Multi-family	2	37	43	15	26	1	6	[illegible]	5	10	3	23	26	20	36
Mobile Home	2	38	43	33	58	[illegible]	14	16	12	21	3	52	59	45	79
RV Site/Motel	4	0	0	0	0	3	0	0	0	0	7	0	0	0	0
TOTAL UNITS	**9**	**99**	**113**	**88**	**153**	**6**	**37**	**42**	**32**	**57**	**15**	**136**	**155**	**120**	**210**

CUMULATIVE[3]

	Direct		Indirect		Total Direct and Indirect	
Housing Type	**Temporary**	**Permanent**	**Temporary**	**Permanent**	**Temporary**	**Permanent**
Single-family	64	268	41	97	105	365
Multi-family	129	103	85	33	214	136
Mobile Home	128	226	84	74	212	300
RV Site/Motel	322	0	212	0	534	0
TOTAL UNITS	**643**	**597**	**422**	**204**	**1,065**	**801**

Source: GeoResearch, Inc., 1993.

Notes:
1. No additional housing units would be required under Alternative A. Actual housing needs would depend on the economic feasibility of Alternatives D and E, as well as the technical logistics and economic feasibility of Alternatives F and G.
2. Estimates based on 1990 Census occupancy information
3. Based on best available information regarding proposed planned projects (see Table 4.33) expected to impact Elko County, excluding the proposed action.

industry workers. It is assumed that nearly all of the new direct and indirect households would settle in the Elko/Spring Creek area where existing housing availability is highest and where most new housing would likely be located.

Alternatives D & E

These alternatives could result in up to 15 temporary and 155 permanent housing units being required for new mining and service sector employees moving into the area. The new mining households would require 113 of the permanent housing units, with the remaining 42 being needed for indirect industry employees.

Alternative F

An estimated total of 15 temporary and 120 permanent housing units could be required as a result of in-migration under this alternative. New mining employees would require 88 units and indirect industry employees would require 32 units.

Alternative G

An estimated total of 15 temporary and 210 permanent units could be required under this alternative, 153 units for in-migrating mine employees, and 57 units for in-migrating indirect industry employees.

Cumulative Effects

Based on in-migration projections associated with the seven mining projects proposed in the region (not including the Jerritt Canyon Expansion), an estimated total of 1,065 temporary housing units, primarily RV sites, motel units and apartments, could be required in Elko County during the highest projected demand period expected to occur from 1993 through 1995. The actual number of units required at a given time would vary depending on timing and duration of project construction phases. All temporary units are assumed to be rentals. An estimated 801 permanent units could be required over the cumulative life (two to 15 years) of the proposed projects. Based on 1990 Census occupancy statistics, 64.5 percent of the permanent housing demand would be for homes to purchase, and 35.5 percent would be for rentals (US Bureau of the Census 1990). The need for additional housing units would not occur simultaneously, but would correspond to growth over time.

Financial Resources

Elko County is highly dependent on tax revenues received from IMC in the form of sales and use taxes, property taxes and net proceeds taxes, the county's three most important sources of revenue (Chapman, pers. comm., May 1993). Receipts from sales and use taxes and property taxes are expected to increase upon expansion of mine facilities, purchase of new equipment and increased purchases of services and supplies. For example, purchase of new equipment, such as a haul truck, would be assessed a 6.5 percent sales tax upon purchase, and would then be added to IMC's personal property tax listing and taxed accordingly each year. From a strictly economic perspective, the local government would have a funding source if the truck were purchased. If no truck is purchased, there would be no taxes paid (Chapman, pers. comm., June 1993). Revenues received by local governments from sales, use, and property taxes are expected to increase under all Alternatives except Alternative A, under which substantial decreases in revenues would result. Potential losses of revenues from taxes paid by IMC, its employees, and by secondary businesses and their employees, could have significant negative impacts on the county's financial solvency (Chapman, pers. comm., June 1993).

Net proceeds of mines tax revenues would vary considerably as a result of differing costs of production among the alternatives. Net proceeds taxes, assessed at five percent of mining profits, are influenced by the price of gold and cost of production. Operating expenses that directly affect mining operations are deductible. Therefore, the proceeds tax is assessed against only the net mining profits. Consequently, selection of an alternative which requires costly implementation measures to produce the same amount of gold in a given year above the cost of Alternative B - Proposed Action, would erode the county's tax base significantly by reducing potential net proceeds revenues (Chapman, pers. comm., June 1993).

Analysis of impacts to net proceeds tax revenues is based on a relative comparison of estimated costs of implementing Alternatives B through G. Under Alternative A - No Action, the state and county would no longer receive net proceeds revenues from the Jerritt Canyon Mine, as operations would cease. The relative costs of implementation and impacts to net proceeds tax revenues for the action alternatives are displayed in Table 4.37. Alternative B is presented as the base level, to which the added costs of implementing the other alternatives are compared. The potential loss of net proceeds tax revenue is indicated as $0 for Alternative B, while losses presented for the other alternatives are based on reductions to taxable income resulting from added costs of implementation. (Refer to Table 4.31 for a detailed explanation of costs by alternative.) As IMC's costs of operation rise, net proceeds tax revenues to the county would decrease as indicated in Table 4.37, or cease entirely if added costs of implementation caused the project to be economically infeasible.

Public Facilities and Services

Public officials indicate they are "catching up" with the increased demand for public facilities and services resulting from rapid growth experienced in the latter half of the late 1980s. Sustained economic growth is necessary for the local governments to continue to finance ongoing capital improvement and infrastructural expansion programs, e.g. siting new landfills, transportation and roads, new schools (Boucher pers. comm., Chapman pers. comm, Lipparelli pers. comm.). At projected growth rates associated with the proposed action, public facilities and services would continue to be adequate, with the exception of some public schools in the Elko, Spring Creek and Carlin areas which are currently near-capacity or overcrowded.

Continued growth in Elko County is not deemed by county officials to be problematic or negative in terms of additional demand for public facilities and services. Local officials

Table 4.37
Impacts to Net Proceeds Tax Revenues by Alternative Over the Life of the Project

Costs		Potential Reduction of Net Proceeds Tax Revenues[1] Over the Life of the Project Compared to Alternative B
Base Level[2]		
Alternative B	$ 0.00	$0.00
Added Costs[2] (in millions)		
Alternative C	$ 2.13	$106,500.00
Alternative D	$ 35.13	$1,756,500.00
Alternative E	$ 17.74	$887,500.00
Alternative F[3]	$ 0.41	$20,500.00
Alternative G	$ 0.20	$10,000.00

Source: IMC 1993 and GeoResearch, Inc. 1993.

Notes: [1] Net Proceeds tax revenues are assessed at 5% of net mining profits. Losses are calculated as 5% of added costs.
[2] Refer to Table 4.31 for detailed explanation of costs by alternative. Costs for Alternative B were assumed to be $0 as a baseline for purposes of comparison.

are concerned that a decision which is unfavorable to the proponent, or which would delay the proposed expansion, would cause negative impacts to the county in terms of negative effects to businesses, lost jobs, wages, and tax revenues (Chapman, pers. comm. May 1993, June 1993).

A ten-year school construction plan is in place which provides for new facilities to be built and which is expected to meet demand by the year 2002. This construction is based on a pay-as-you-go financing plan which depends on continued property tax and net proceeds tax revenues from IMC and contributions from regional mining companies whose employees and their families live in Elko County (Chapman, pers. comm. May 1993). Approximately 60% of county tax receipts go to support the public school system. The county's ability to meet financial obligations incurred for the school expansion program would be seriously jeopardized if the revenue stream generated from taxes paid by IMC and its employees, and indirect businesses and their employees, were interrupted, decreased, or no longer flowing into county coffers (Chapman, pers. comm., May 1993).

IMC's Jerritt Canyon operation is located in Elko County. Therefore, all associated property, net proceeds, and sales taxes benefit Elko County directly to compensate for the increased enrollments. This may not be the case with other proposed mining projects which are located in Lander and Eureka Counties.

Alternative A - No Action

An increase in the school-age population associated with in-migration would not occur under this alternative and the student population could decline by approximately 975 if displaced IMC employees and service sector families moved out of Elko County as a consequence of the shut-down of the Jerritt Canyon project.

This decline in student population would result in an immediate loss of approximately $3.7 million in revenues to the Elko County School District (based on state tax distributions of $3,800 per student). The school district would also lose federal revenues generated from payments for those dependents of wage earners working on federal lands (Chapman, pers. comm., July 1993).

Alternative B - Proposed Action & Alternative C

Based on a 1990 household average of 1.25 school-age children in public schools in Elko County (US Bureau of the Census), the total number of school-age children (K-12) is projected to increase by 179 due to in-migration under these alternatives. Of the projected permanent increase, 124 would be children of mine employees and 46 would be children of service sector employees. In-migrating permanent students would likely begin to attend Elko or Spring Creek schools beginning late 1994 and early 1995. In addition, 9 temporary students would probably be in Elko or Spring Creek schools in the fall of 1994. (Refer to Table 4.33 for summary of new school-age population).

Alternatives D & E

Approximately 203 additional new students would attend local schools if either one of these alternatives were selected. Of these students, nine would be temporary and 194 permanent. The number of permanent students from households directly employed in mining would be 141, while 53 would come from residents indirectly employed by mining.

Alternative F

There would be an influx of 160 new students under this alternative: 9 temporary; and 151 permanent, 112 direct employment-related and 48 indirect employment-related. Place and timing of attendance would be similar to that described for Alternatives B and C.

Alternative G

There would be 271 new students associated with in-migration projections under this alternative: 9 temporary, and 262 permanent, 191 mine-related and 71 indirect employment-related. Place and timing of attendance would be similar to that described for Alternatives B, C and F.

Cumulative Effects

There could be an influx of 672 temporary school-age students into the public schools in Elko, Spring Creek and Carlin due to implementation of the seven mining related projects in the area. The greatest impacts expected during the 1993 to 1995 period when most project-related construction is scheduled. Actual numbers of temporary students would vary depending on time of year and duration of construction phases for the various proposed projects. The total cumulative number of in-migrating permanent students would be 1,029. Some of these students would arrive in Elko County with their families beginning in 1993, with others expected to arrive from 1994 to 1997 as proposed projects come on line. It is anticipated that most of the new student population would attend schools in Elko, Spring Creek and Carlin.

Transportation and Energy

Impacts to power, communications, and public transportation systems would not vary significantly among alternatives. Powerlines are expected to be installed from the existing Mine Services and Administration (MSA) complex to the mine areas. Plans showing the facilities layout and powerline routes would be included in the final POO for this project (IMC 1993a).

Existing electronic sites would be utilized for the majority of radio communications. An additional radio repeater station may be installed adjacent to the Burns Basin mine area. IMC would submit layout and development plans for housing and mounting facilities and antenna towers to the USFS for review and approval prior to installation of new electronic sites on National Forest System land (IMC 1993a).

Public transportation systems would not be adversely affected by the proposed action. Movement of over-size loads or hazardous materials on public roads would be subject to state permits. Increased traffic on Highway 225 from additional employees would be minimal due to busing.

A comparison of estimated fuel use related to projected fuel consumption by alternative is shown in Table 4.38. Energy would continue to be conserved as a consequence of busing employees from Elko to the mine site.

4.6 Visual Resources

Visual resources were identified through public and agency scoping as an issue. As described in Chapter 3, portions of the Project area can be seen from a distance in the Independence Valley. Once mining operations cease, the area would be open for public recreation and changes which may not have been visible from Independence Valley would

Table 4.38 A Comparison of Fuel Use By Alternative			
Total Fuel Consumption (MM Gallons)		Difference from Alternative B (MM Gallons)	Percent Change from Alternative B
Alternative B	161.1	0	-
Alternative C	161.4	+0.3	+0.2%
Alternative D	168.8	+7.7	+5%
Alternative E	165.7	+4.6	+3%
Alternative F	82.6	-78.5	-49%
Alternative G	243.7	+82.6	+51%

Source: IMC July 1993.

be visible from the foreground. Changes in views from a distance and within the Project area are described below.

Views from the Independence Valley were analyzed using computerized viewsheds generated with GIS data. Five locations were selected as observation points by the USFS. These locations are identified on Map 4.2. A computer program simulated the areas seen within a 360 degree radius from each of the five observation points.

Alternative A - No Action

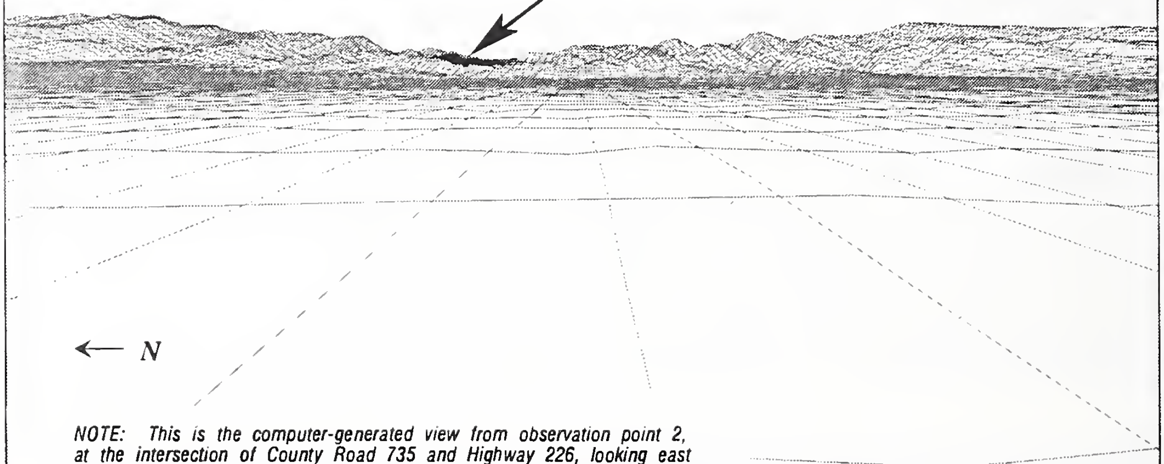
There would be no impacts to visual resources other than those that would occur as a result of existing and approved operations. The existing visual resource conditions are described in Chapter 3. Portions of existing operations can be seen from the Independence Valley. Persons travelling on Highway 226 would see portions of the area from a minimum distance of approximately five miles.

Effects Common To All Action Alternatives

The areas affected by the proposed mining activities under all action alternatives are within a USFS-designated VQO of maximum modification and implementation of an action alternative would not result in changes to that classification.

Changes to the visual resource would occur as changes to topography and vegetative cover. The greatest impact would occur during mining operations, although reclamation in the Project area would also be conducted in selected areas as existing and approved

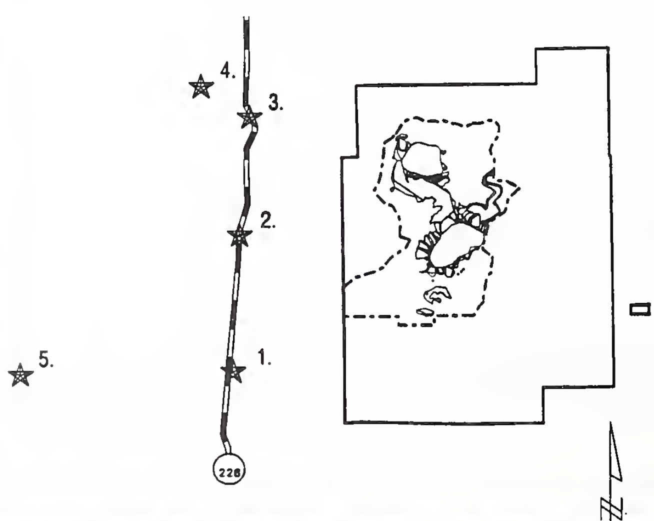
DATA SOURCE: USFS GIS data and DEM files, June 1993



NOTE: This is the computer-generated view from observation point 2, at the intersection of County Road 735 and Highway 226, looking east toward the Independence Mountain Range. It depicts existing topography, and the areas proposed for disturbance are shown as completely black areas. Saval, Steer and Burns Basin operations would not be seen from this observation point

Viewshed Observation Points:

1. Independence Valley School
2. County Road #735 Intersection
3. Intersection with Access Road to China Creek
4. Spanish Ranch
5. Tuscarora Townsite



Viewshed From Highway 226 in the Independence Valley

LEGEND

- Viewshed Observation Points
- General Study Area
- Project Area
- State Highway

No Scale - Due to Perspective View

Map 4.2

11/16/93

operations cease. Impacts during operations include construction of haul roads and facilities and development of pits and dumps. These developments would change the form, line, texture, and color of the areas of proposed disturbance.

Areas proposed for pit development currently consist of steep slopes, ridges, and canyons. These areas would be excavated and would result in cone-shaped pits with highwalls and benches. Pit appearance would change after mining operations cease. Weathering of the pit benches and walls over time would generally result in an appearance resembling talus slopes or escarpments. Portions of the Saval and Steer pit bottoms may be revegetated. Water may be retained at the bottom of the New Deep pit and would give the appearance of a lake surrounded by steep slopes under all action alternatives except Alternative F.

Waste rock dumps are proposed in canyon areas with a majority of existing slopes at angles greater than 40 percent. During operations, all waste rock dumps would be constructed by end-dumping from haul trucks, which would result in angle-of-repose slopes under all alternatives during this phase. From the Independence Valley, portions of the waste rock dumps would be visible because the line, form and color of the topography would be changed. Undisturbed slope areas would be interrupted by the horizontal line at the top of a waste rock dump or bench. Areas proposed for 3:1 slopes may have more benches than the same areas proposed for final angle-of-repose slopes. As part of reclamation, some areas of waste rock dumps would be reshaped to 3:1 or 2:1 under Alternatives C, D, and E as indicated on the Alternative Maps in Chapter 2. Slopes at 3:1 would be distinguished by their shape and line from surrounding topography which is generally at a steeper angle. The slopes at 3:1 were proposed in part to provide greater potential for successful revegetation. Areas that are successfully revegetated would reduce differences in color and texture among disturbed and undisturbed areas. Some of the coarse and durable material that would be placed on angle-of-repose slopes that are not revegetated may be darker than naturally exposed rock surfaces in the area. Over time, as the rock is weathered, these changes may become less visible and more closely resemble naturally occurring talus slopes and rock surfaces in the surrounding areas.

Portions of haul roads under any action alternative would appear as areas of cut and fill during the mining operations. Portions of haul roads would be visible from Independence Valley and would appear as changes to the form, line, and color of surrounding undisturbed areas. As part of reclamation, most roads would be completely or partially recontoured but some would remain for public access. Recontoured areas would approximate the pre-mining form and line. Recontoured and partially recontoured areas would be revegetated during reclamation and would result in texture and color that would resemble surrounding undisturbed areas.

Facilities, such as mine services areas, that may remain on privately owned land may remain a long-term change to the visual resource.

Alternatives B, C, D, E, and G

Changes to the visual resource would be similar among alternatives B, C, D, E, and G. Portions of the proposed disturbance would be seen from the five selected observation points in the Independence Valley but due to the viewing distance, differences among the alternatives would not be significant. A representative example of the viewing distance from Highway 226 is included in Map 4.2. Portions of the New Deep operations would be within the viewshed of the five observation points, but the Saval and Steer operations would be seen from only two observation points in the northern part of the valley. New disturbance in the Burns Basin would not be seen from any of the Independence Valley observation points. Under all action alternatives, the Burns Basin operations and the dumps south of Saval and Steer pits would be visible from Gance Creek Road.

Alternative F

Neither of the small dumps proposed for the New Deep operations under Alternative F would be visible from any of the five observation points. With the exception of the portions of the Saval and Steer operations that could be viewed from Spanish Ranch and China Creek Intersection observation points, portions of the haul roads associated with the underground operations would be the only disturbance within the viewshed under this alternative.

Cumulative Impacts

Cumulative impacts to the visual resource include impacts from past, existing and reasonable foreseeable future mining operations. The area of cumulative impacts from the Jerritt Canyon operations extends beyond the Project area and includes the disturbance displayed on Map 2.1 for Alternative A. Cumulative impacts include changes to the form, line, texture, and color of pre-mining topography and ground cover similar to those described above for short term and long term impacts. Cumulative impacts include disturbance from pits, waste rock dumps, haul roads and exploration roads in an area characterized by mountainous terrain primarily covered with sagebrush and grass prior to mining. Once vegetation has established on fully recontoured roads, cumulative long term visual impacts from those roads would not be readily apparent to the casual observer. Visual impacts associated with cumulative impacts for pits, waste rock dumps, facilities and partially recontoured roads would be similar to those described for the action alternatives but would encompass a larger area.

Portions of existing, approved, and proposed mining operations would be visible from the Independence Valley as described above. Once public access is reopened, post-mining changes would be viewed from the foreground. More of the disturbance would be visible from within the Project area, so that those alternatives with a greater disturbance area would result in a greater area of impact to the visual resource. Alternative F, the underground mining alternative, would result in the least amount of disturbance. Of the surface mining alternatives, Alternative B would result in the least amount of disturbance and Alternative D would result in the greatest area of disturbance.

The TOC for visuals defined by the CEA is any change in retention and partial retention VQO Classes. The area of cumulative impacts from the Jerritt Canyon mine operations is entirely within an area classified by the USFS as a maximum modification VQO. The cumulative changes could occur and still meet the USFS VQO criteria for maximum modification.

4.7 Cultural Resources

The area of analysis for impacts to cultural resources is the general study area. As defined by the CEA Technical Guide, the TOC for cultural resources is any unauthorized damage in the short-term and/or loss of 20 percent of the sites eligible for the National Register of Historic Places (NRHP) in the long-term. The TOC for Native American Religious Sites is any projected impact that is a concern to the Native American population.

For purposes of this analysis, direct impacts are considered to be any disturbance of sites that are NRHP eligible or that have religious value to the Native American population. Under all alternatives, previously unidentified cultural resources discovered during operations would be avoided and/or activities which could damage the resource would cease. On-site mitigation measures for previously unidentified sites would be conducted in consultation with the USFS and the State Historic Preservation Office (SHPO).

Indirect impacts can include damage caused by activity outside of the projected disturbance area. Mitigation common to all alternatives includes the restriction of heavy equipment to roads and operational areas developed pursuant to the final POO. On past operations, the Mountain City Ranger District has specified buffer zones of varying distances around identified sites eligible for the NHRP as an additional mitigation for indirect effects. A 300 foot buffer zone was used for analyzing potential impacts of alternatives in this DEIS.

Additional indirect impacts include the potential for increased access for unauthorized collection of cultural resources once mining has ceased and public access is reopened.

Alternative A

Under Alternative A, any impacts to cultural resources would be those that have already been identified and approved for existing operations. In order to avoid damage to unidentified sites, IMC contributes funds for the Humboldt National Forest Service to inventory and evaluate areas before they are developed. (IMC and USDA Forest Service, Collection Agreement 1993).

Effects Common to All Action Alternatives

There are no sites identified as significant or unevaluated that would fall within the proposed disturbance of any of the action alternatives. There are no additional identified significant or unevaluated sites that fall within a 300 foot buffer zone. Initial consultations with descendants of the Tosawihi indicate there would be no direct or indirect impacts on the Native American traditional sacred areas under these alternatives.

Cumulative Impacts

Cumulative impacts for the existing and proposed operations are not significant within the definition of the CEA model. There has been no unauthorized damage of sites. Of a total of 11 identified significant sites in the general study area, none has been disturbed as a result of existing mine operations or would be disturbed during the proposed expansion under any alternative.

Chapter 5

List of Preparers

Photo Description: Burns Basin haul road system (Fall 1991).

CHAPTER 5

LIST OF PREPARERS

5.0 LIST OF PREPARERS

5.1 Introduction

This DEIS has been prepared by GeoResearch, a third-party consultant. GeoResearch has responsibility for completion of the DEIS under the direction of the Forest Service. Representatives from the cooperating and participating agencies have contributed to and participated in the NEPA process. Technical input regarding the proposed Project has been provided by IMC. Additional technical information regarding specific components of the proposed Project has been provided by USFS and consultants under contract to GeoResearch, Inc., and IMC. The following sections present the names of individuals and their area(s) of responsibility from Forest Service, cooperating agencies, GeoResearch, IMC, and associated consultants that have been involved in the preparation of portions of the DEIS. Brief biographical information is provided for some individuals where appropriate.

5.2 USDA - Forest Service

Key Team Members

NAME	CONTRIBUTION	DEGREE/YEARS OF EXPERIENCE
Donald Carpenter	Project Coordinator	B.S. Forest Management 23
Steve Anderson	Biological Environment	B.S. Wildlife Resources 16
Chris Butler	Surface and Ground Water Air Quality	B.S.,M.S. Watershed Sciences A.A. Forestry 12
Mary Beth Marks	Soils, Geology, Reclamation, Geochemistry, Economics	B.S. Geology 12
Jed Parkinson	Transportation, Mine Engineering	B.S. Civil & Environmental Engineering 14

Interdisciplinary and Support Team Members

NAME	CONTRIBUTION
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Doug Clarke	Land Use, Mine Reclamation
Gene Farmer	Mine Reclamation, Geochemistry
Fred Frampton	Cultural Resources
Jeff Gabardi	Mine Engineering
Roger Johnson	Cultural Resources
Dean Morgan	Land Use, Reclamation
Chrys Olsen	Range, Vegetation
Gary Schaffran	Recreation, Land Use, Visuals
Irene Smith	GIS Support Services
Jon Warder	Wildlife, Fisheries, Threatened and Endangered Species
Karla Warder	Range, Vegetation
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5.3 Cooperating/Participating Agencies

NAME	AGENCY	CONTRIBUTION
Terri Knutson	BLM	Environmental Resources
Kevin Roukey	Corps	Wetlands
Llee Chapman	Elko County	Socioeconomics
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Russ Fields	NDOM	Mineral Resources
Jeannie Geselbracht	EPA	Environmental Resources
MaryJo Elpers	USFWS	Wildlife, Wetlands, TES

5.4 GeoResearch, Inc.

NAME	CONTRIBUTION	DEGREE/YEARS OF EXPERIENCE
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Curt Coover	Soils Surface Water Resources	B.A. Geology 9
Valerie Counts	Socioeconomics	B.S. Geography 5
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Dwayne H. Jelinek	Socioeconomics	B.A. M.B.A. 29
Thomas Graves Lyman, Jr.	GPS/GIS Support Services	M.Ed. 25
Michael G. Machler	Climatology/Air Quality	B.S. Meteorology 22
Thad Mauney, Ph.D	GPS/GIS Support Services	B.S. Chemistry Ph.D. Analytical Chemistry 19
Jim McInerney	GPS/GIS Support Services	B.S. Meteorology (Chemistry) M.S. Computer Science 16
Douglas B. Richardson, Ph.D.	Project Management GPS/GIS Support Services Soils/Geology	B.S. General Studies Ph.D. Geography 16

NAME	CONTRIBUTION	DEGREE/YEARS OF EXPERIENCE
Peter Sawyer	Vegetation/Range	B.S. Geography M.S. Silviculture 15
Cynthia L. Tolle	GPS/GIS Support Services	B.S. Biology M.S. Microbial Ecology 14
Scott Wanstedt	GIS Support Service	B.S. Range Sciences 7
Theresa Whistler	GPS/GIS Support Services	B.A., M.A. Geography 6
Theodore J. Wirth	Visual Quality	B.S. Landscape Architecture 43

5.5 IMC

NAME	CONTRIBUTION	DEGREE/YEARS OF EXPERIENCE
Scott Lewis	Project Manager	B.S. Range Management 10
Julia Bosma-Douglas	Project Coordinator	B.S., M.S. Geological Sciences 9
Judy Bertuca	Mine Engineering	B.S. Mine Engineering 10
Matt Thiel, PE	Mine Engineering, Economics	B.S. Mine Engineering 18

5.6 Other Consultants

NAME	CONTRIBUTION
Westec Reno, Nevada Catherine Clark Mary E. Coburn, J.D. Daniel J. Davis Timothy M. Dyhr John O. Heggeness Michael Henderson Patricia K. Johnston Lynda Nelson Carol Oberholtzer Kara Pack William J. Reich Joan A. Reynolds Barbara L. Seeger Meg Macdonald	Groundwater, Geology, Paleontology, Vegetation, Livestock Grazing, Wildlife and TES.
Michael S. Smith, P.E. Kennedy/Jenks Consultants Reno, Nevada	Mine Engineering
JBR Consultants Group Reno, Nevada Patricia Johnston Susan Fox J. Kent McAdoo	TES
Thomas Skordal Gibson & Skordal Sacramento, California	Wetlands
Kent Crofts IME Yampa, Colorado	Wetlands
HCI Hydrologic Consultants Lakewood, Colorado Tom Hanna Lee Adkinson	Groundwater, Hydrology
Howard Eriksen Condor Earth Technologies Sonora, California	Surface Water

Chapter 6

List of Agencies, Organizations and Persons to Whom Copies of this Statement were Sent

Photo Description: Looking west from existing operations to the existing West Generator pit and proposed New Deep Pit area. Tuscarora Mountains are in the background. (Fall 1992).

CHAPTER 6

LIST OF AGENCIES, ORGANIZATIONS AND PERSONS TO WHOM COPIES OF THIS STATEMENT WERE SENT

6.0 LIST OF AGENCIES, ORGANIZATIONS AND PERSONS TO WHOM COPIES OF THIS STATEMENT WERE SENT

6.1 Introduction

This section includes the circulation lists of federal, state, and local government agencies, organizations, and interested individuals receiving copies of the DEIS. This is not a comprehensive list since requests for copies continue. Copies of the DEIS, including the proposed Plan of Operations, are available for review at the Mountain City Ranger District Office in Mountain City, Nevada, the Humboldt National Forest Supervisor's Office in Elko, Nevada, and the Elko County Public Library in Elko, Nevada.

6.2 Federal Agencies

U. S. Army Corps of Engineers, Sacramento, CA
USDA - Forest Services, Regional Office, Ogden, UT
USDA - Forest Service, Environmental Coordination, Washington, DC
USDA - Forest Service, Humboldt National Forest, Elko, NV
USDA - National Agricultural Library, Beltsville, MD
USDI - BLM District Office, Elko, NV
USDI - BLM Ely Area Office, Ely, NV
USDI - Fish and Wildlife Service, Reno, NV
U. S. Environmental Protection Agency, Washington, DC
U. S. Environmental Protection Agency, San Francisco, CA.

6.3 State and Local Agencies

State

Nevada Division of Minerals, Carson City, NV
Nevada Division of Environmental Protection, Carson City, NV
Nevada Division of Wildlife, Elko, NV
Nevada State Clearing House, Carson City, NV
Senator Richard Bryan
Senator Harry Reid
Representative Barbara Vucanovich

State Senator Dean Rhoads
Assemblyman John Carpenter

Local

City of Carlin, Mayor
City of Elko, Jim Polkinghorn
Elko County Federal Land Use Planning Commission, Gene Gustin
Elko County Commissioners, Lee Chapman
Elko County Library, Elko
Elko County School District, Paul Billings

6.4 Organizations

Cashman Equipment, Dennis Klus
Cashman Equipment, John Nolan
Eklund Drilling, Marty Dennis
El Tejon Company, Leonard Bidart
Elko Chamber of Commerce, Lorri Kocinski
Elko County Farm Bureau, Paul Sarman
Elko Free Press, Adella Harding
Ellison Ranching, Bill Evans
Environmental Strategies, Stanley Dempsey
High County News, Jon Christensen
Homestake Mining Company, Allan Cox
Howard Ranches, Kent Howard
Independence Mining Company Inc., Dave Jones
Independence Mining Company Inc., Russ Allen
Independence Mining Company Inc., William Neumann
Intermountain Research, Robert Eision
K. Dresser - Haulpak, Joseph Pischer
Knight Peisold and Company, Brett Flint
LASER, John Williams
Mineral Policy Center, Philip Hocker
Monitor Geochemical Labs, Inc., Joseph Koch
National Wildlife Federation, Jacquelyn Bonomo
Nevada Cattleman's Association, Elko NV
Nevada Mining Association, Paul Scheidig
Nevada Waterfowl Association, James Giudici
Newmont Gold Company, Peter "Fritz" Sawyer
Parsons Behle & Latimer, Patrick Garver
Pioneer Equipment, Jay Cailisto
Santa Fe Pacific Minerals Corporation, Denise Gallegos
Saval Ranching Company, A.G. Edwards, Jr.
Shoshone-Paiute Tribes, Lindsey Manning
Sierra Club, Glen Miller

Sierra Club, Toiyabe Chapter, Lois Snedden
Smith DDA, Todd McCadden
Suburban Propane & Petrolane, Neil Cook
Te-Moak Tribe, Dale Malotte
Turner's Jewelry & Gifts, Daniel Turner
Van Norman Ranches, Bill Van Norman
Westec, William Reich
Westec, Colleen Bathker
Westec, Catherine Clark
Westec, Meg McDonald
Western Shoshone Historic Preservation Society, Larry Kirby
Wilderness Society, Barbara Spolter
Wright Ranches, James Wright

6.5 Individuals

Russell Alen
Tim Arnold
John Catledge
Llee Chapman
Mary Coburn
Denise Connow
Ronald Crouse
Lesley Cusick
John Geddie
Paula Del Guidice
Royce Hackworth
Martin Jones
Pierre Mousset Jones
Linda Kantor
Cecil L. Kinard
Rory Lamp
Dan Lunsford
Craig McCaa
Robert & Bonnie Mochizuki
Thomas Muth
Ross Oliver
Richard Perry
Val Sawyer
Marjorie Sill
Roger Steninger
Robert Stuart
Ed Sutich
Larry Sutter
Cynthia Wood
Stanley Zunino

Supplemental Information

Photo Description: Looking south down Jerritt Canyon tributary (Spring 1993).

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GLOSSARY

Acid Mine Drainage - Drainage with a pH of 2.0 to 4.5 from mines and mine wastes that is the result of oxidation of sulfides exposed during mining.

Acre-feet - The volume of liquid or solid required to cover one acre to a depth of one foot, or 43,560 cubic feet; measure for volumes of water, reservoir rock, etc.

Activated Carbon - Highly adsorbent carbon formed by heating granulated charcoal to exhaust contained gases.

Ad valorem tax - Property tax.

Adit - A nearly horizontal passage in an underground mine, driven from the surface, by which a mine may be entered, ventilated, and/or dewatered.

Allotment - A unit of land suitable and available for livestock grazing that is managed as one grazing unit.

Alluvium - Unconsolidated or poorly consolidated gravel sands and clays, deposited by streams and rivers on riverbeds, floodplains, and alluvial fans.

Ambient - The environment as it exists at the point of measurement and against which changes or impacts are measured.

Angle of Repose - The maximum angle of slope at which loose, cohesionless material remains stable. It commonly ranges between 33° and 37° on natural slopes.

Animal Unit Months (AUMs) - Grazing of a cow/calf pair for one month.

Anomaly - A geological feature, especially in the subsurface, distinguished by geological, geophysical, or geochemical means, which is different from the general surroundings.

Aquatic Bed - An area that is submerged most of the time, supports submerged vegetation and can be periodically exposed.

Aquatic Resources - Biological resources (plants, animals, and other life forms) present in or dependent on streams, lakes, and other surface water.

Aquifer - A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

Argillite - A compact rock, derived from mudstone or shale, more highly indurated than either of those rocks.

Aspect - The direction toward which a slope faces with respect to the compass or the sun.

Assemblage - A group of rocks grouped together by age or similar origin.

Background - The viewing area of a distance zone that lies beyond the foreground-middleground. Usually from a minimum of 3 to 5 miles to a maximum of about 15 miles from a travel route, use area, or other observer position. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

Baseline Study - A study conducted to gather data prior to mining for the purpose of outlining conditions existing on an undisturbed site. Impacts are evaluated against the baseline data and reclamation success is measured against baseline data.

Biota - The animal and plant life of a region; flora and fauna collectively.

Broadcast seeding - Distribution of seed by a fan spreader or by hand spreading.

Carbonation - An alteration process that involves precipitation of dissolved calcium carbonate as veins and veinlets.

CFR - Code of Federal Regulations, the compilation of federal regulations adopted by federal agencies through a rule-making process.

Characteristic Landscape - The established landscape within an area being viewed. The term does not necessarily mean a naturalistic character, but may refer to features of the cultural landscape, such as a farming community, an urban landscape, or other landscape that has an identifiable character.

Chert - A sedimentary rock composed of cryptocrystalline quartz.

Collar - The mouth or upper end of a mine shaft.

Colluvium - General term applied to loose and incoherent deposits, usually at the foot of a slope of cliff and brought there chiefly by gravity; such as talus and cliff debris.

Community Types (vegetation) - A group of plants living in a specific region under relatively similar conditions.

Contrast - The effect of a striking difference in the form, line, color, or texture of the landscape features within the area being viewed.

Critical Habitat - Habitat that is present in minimum amounts and is the determining factor in the potential for population maintenance and growth.

Crosscut - Level passage that connects drifts in an underground mine.

Cultural Resources - The archaeological and historical remains of human occupation or use. Includes any manufactured objects, such as tools or buildings. May also include objects, sites, or geological/geographical locations significant to Native Americans.

Cumulative Effects - The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be significant. Included are activities of the past, present, and reasonably foreseeable future.

dBA - The sound pressure levels in decibels measured with a frequency weighing network corresponding to the A-scale on a standard sound level meter. The A-scale tends to suppress lower frequencies, e.g., below 1,000 Hz.

Decibel (dB) - A unit used in expressing ratios of electric or acoustic power. The relative loudness of sound.

Direct Impacts - Impacts which are caused by the action and occur at the same time and place (40 CFR 1508.7). Synonymous with direct effects.

Discharge - The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second (cfs), gallons per minute (gpm), or million gallons per day (mgd).

Disturbed Area - Area where natural vegetation and soils have been removed or disrupted.

Diurnal Surface Wind - Daily variation between night and day in the direction of flow and speed of surface wind.

Dore Bars - Metal alloy composed of gold, silver, and other precious metals. Bullion containing unparted metallic gold and silver.

Drainage - Natural channel through which water flows some time of the year. Natural and artificial means for effecting discharge of water as by a system of surface and subsurface passages.

Drawdown - The lowering of the water level in a well as a result of withdrawal.

Drift - Level passage that follows the ore in an underground mine.

Earthquake - Sudden movement of the earth's crust resulting from faulting, volcanism, or other mechanisms.

Ecological Site - Subdivisions of rangeland differentiated by the potential natural vegetation they are capable of supporting.

Endangered Species - Any species in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Ephemeral Stream - A stream or portion of a stream that flows briefly in direct response to precipitation in the immediate vicinity, and whose channel is at all times above the water table.

Epicenter - The location of the earth's surface directly above the focus or origin of an earthquake.

Erosion - The wearing away of soil and rock by weathering, mass wasting, and the action of streams, glaciers, waves, wind, and underground water.

Evapotranspiration (ET) - The portion of precipitation returned to the air through evaporation and plant transpiration.

Exploration - The search for economic deposits of minerals, ore, and other materials through practices of geology, geochemistry, geophysics, drilling, and/or mapping.

Fault - A fracture or one of fractures in rock units along which there has been displacement of the sides relative to one another parallel to the fracture.

Fisheries - Streams and lakes used for fishing.

Floodplain - That portion of a river valley, adjacent to the channel, which is built of sediments deposited during the present regimen of the stream and is covered with water when the river overflows its banks at flood stages.

Flume - A structure built in an open channel that constricts water flow through a designed opening to measure rate of water flow.

Footprint - The actual surface area physically disturbed by mining operations and ancillary facilities.

Footwall - The underlying side of a fault, orebody, or mine working. The wall rock beneath an inclined vein or fault.

Forage - Vegetation used for food by wildlife, particularly big game wildlife and domestic livestock.

Forb - Any herbaceous plant other than a grass, especially one growing in a field or meadow.

Foreground-Middleground - The area visible from a travel route, use area, or other observer position to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape, and vegetation is apparent only in pattern or outline.

French Drain - A water passage made by filling a trench or foundation area with loose stones or rock and covering with earth or other materials.

Fugitive Dust - Dust particles suspended randomly in the air from road travel, excavation, and rock loading operations.

g - The force of gravity at the earth's surface or at sea level.

Game Species - Animals commonly hunted for food or sport.

Geochemistry - The study of the distribution and amounts of the chemical elements in minerals, ores, rocks, soils, water, and the atmosphere, and their circulation in nature, on the basis of the properties of their atoms and ions.

Geotechnical - A branch of engineering concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.

Grade - A slope stated in terms of feet per mile or as feet per feet (percent); the content of precious metals per volume of rock (ounces per ton).

Graminoid - Grasses or grain-bearing plants.

Ground Cover - The amount of ground surface covered by vegetation.

Ground Water - All subsurface water, especially that as distinct from surface water portion in the zone of saturation.

Ground Water Table - The surface between the zone of saturation and the zone of aeration; that surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.

Growth Medium - Topsoil with sufficient organic matter and nutrients to support plant life.

Habitat - The place or type of site where a plant or animal naturally or normally lives and grows. Includes all biotic, climatic, and soils conditions, or other environmental influences affecting living conditions.

Hanging Wall - The overlying side of an orebody, fault, or mine working. The wall rock above an inclined vein or fault.

Haul Road - All roads utilized for transport of an extracted mineral, waste, overburden, or other earthen materials.

Heap Leach - The process of recovering gold from low-grade ores by leaching ore that has been mined and placed on a specially prepared pad. A dilute sodium cyanide solution is applied through low-volume emitters and, the metal-bearing leachate solution percolates and is collected.

Heavy Metals - A group of elements that may be acquired by organisms in trace amounts that are toxic in higher concentrations. Includes copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), cobalt (Co), chromium (Cr), iron (Fe), silver (Ag), etc.

Herbaceous Perennials - Leafy, non-woody plants with fleshy stems that have a life span of more than two years.

Host Rock - A body of rock serving as a host for mineral deposits.

Hydrology - A science that deals with the properties, distribution, and circulation of surface and subsurface water.

Hydrophitic Vegetation - Plants that grow in and are adapted to an aquatic or very wet environment.

Hydrostatic Head - The height of a vertical column of water, the weight of which, if of unit cross-section, is equal to the hydrostatic pressure at a point.

Igneous - Rock or mineral that solidified form molten or partly molten magma, processes relating to or resulting from the information of such rocks.

Impoundment - The accumulation of any form of water in a reservoir or other storage area.

Incised Streams - Streams that have deep channels and high, steep banks due to erosion.

Inclined Shaft - A passage in an underground mine inclined from vertical to 45° or less.

Indirect Impacts - Impacts which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. (40 CFR 1508.8). Synonymous with indirect effects.

Infiltration - The movement of water or some other liquid into the soil or rock through pores or other openings.

Infrastructure - The basic framework or underlying foundation of a community including road networks, electric and gas distribution, water and sanitation services, and facilities.

Intermittent Stream - 1) A stream that flows only at certain times of the year, as when it receives water from springs or from a surface source; and 2) a stream that does not flow continuously, as when water losses from evaporation or seepage exceed the available stream flow.

Irreversible - Applies primarily to the use of nonrenewable resources, such as minerals, cultural resources, wetlands, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Jurisdictional Wetland - A wetland area identified and delineated by specific technical criteria, field indicators, and other information for purposes of public agency jurisdiction. The public agencies which administer jurisdictional wetlands are the US Army Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service, and USDA-Soil Conservation Service.

Land Use - Land uses determined for a given area that establish the types of activities allowed (e.g., mining, agriculture, timber production, residences, industry) and the size of buildings and structures permitted.

Landform - Any physical, recognizable form or feature of the Earth's surface, having a characteristic shape and produced by natural causes. Includes major features such as plains, plateaus, and mountains, and minor features, such as hills, valleys, slopes, canyons, arroyos, and alluvial fans.

Landscape Character - The arrangement of a particular landscape as formed by the variety and intensity of the landscape features as defined as the four basic elements (form, line, color, and texture). These factors give the area a distinctive quality that distinguishes it from its immediate surroundings.

Landscape Features - The land and water forms, vegetation, and structures that compose the characteristic landscape.

Lifts - Changes in slopes on the faces of waste rock or heaps that are the result of construction of the dump or heap in a series of layers.

Lithic Scatter - (Archaeology): A discrete grouping of flakes of stone created as a byproduct in the tool-making process. Often includes flakes used as tools as well as formal stone tools, such as projectile points, knives, or scrapers.

Lithology - The description of rocks in terms of the physical character of a rock, mineral composition, grain size, color and other physical characteristics.

Maximum Modification - A visual quality objective that allows activities that alter the vegetation and landform to dominate the original characteristic landscape with some limitations.

Mesic - Moist habitats associated with springs, seeps and riparian areas.

Mill feed - The supply of mined ore transported to the mill for processing.

Milling - The general process of separating the economic constituents (metals) from the undesired or un-economic constituents of ore material (tailings).

Mineralization - The process by which a valuable mineral or minerals are introduced into a rock.

Mining Claims - That portion of the public estate held for mining purposes in which the right of exclusive possession of locatable mineral deposits is vested in the locator.

Mitigate, Mitigation - To cause to become less severe or harmful to reduce impacts. Actions to avoid, minimize, rectify, reduce or eliminate, and compensate for impacts to environmental resources.

Modification - A visual quality objective in which man's activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

Monitor - To systematically and repeatedly watch, observe or measure environmental conditions in order to track changes.

Muck - (1) Broken ore and rock. (2) The process of removing broken waste rock.

Multiple Use - The management concepts under which National Forest System lands are managed that involve the management of resources in combinations that will best serve the public.

National Pollutant Discharge Elimination System (NPDES) - NPDES is a part of the Clean Water Act, which requires point source dischargers to obtain permits. These permits are referred to as NPDES permits and are administered by the Environmental Protection Agency.

National Register of Historic Places - A list, maintained by the National Park Service, of areas which have been designated as being of historical significance.

Native Species - Plants that originated in the area in which they are found, i.e., they naturally occur in that area.

NEPA - The National Environmental Policy Act of 1969. It is the national charter for protection of the environment. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Regulations at 40 CFR 1500-1508 implement the act.

Net Proceeds Tax - This is a form of income tax assessed as a property tax intended to assess the value of the minerals which are being extracted.

Nutrients - Essential chemicals needed by plants or animals for growth and health. If other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation and subsequent decay of plants, especially algae. Some nutrients can be toxic to animals in high concentrations.

Ordinary high water mark (OHWM) - line on the shore established by the fluctuation of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas

Ore - A deposit of rock from which a valuable mineral or minerals can be economically extracted.

Organic Administration Act of 1897 - Act which provides the authority for the Forest Service to administer reserved and outstanding mineral operations in conjunction with the Secretary of Agriculture. The law specifically authorizes the Forest Service to manage the surface resources on National Forest System lands. It also provides a) the right to conduct mining activities and b) the right of ingress and egress on National Forest System lands to conduct mineral activity.

Overburden - Material which overlies a deposit of valuable material.

Overstory - That portion of the trees, in a forest of more than one story, forming the upper or uppermost canopy.

Paleontology - The study of the forms of life existing in former geologic periods, as represented by fossil animals and plants.

Partial Pit Backfill - Placing waste rock in a mined-out pit to less than the capacity of the pit.

Partial Retention - A visual quality objective in man's activities may be evident, but must remain subordinate to the characteristic landscape.

Patent - A document conveying title to land from the U. S. Government to private ownership.

Patented Claims - Private land which has been secured from the U. S. Government by compliance with laws relating to such lands.

Perched Water - Unconfined groundwater separated from the underlying main body of groundwater by unsaturated rock.

Perennial Stream - A streamor reach of a stream that flows throughout the year.

Permeable - The property or capacity of a porous rock, sediment, or soil to transmit a liquid.

pH - The negative $\log_{10}$ of the hydrogen ion activity in solution; a measure of acidity or basicity of a solution.

Phenologically - Relating to biological phenomena such as flowering, breeding, and migration, especially in conjunction with variation in climate.

Pillars - Ore or rock material used to support the walls or ceiling in an underground operation.

Plan of Operations - As required by 36 CFR 228.4: Plan of operations submit outlines to the USFS by the operator that include: the name and address of the operator, location of the proposed area of operations; and information sufficient to describe the type of operations proposed, the type and stands of roads, the means of transportation used, the period when the proposal will take place, and measures to be taken to meet the requirements for environmental protection.

Peak Flow - The greatest flow attained during melting of winter snowpack or during a large precipitation event.

Portal - The mouth of an underground adit or tunnel.

Precious Metal - A general term for gold, silver or any of the minerals of the platinum group.

Pregnant Solution - Solutions derived from the leaching process which contain dissolved metals.

Preservation - A visual quality objective that provides for ecological change only.

Productivity - In reference to vegetation, productivity is the measure of live and dead accumulated plant materials.

Project Alternatives - Alternatives to the proposed Project developed through the NEPA process.

Public Scoping - Scoping is the process for determining the scope of issues and concerns to be addressed and for identifying the significant issues related to a proposed action. (40 CFR 1501.7).

Raise - Vertical or inclined opening that connects underground mine workings from level to level. Raises are designed to serve as an ore pass, a manway, or for ventilation, and are driven upwards.

Raptor - A bird of prey (e.g., eagles, hawks, falcons, and owls).

Recontouring - Restoration of the natural topographic contours by reclamation measures, particularly in reference to roads.

Record of Decision (ROD) - A decision document for an Environmental Impact Statement or Supplemental EIS that publicly and officially discloses the responsible official's decision regarding the actions proposed in the Environmental Impact Statement and their implementation.

Refractory - Said of an ore from which it is difficult to recover the valuable constituents.

Reserves - Identified resources of mineral-bearing rock from which the mineral can be extracted profitably with existing technology and under present economic conditions.

Resources (geologic) - Reserves plus all other mineral deposits that may eventually become available - either known deposits that are not recoverable at present, or unknown deposits, that may be inferred to exist but have not yet been discovered.

Retention - A visual quality objective which, generally means man's activities should not be evident to the casual forest visitor.

Riparian - Situated on or pertaining to the bank of a river, stream, or other body of water. Riparian is normally used to refer to plants of all types that grow along streams, rivers, or at spring and seep sites.

Runoff - That part of precipitation that appears in surface streams; Precipitation that is not retained on the site where it falls and is not absorbed by the soil.

Scoping - Procedures by which agencies determine the extent of analysis necessary for a proposed action, (i.e., the range of actions, alternatives, and impacts to be addressed; identification of significant issues related to a proposed action; and the depth of environmental analysis, data, and task assignments needed).

Sediment Load - The amount of sediment (sand, silt, and fine particles) carried by a stream or river.

Sediment - Material suspended in or settling to the bottom of a liquid. Sediment input comes from natural sources, such as soil erosion, rock weathering, or anthropogenic sources, such as forest or agricultural practices, or construction activities.

Seismicity - The likelihood of an area being subject to earthquakes; the phenomenon of earth movements.

Shaft - An underground vertical passage sunk into an orebody or near an orebody, generally on the footwall side.

Significant - As used in NEPA determination of significance requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts (40 CFR 1508.27).

Silification, Silicified - A type of alteration in which the original minerals in the rock are replaced by silica.

Stopes - An underground excavation formed by the extraction of ore.

Sub-grade - Ore from which minerals cannot be extracted profitably with existing technology and under present economic conditions.

Threatened Species - Any species of plant or animal which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Total Dissolved Solids (TDS) - Total amount of dissolved material, organic or inorganic, contained in a sample of water.

Total Suspended Particulates (TSP) - Particulates less than 100 microns in diameter suspended in a liquid sample. (Stokes equivalent diameter).

Total Suspended Soils (TSS) - Amount of undissolved particles suspended in liquid.

Tunnel - A relatively level underground passage through a mountain with two openings.

Visual Quality Objective (VQO) - A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

Visual Resource - The composite of basic terrain, geologic features, water features, vegetation patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for viewers.

Waste Dump - Location and/or destination of waste, spoil, or overburden material removed during the mining operation to expose the orebody, but not including the marketable mineral, subsoil and topsoil.

Waste Rock - Non-ore rock that is extracted to gain access to ore. It contains no ore metals or ore metals at levels below the economic cutoff value, and must be removed to recover the ore.

Waters of the United States - A jurisdictional term from Section 404 of the Clean Water Act referring to waterbodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce.

Watershed - The geographic region from which water drains into a particular stream, river or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains. Watershed boundaries are defined by the ridges or divides separating watersheds.

Wetlands - Areas that are inundated by surface or groundwater with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wilderness - Land designated by Congress as a component of the National Wilderness Preservation System.

Winze - A large blind shaft that is sunk underground.

Appendices

Appendix A

Surface Water Sampling

TABLE A.1
SUMMARY OF MONTHLY WATER QUALITY MONITORING
JERRITT CANYON PROJECT, 1978-79

	JERRITT CREEK (#1)			SOUTH FORK JERRITT CREEK (#2)		
PARAMETERS	MAX	MIN	AVERAGE	MAX	MIN	AVERAGE
Temperature (°c)	25	8	43.8	25	1.0	9.9
pH (s.u.)	8.2	7.2	7.8	8.4	7.10	7.9
Dissolved Oxygen	9.5	7.5	8.5	10.8	8.1	10.6
Total Alkalinity as $CaCo_3$	240	105	167	260	110	183
COD	12.8	4.4	8.5	11.0	<2.0	7.1
Color (color units)	70	<1	27	50	3	12
Turbidity (NTU)	132	0.2	22.2	67	0	8.23
Total Dissolved Solids	400	110	254	310	135	228
Ammonia	1.05	0.1	0.40	1.33	0.1	0.56
Nitrate	13.5	<1.0	6.91	15.55	<0.1	7.36
Cyanide	<1.0	<0.1	<0.32	<1.0	<0.01	<0.14
Total P	7.6	0.1	1.91	3.22	<0.01	0.86
Calcium	65.0	22.4	47.1	75.32	23.5	49.6
Magnesium	43.0	12.5	25.3	33.1	12.5	23.3
Potassium	95.5	0.9	13.6	2.39	9.5	1.66
Sodium	9.6	3.8	5.8	10.8	0.1	6.57
Sulfate	79.8	7.29	43.8	68.9	1.92	39.5
Fluoride	0.3	0.02	0.15	0.4	<0.01	0.18
Chloride	2.8	0.1	0.84	9.6	0.5	1.76
Aluminum	5.45	<0.1	0.84	3.94	<0.1	1.35
Boron	0.1	<0.01	0.05	0.29	<0.01	0.11
Beryllium	0.12	<0.01	0.02	<0.05	<0.01	0.015
Cadmium	<0.01	<0.001	<0.008	<0.01	<0.001	<0.006
Chromium	0.16	<0.01	0.055	0.52	0.001	0.09
Copper	0.11	0.001	0.023	0.05	<0.01	0.03
Iron	10.8	0.22	2.65	9.38	0.02	2.22
Lead	0.11	<0.001	0.055	<0.01	<0.001	0.008
Mercury	0.001	<0.001	0.003	0.012	<0.001	0.008
Nickel	0.29	<0.01	0.09	0.20	<0.01	0.008
Selenium	<0.1	<0.001	<0.017	<0.01	<0.001	<0.006
Zinc	-	-	-	0.50	0.02	0.302
Total Coliform (MPN/100ml)	790	130	292[1]	54,000	0	-
Fecal Coliform (MPN/100ml)	330	0	-	490	0	-

NOTE: All units are mg/l unless otherwise noted. For averages, values below detection are assumed to be equal to the detection limit.
[1] Geometric mean, cannot be computed for zero values.

Source: Environmental Research Technology, Inc., August 1979b. Water Quality Technical Report for the Jerritt Canyon Project.

TABLE A.1 (continued) SUMMARY OF MONTHLY WATER QUALITY MONITORING JERRITT CANYON PROJECT, 1978-79						
	JERRITT CREEK AT HIGHWAY 11 (#13)			JERRITT CREEK AT BASE CAMP (#17)		
PARAMETERS	MAX	MIN	AVERAGE	MAX	MIN	AVERAGE
Temperature (°c)	19	15	17	17	0	8.7
pH (s.u.)	8.6	7.5	8.1	8.4	[illegible].1	7.7
Dissolved Oxygen	8.8	8.5	8.6	13.2	8.0	9.9
Total Alkalinity as $CaCo_3$	105	100	102.5	215	19.5	167
COD	18.4	16.5	17.4	9.7	[illegible].3	8.7
Color (color units)	54	38	45.7	26	0	6.51
Turbidity (NTU)	24	11	16.8	12	0	2.38
Total Dissolved Solids	154	115	131	244	147	212
Ammonia	0.45	0.2	0.32	1.4	0.05	0.35
Nitrate	[illegible].1	2.4	4.13	15.55	<0.1	4.91
Cyanide	<1.0	<0.01	0.37	<1.0	<0.01	<0.15
Total P	3.23	0.3	1.92	1.63	<0.01	0.82
Calcium	30.2	27.2	28.9	68.6	36.3	49.9
Magnesium	10.5	5.7	7.7	28.0	10.4	20.0
Potassium	6.8	2.9	3.7	3.18	0.8	1.58
Sodium	11.0	9.1	10.3	12.0	0.1	5.93
Sulfate	7.9	4.8	6.4	41.72	16.5	28.4
Fluoride	0.1	0.1	0.1	0.18	<0.01	0.14
Chloride	[illegible].0	0.2	1.93	3.50	0.8	1.55
Aluminum	2.37	0.38	1.21	2.32	<0.10	0.85
Boron	0.18	<0.01	0.07	0.17	<0.01	0.09
Beryllium	<0.01	<0.01	<0.01	<0.10	<0.01	0.03
Cadmium	<0.01	<0.01	<0.01	<0.01	<0.001	<0.007
Chromium	0.10	0.04	0.073	0.13	0.001	0.028
Copper	0.33	<0.01	0.12	0.19	<0.01	0.043
Iron	6.80	0.38	2.61	2.9	0.04	0.09
Lead	0.01	<0.01	0.01	<0.01	<0.001	<0.006
Mercury	0.011	<0.001	0.004	0.074	<0.001	0.028
Nickel	0.33	<0.10	0.12	0.12	<0.01	0.06
Selenium	<0.01	<0.001	<0.007	<0.01	<0.001	<0.006
Zinc	15.1	0.03	5.57	1.84	0.02	0.34
Total Coliform (MPN/100ml)	630	0	-	170,000	50	705[1]
Fecal Coliform (MPN/100ml)	0	0	-	170,000	0	-

NOTE: All units are mg/l unless otherwise noted. For averages, value below detection are assumed to be equal to the detection limit.
[1] Geometric mean, cannot be computed for zero values.

Source: Environmental Research Technology, Inc., August 1979b. Water Quality Technical Report for the Jerritt Canyon Project.

TABLE A.1 (continued) SUMMARY OF MONTHLY WATER QUALITY MONITORING JERRITT CANYON PROJECT, 1978-79	BURNS CREEK (#6)			MILL CREEK (#7)			BURNS CREEK AT HIGHWAY 11 (#11)		
PARAMETERS	MAX	MIN	AVERAGE	MAX	MIN	AVERAGE	MAX	MIN	AVERAGE
Temperature (°c)	10	0.1	7.7	20	5.0	13.2	17	10	13.5
pH (s.u.)	8.39	7.30	7.9	8.15	6.2	7.6	8.2	8.2	8.2
Dissolved Oxygen	13.0	7.9	10.1	11.8	7.7	9.5	10.7	8.4	9.6
Total Alkalinity as $CaCo_3$	260	105	185	240	120	158	195	190	192
COD	8.64	<0.02	3.97	10.6	3.8	6.6	11.5	9.9	19.7
Color (color units)	49	0	8.6	33	<1	17.6	72	36	54
Turbidity (NTU)	10	0	1.58	7.5	<1	3.7	37	6	21.5
Total Dissolved Solids	235	134	199	314	187	238	227	129	178
Ammonia	1.17	0.02	0.46	0.57	0.1	0.32	1.17	0.2	0.68
Nitrate	14.06	<0.1	6.11	15.9	0.1	8.5	5.3	3.7	4.5
Cyanide	<1.0	<0.01	<0.16	<1.0	<0.10	<0.28	<1.0	<0.10	<0.55
Total P	2.0	<0.01	0.57	2.27	0.20	1.31	3.10	2.27	2.68
Calcium	62.06	33.2	46.7	60.5	38.4	49.02	26.3	4.94	15.6
Magnesium	27.5	11.6	20.4	28.0	16.0	22.2	31.1	10.2	20.6
Potassium	1.50	0.097	0.70	1.3	5.0	1.2	1.7	1.3	1.5
Sodium	6.2	3.0	4.28	7.5	3.7	5.2	5.6	1.3	5.2
Sulfate	29.4	3.9	19.2	91.2	32.8	56.1	21.4	18.0	19.7
Fluoride	0.3	<0.01	0.11	0.09	0.01	0.11	0.10	0.08	0.10
Chloride	2.10	0.2	4.28	2.9	0.1	0.65	0.4	0.2	0.3
Aluminum	1.23	<0.1	0.84	1.27	0.48	0.92	1.18	0.88	1.03
Boron	0.15	<0.01	0.09	0.08	<0.01	0.05	0.09	<0.01	0.05
Beryllium	<0.10	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	<0.01	<0.001	<0.007	<0.01	<0.001	<0.008	<0.01	<0.01	<0.01
Chromium	0.09	<0.001	0.031	0.09	<0.01	0.03	0.01	0.02	0.015
Copper	0.29	<0.01	0.053	0.08	<0.01	0.02	0.07	0.09	0.05
Iron	8.39	0.01	1.45	6.51	0.46	2.22	7.90	0.026	3.96
Lead	0.57	<0.001	0.013	0.28	<0.001	0.06	0.01	<0.01	0.01
Mercury	0.002	<0.001	0.001	0.001	<0.001	0.001	0.008	<0.001	0.004
Nickel	0.39	0.01	0.023	0.08	<0.01	1.96	0.10	<0.10	0.015
Selenium	<0.01	<0.001	<0.006	<0.01	<0.001	<0.005	<0.01	<0.001	<0.006
Zinc	4.77	0.04	0.792	0.15	0.05	0.078	0.83	0.09	0.46
Total Coliform (MPN/100ml)	1700	0	—	1300	0	—	490	490	490[1]
Fecal Coliform (MPN/100ml)	20	0	—	490	0	—	230	220	225[1]

NOTE: All units are mg/l unless otherwise noted. For averages, value below detection are assumed to be equal to the detection limit.
[1] Geometric mean, cannot be computed for zero values.

Source: Environmental Research Technology, Inc., August 1979b. Water Quality Technical Report for the Jerritt Canyon Project.

TABLE A.2 SUMMARY OF WATER QUALITY MONITORING JERRITT CANYON PROJECT, 1981-92						
	JERRITT CREEK (JC)			JERRITT CREEK (JC-2)		
PARAMETERS	MAX	MIN	AVERAGE	MAX	MIN	AVERAGE
Discharge (cfs)	16.85	0.0	1.036	0.0	0.0	0.0
pH (s.u.)	8.60	7.50	8.11	8.67	8.32	8.50
Electrical Conductivity (μhmos/cm)	841	180	413	515	480	550
Total Dissolved Solids	540	121	258	367	323	345
Total Suspended Solids	206	1	22	14	1	8
Turbidity (NTU)	85.0	0.0	10.3	3.0	0.2	1.6
Total Alkalinity as $CaCo_3$	275	85	165	169	148	159
Carbonate as $CaCO_3$	28	0	2	12	2	7
Bicarbonate as $CaCO_3$	275	85	163	167	136	152
Sodium	11.0	8.0	6.8	32.0	6.7	19.4
Chloride	25.9	8.0	5.7	8.0	8.0	8.5
Magnesium	42.0	11.0	22.2	32.0	29.2	30.6
Arsenic	0.003	0.001	0.002	0.001	0.001	0.001
Calcium	85.1	25.1	46.4	62.0	59.8	60.9
Sulfate	235	19	61	121	100	111
Nitrate	8.8	<0.01	6.3	0.70	0.10	0.40
Total P	0.20	0.02	0.12	0.04	0.02	0.03
Iron	0.79	0.02	0.14	0.02	0.02	0.02

NOTE: All units are mg/l unless otherwise noted.

Source: IMC, 1981-1992. Surface Water Sampling Program.

TABLE A.2 (continued)
SUMMARY OF WATER QUALITY MONITORING
JERRITT CANYON PROJECT, 1981-92

	BURNS CREEK #1 (BC-1)			BURNS CREEK #2 (BC-2)			BURNS CREEK #3 (BC-3)		
PARAMETERS	MAX	MIN	AVERAGE	MAX	MIN	AVERAGE	MAX	MIN	AVERAGE
Discharge (cfs)	2.125	0.0	0.178	0.0	0.0	0.0	14.6	0.0	4.631
pH (s.u.)	8.4	7.20	7.96	8.2	7.8	8.05	8.6	7.6	8.26
Electrical Conductivity (μhmos/cm)	525	310	407	490	375	445	525	320	440
Total Dissolved Solids	607[(1)]	168	295	238	193	215	601[(1)]	170	253
Total Suspended Solids	1690	1	278	17	1	16	136	1	9
Turbidity (NTU)	600	0.1	77.2	1.4	0.5	1.0	82.0	0.03	3.86
Total Alkalinity as $CaCo_3$	260	130	176	213	167	196	239	125	199
Carbonate as $CaCO_3$	4	0	0	0	0	0	18	0	3
Bicarbonate as $CaCO_3$	260	130	176	213	167	196	221	125	196
Sodium	8.7	3.8	5.8	6.0	4.0	4.8	17.6	1.0	5.3
Chloride	14.0	2.0	4.8	12.0	3.0	7.5	12.0	2.0	4.4
Magnesium	29.0	10.0	18.5	19.8	15.1	18.1	29.0	12.5	22.3
Arsenic	0.013	0.001	0.005	0.012	0.006	0.008	0.014	0.001	0.009
Calcium	54.0	35.0	42.6	47.8	38.2	44.4	57.7	29.8	49.4
Sulfate	41	8	25	21	11	14	56.0	16.0	29.3
Nitrate	2.4	0.1	0.6	0.1	0.1	0.1	3.2	0.1	0.3
Total P	1.00	0.04	0.25	0.20	0.05	0.12	0.35	0.01	0.04
Iron	6.80	0.02	0.97	0.04	0.02	0.03	0.34	0.00	0.04
Mercury	ND	ND	ND	ND	ND	ND	0.0005	0.0005	0.0005

NOTE: All units are mg/l unless otherwise noted.

[(1)]Sample taken 7/23/91.

Source: IMC, 1981-1992. Surface Water Sampling Program.

Appendix B

Water Quality Criteria and Standards for Nevada

Table B.1
Water Quality Criteria and Standards for Nevada

Parameter[1] (mg/L)	Drinking Water Std.		Municipal or Domestic Supply	Aquatic Life		Agriculture		Wildlife Propagation
	Primary	Secondary		1 Hr. Ave.	96 Hr. Ave.	Irrigation	Stock Water	
Arsenic	0.05	-	0.05	0.36 As(III)	0.19 As(III)	0.1	0.2	-
Barium	2.0	-	0.1	-	-	-	-	-
Beryllium	-	-	0	-	-	0.1	-	-
Boron	-	-	-	0.55	0.55	0.75	5.0	-
Cadmium	0.05	-	0.01	[2]	[2]	0.01	0.05	-
Chromium	0.05	-	0.05	0.016 Cr(VI)	0.0011 Cr(VI)	0.1	1.0	-
Copper	-	1.0	-	[2]	[2]	0.2	0.5	-
Iron	-	0.6	-	1.0	1.0	5.0	-	-
Lead	0.05	-	0.05	[2]	[2]	5.0	0.1	-
Manganese	-	0.1	-	-	-	0.2	-	-
Mercury	0.002	-	0.002	0.0024	.000012	-	0.01	-
Nickel	-	-	0.0134	[2]	[2]	0.2	-	-
Selenium	0.01	-	0.01	0.020	0.005	0.02	0.05	-
Silver	-	-	0.05	[2]	[2]	-	-	-
Thallium	-	-	0.013	-	-	-	-	-
Zinc	-	5.0	-	[2]	[2]	2.0	25.0	-
Cyanide (WAD)	-	-	0.2	0.022	0.0052	-	-	-

Parameter[1] (mg/L)	Drinking Water Std.		Municipal or Domestic Supply	Aquatic Life[3]		Agriculture		Wildlife Propagation
	Primary	Secondary		Propagation	Put & Take	Irrigation	Stock Water	
Alkalinity	-	-	-	less than 25% change		-	-	30-130
Chloride	-	400	400	-	-	-	1500	1500
Color (PCU)	-	15	75	-	-	-	-	-
Dissolved Oxygen	-	-	Aerobic	5.0	5.0	-	Aerobic	Aerobic
Fluoride	4.0	2.0	-	-	-	1.0	2.0	-
Nitrate as N	10	-	-	90(w)	90(w)	-	100	100
ph (SU)	-	6.5-8.5	5.0-9.0	6.5-9.0	6.5-9.0	4.5-9.0	5.0-9.0	7.0-9.2
Sulfate	-	500	500	-	-	-	-	-
Temp °C	-	-	-	site specific determination		-	-	-
TDS	-	1000	1000	-	-	-	3000	-
TSS	-	-	-	25-80	25-80	-	-	-
Turbidity (NTU)	1.0[4]	-	-	50(w);10(c)	50(w);10(c)	-	-	-

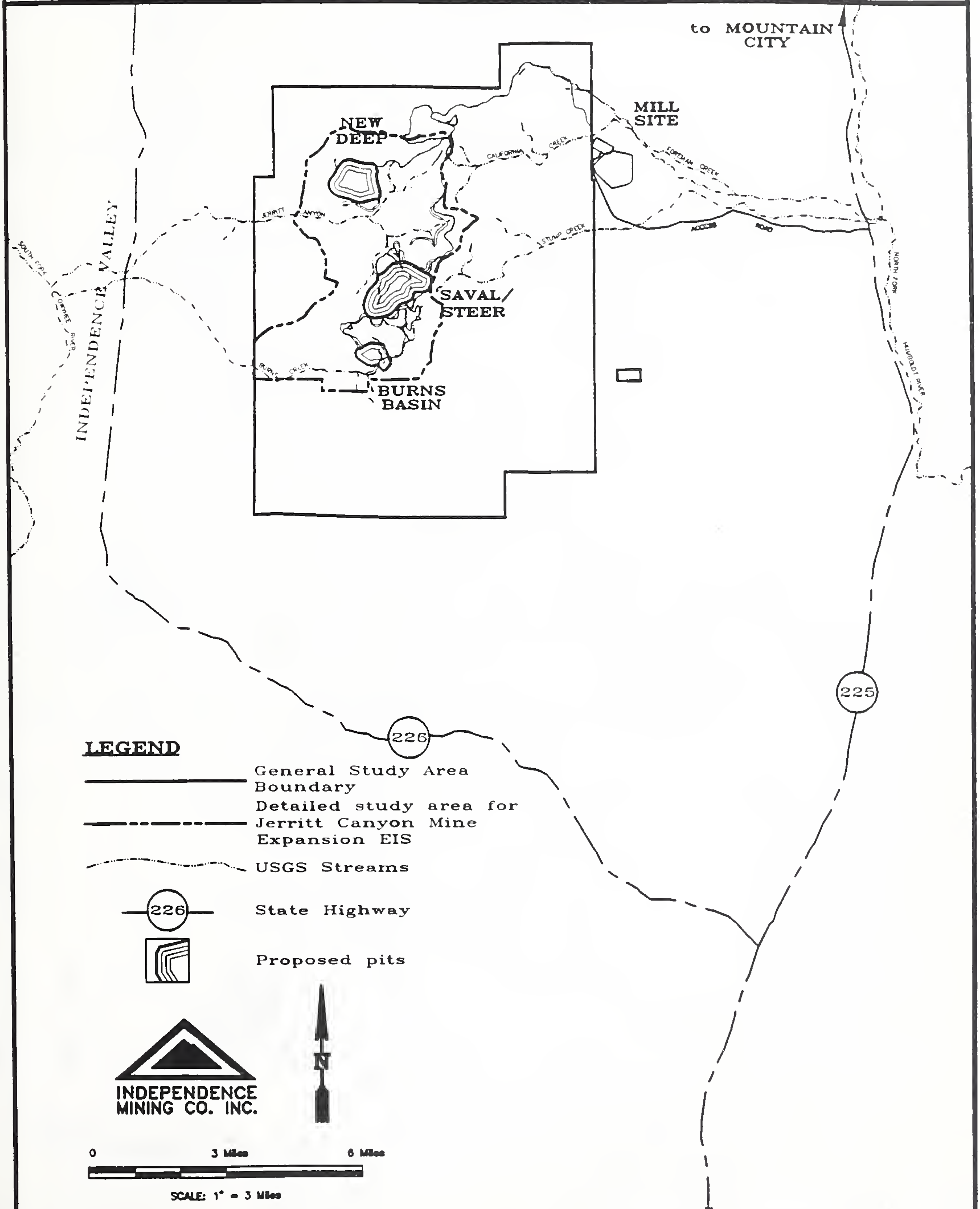
Sources: NAC 445.117; NAC 445.1339, Steve Brockway, Nevada Health Protection Services

Notes:
1. mg\L = milligrams per liter; PCU = Photoelectric color units; SU = standard units; NTU = nephelometric turbidity units; TDS = total dissolved solids; TSS = total suspended solids; C = degrees Celsius.
2. Parameter dependent on hardness; see NAC 445.1339 for equations to determine concentration.
3. (w) refers to warm water and (c) is for cold water. No letter designation indicates criteria are common to both warm and cold water.
4. for surface water only

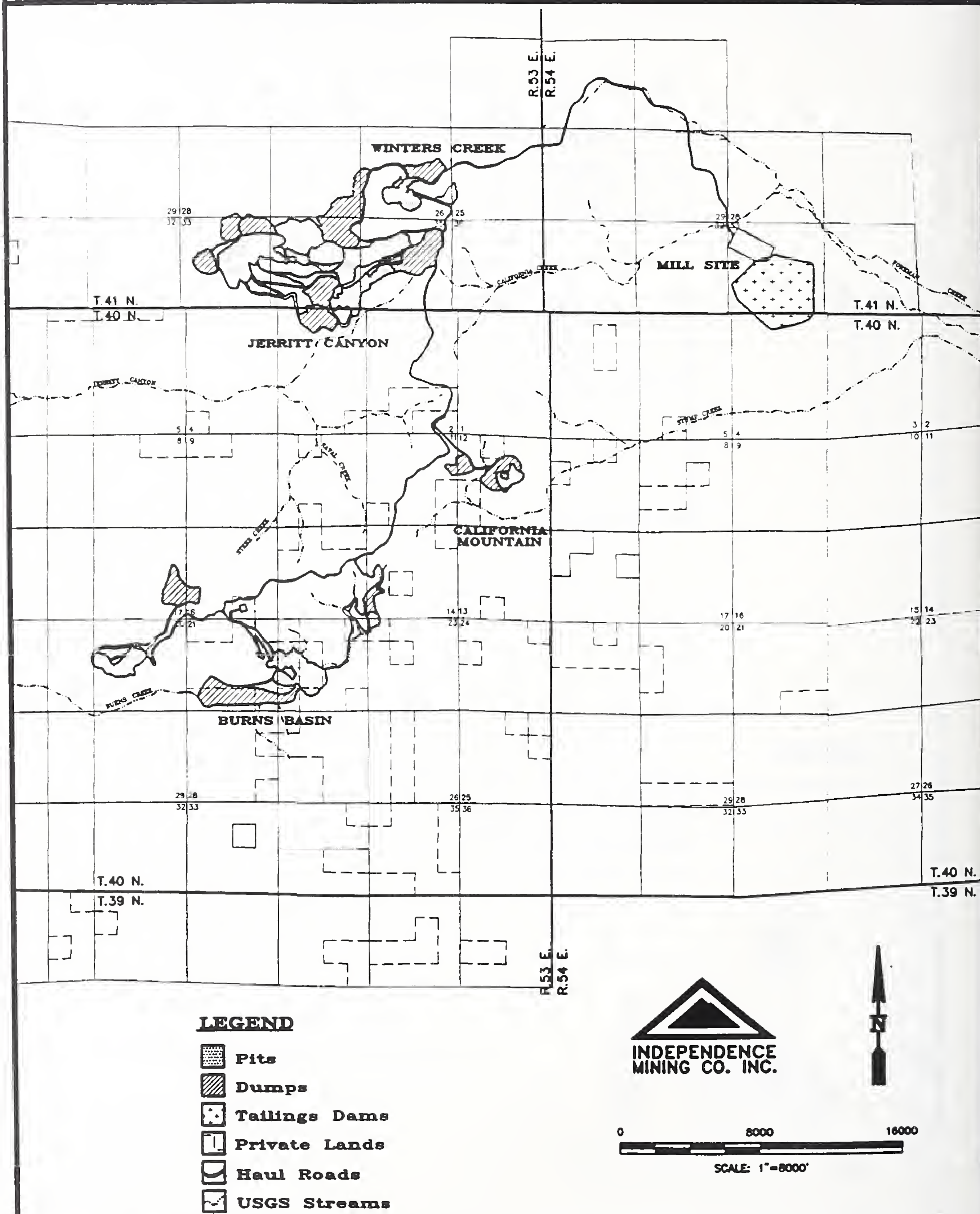
Appendix C

Detailed Maps of Wetlands and Stream Channels (in relation to Alternative B)

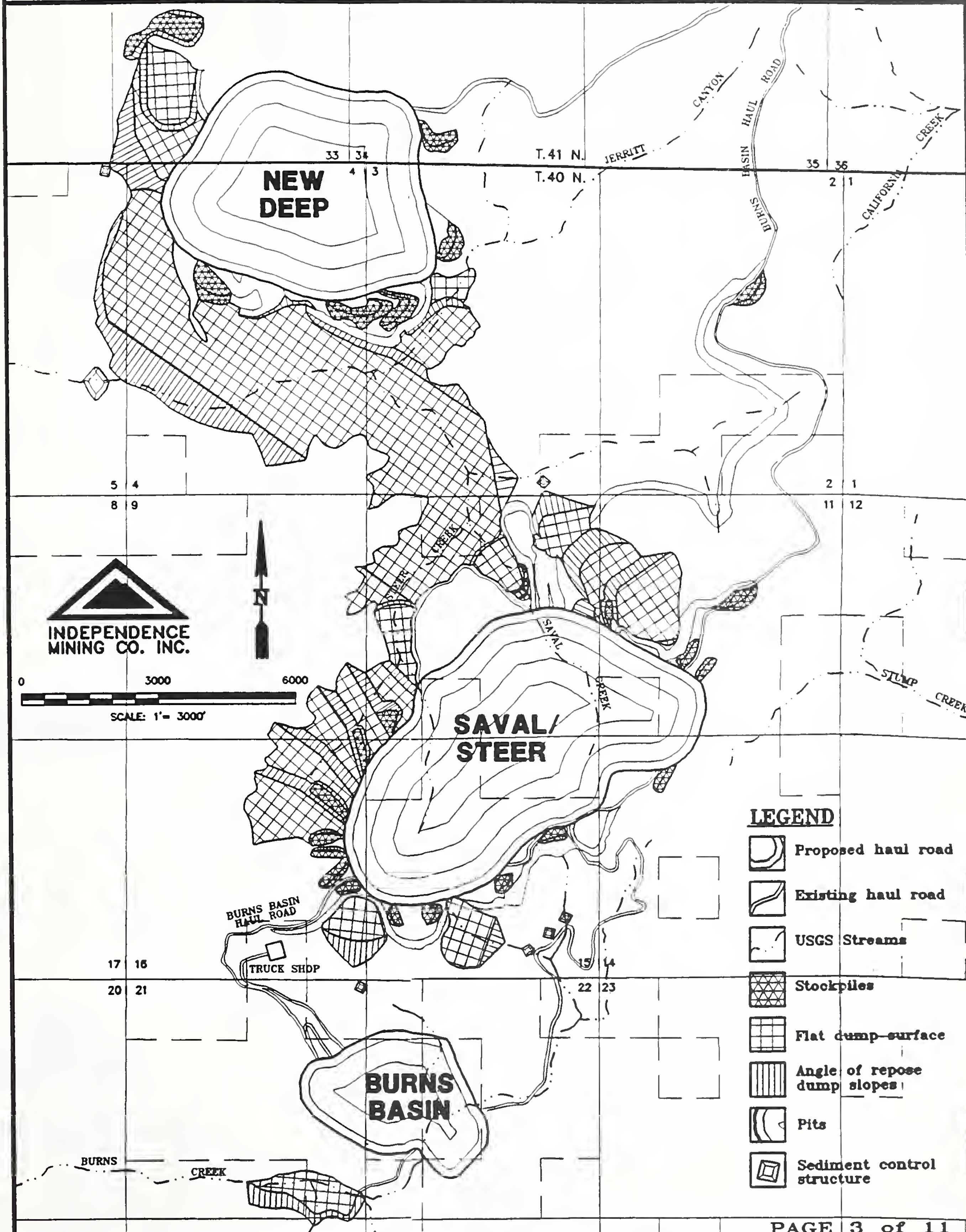
INDEPENDENCE MINING COMPANY, INC.
JERRITT CANYON MINE EXPANSION PROJECT
LOCATION MAP
MAP 1

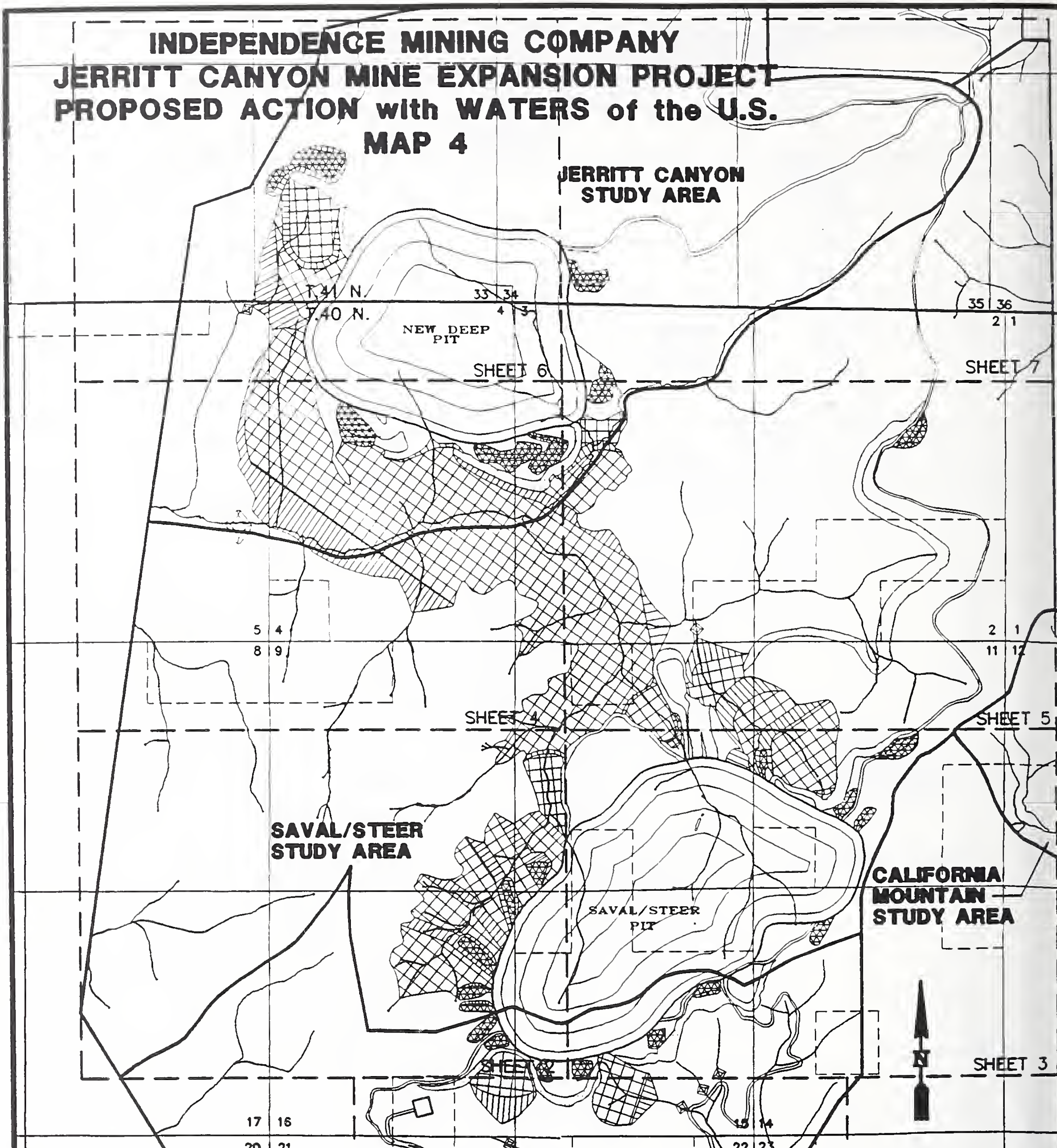


INDEPENDENCE MINING COMPANY, INC.
JERRITT CANYON MINE EXPANSION PROJECT
EXISTING / APPROVED DISTURBANCE
MAP 2

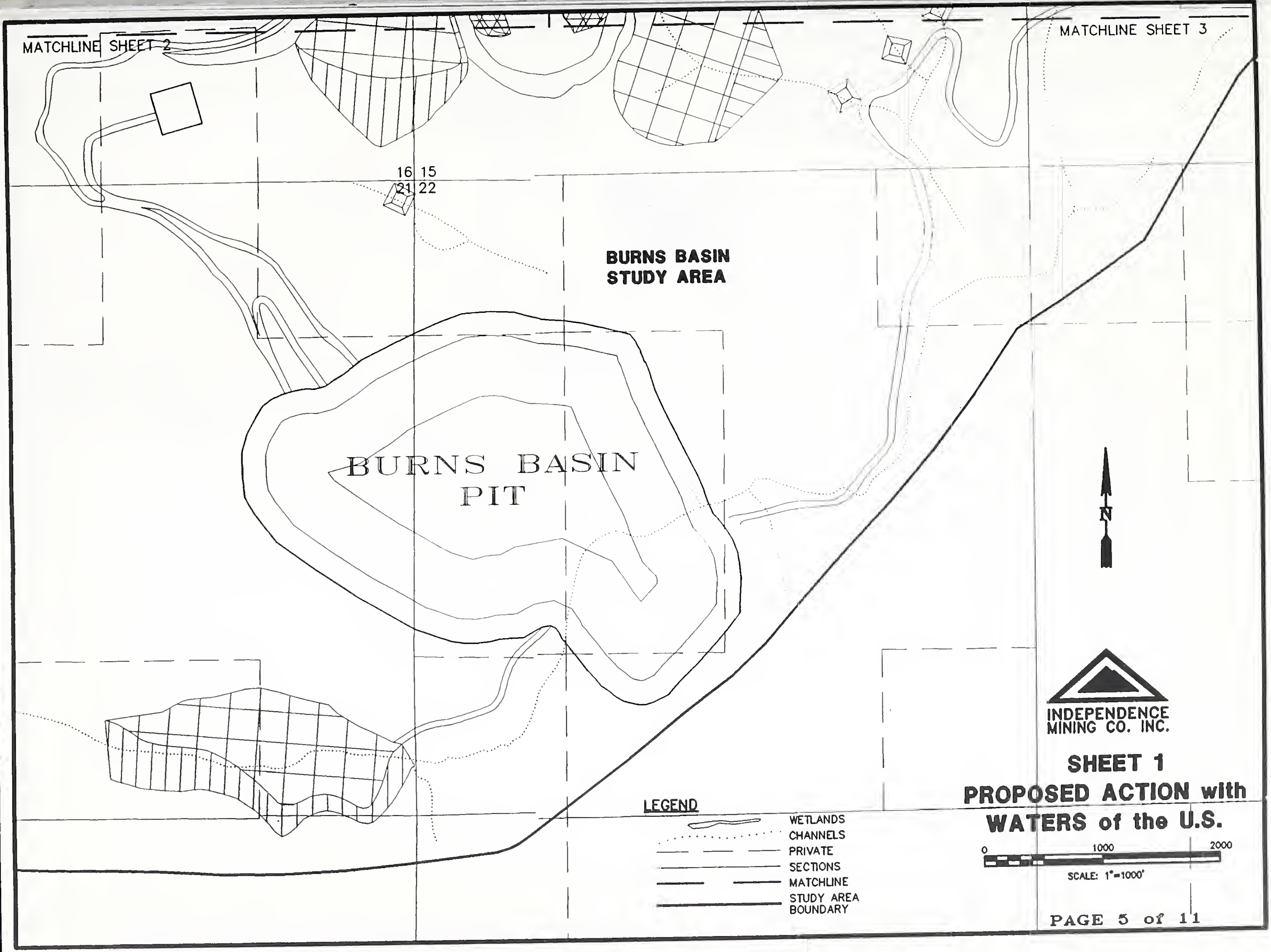


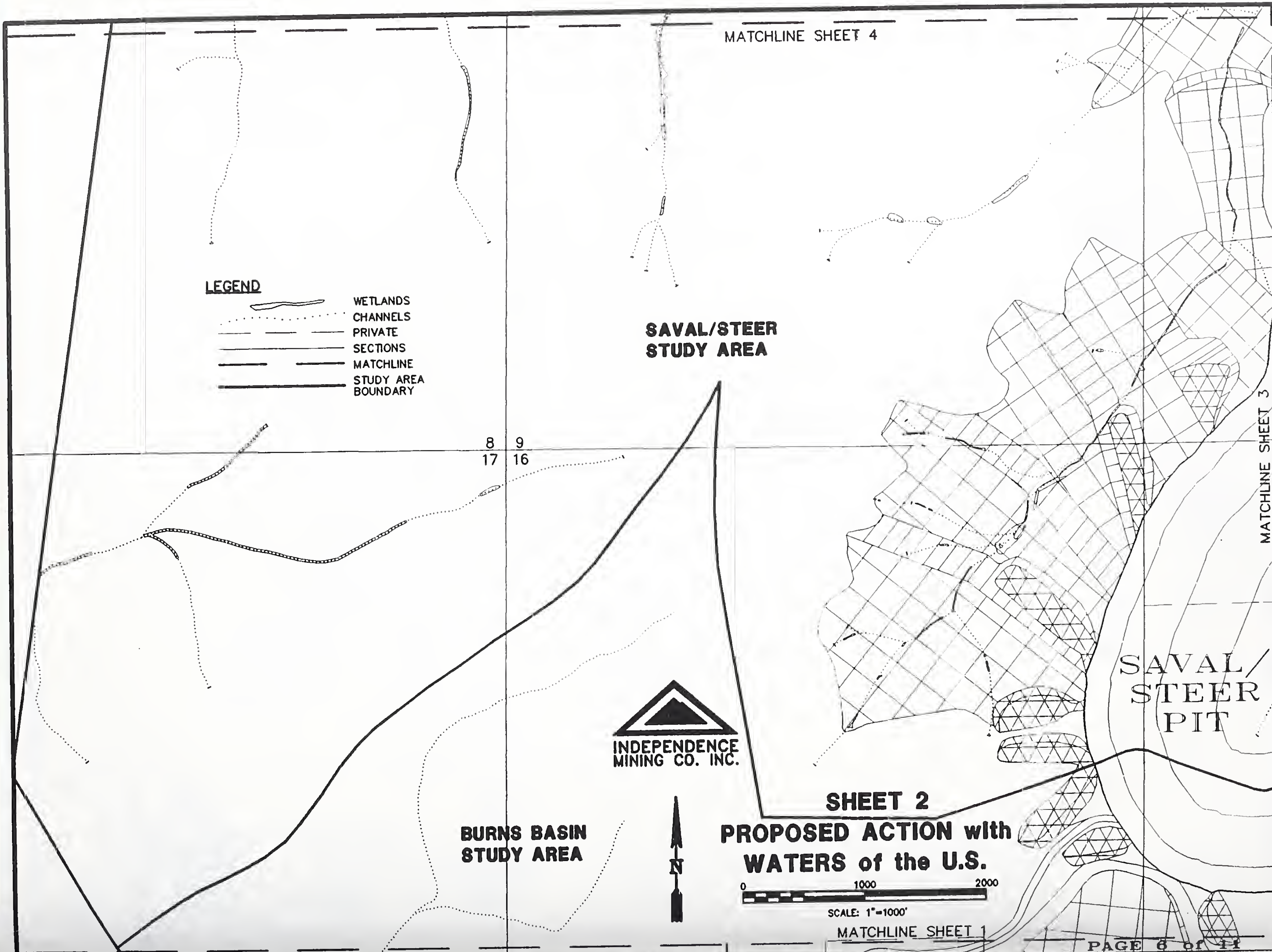
INDEPENDENCE MINING COMPANY, INC
JERRITT CANYON MINE EXPANSION PROJECT
PROPOSED ACTION
MAP 3

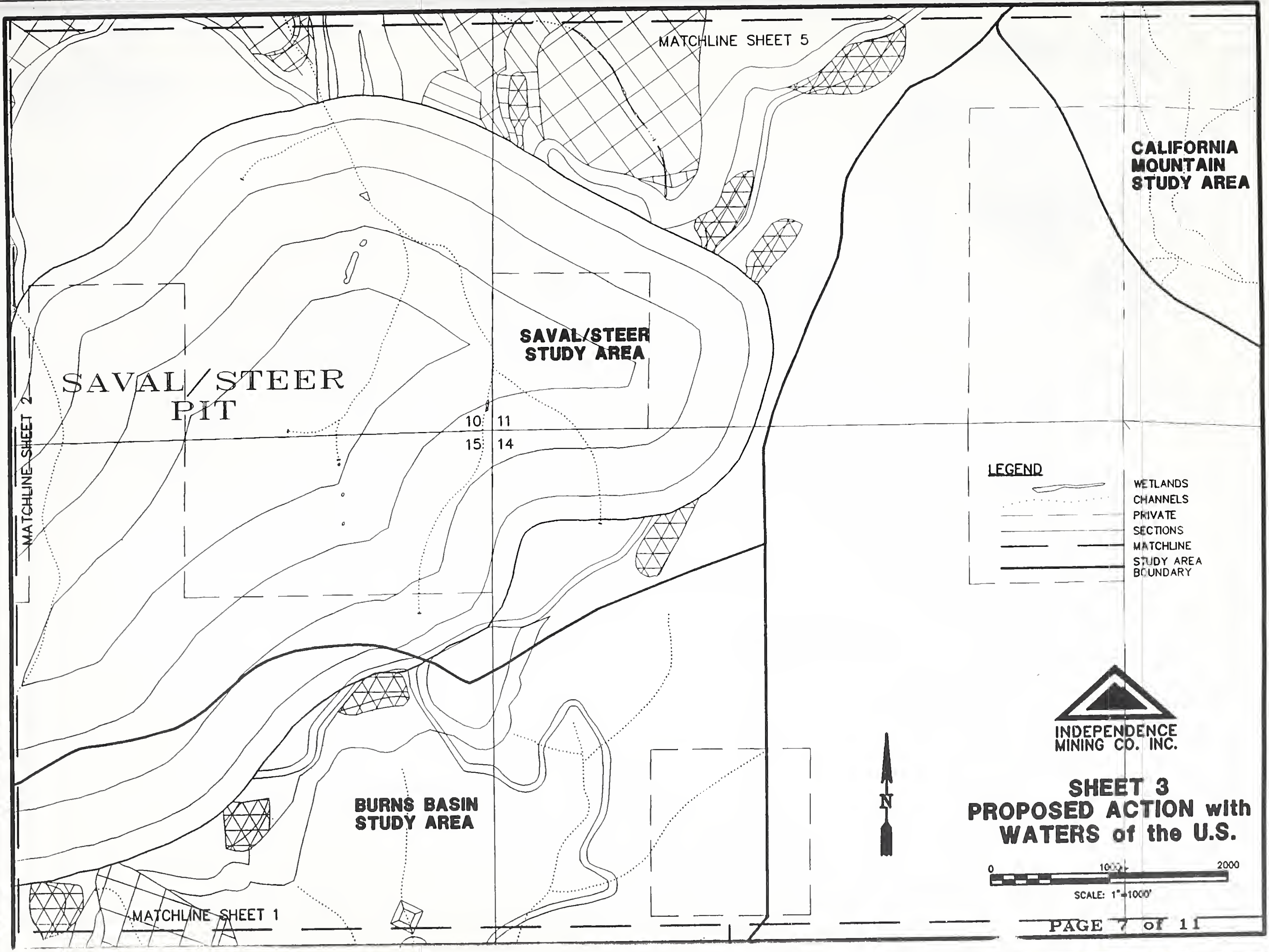


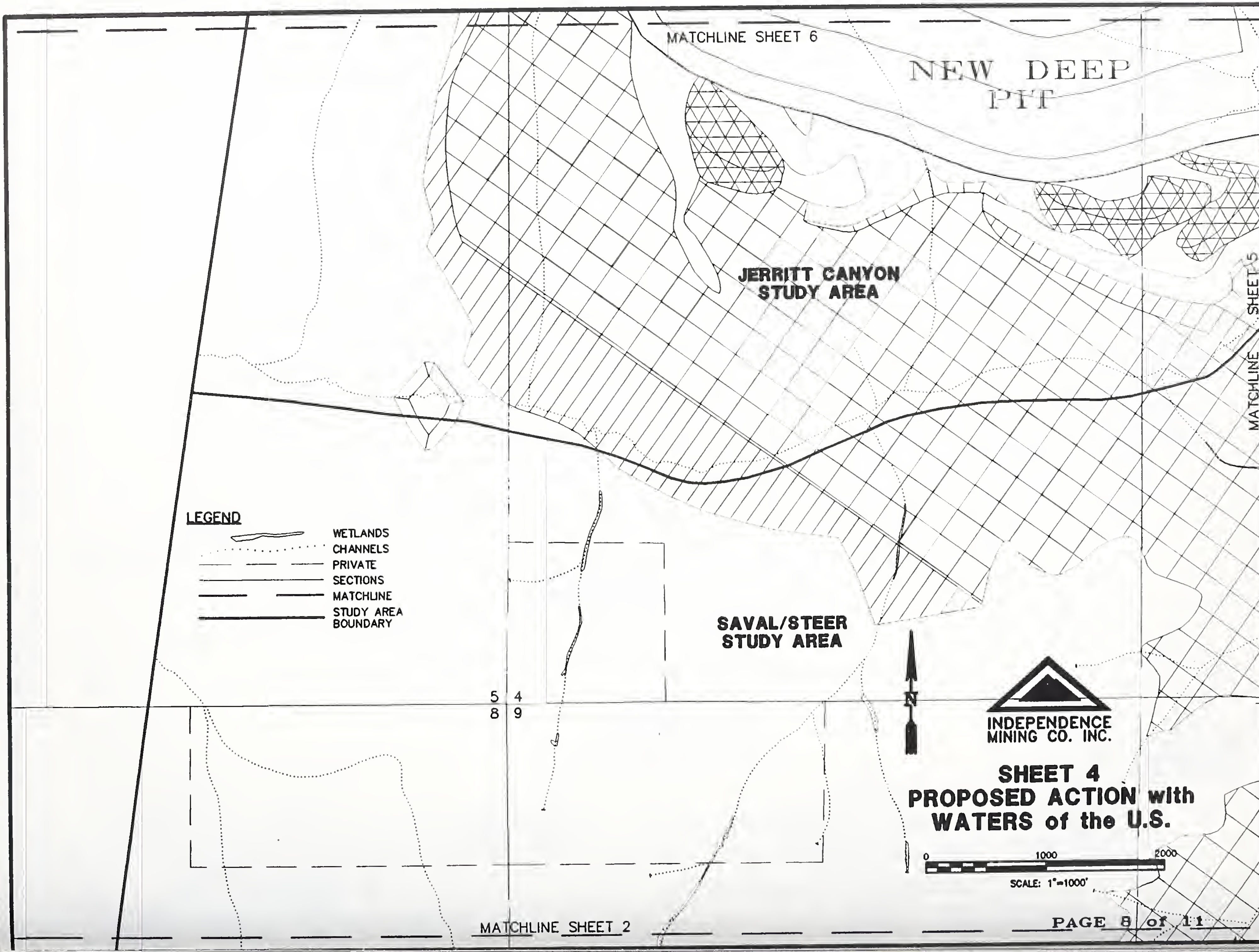


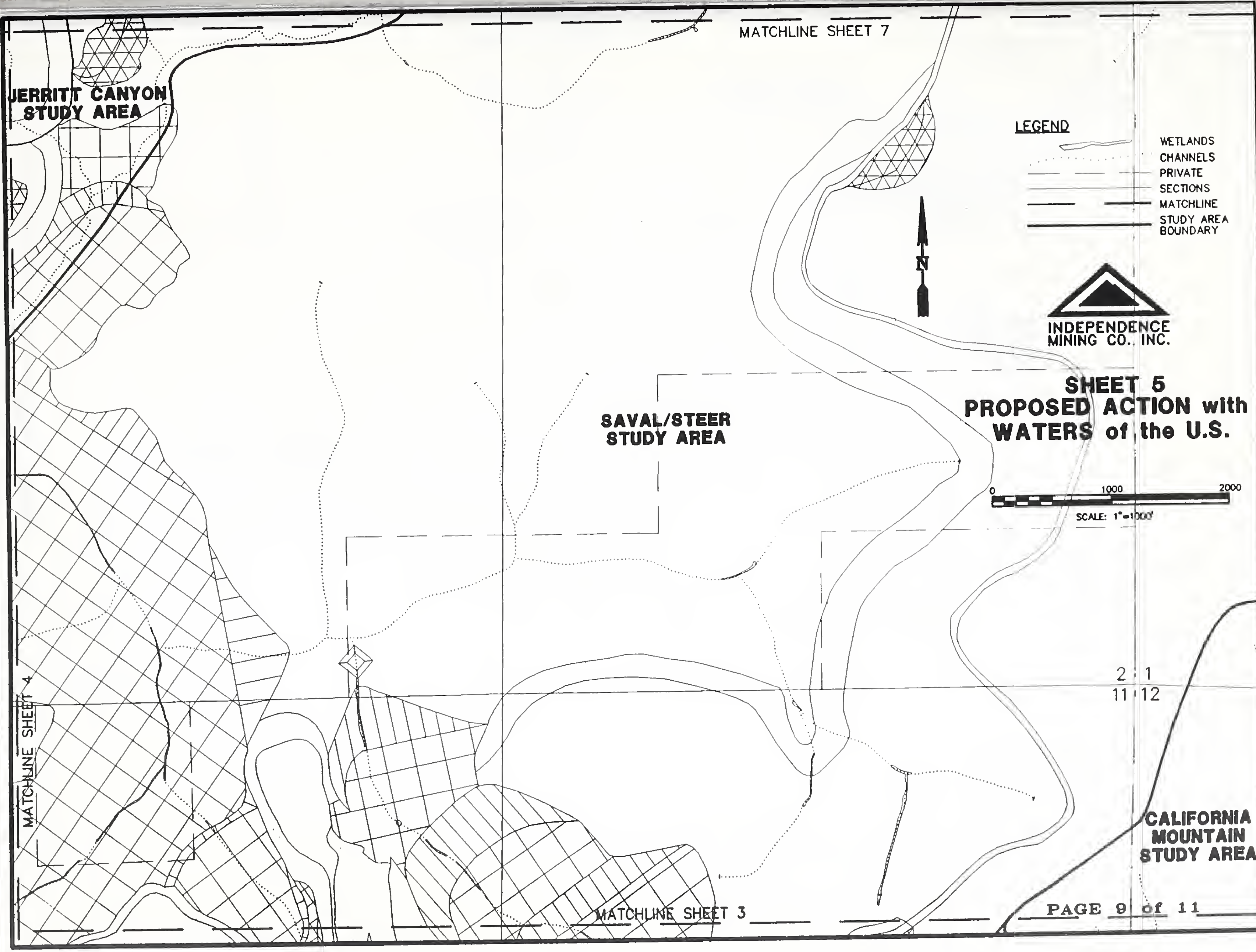
INDEPENDENCE MINING COMPANY
JERRITT CANYON MINE EXPANSION PROJECT
PROPOSED ACTION with WATERS of the U.S.
MAP 4
JERRITT CANYON STUDY AREA
T.41 N.
T.40 N.
NEW DEEP PIT
SHEET 6
SHEET 7
SHEET 4
SHEET 5
SAVAL/STEER STUDY AREA
SAVAL/STEER PIT
CALIFORNIA MOUNTAIN STUDY AREA
SHEET 2
SHEET 3
BURNS BASIN PIT
BURNS BASIN STUDY AREA
INDEPENDENCE MINING CO. INC.
SCALE: 1"= 3000'
KEY FOR PAGES 5 – 11
PAGE 4 of 11
SHEET 1

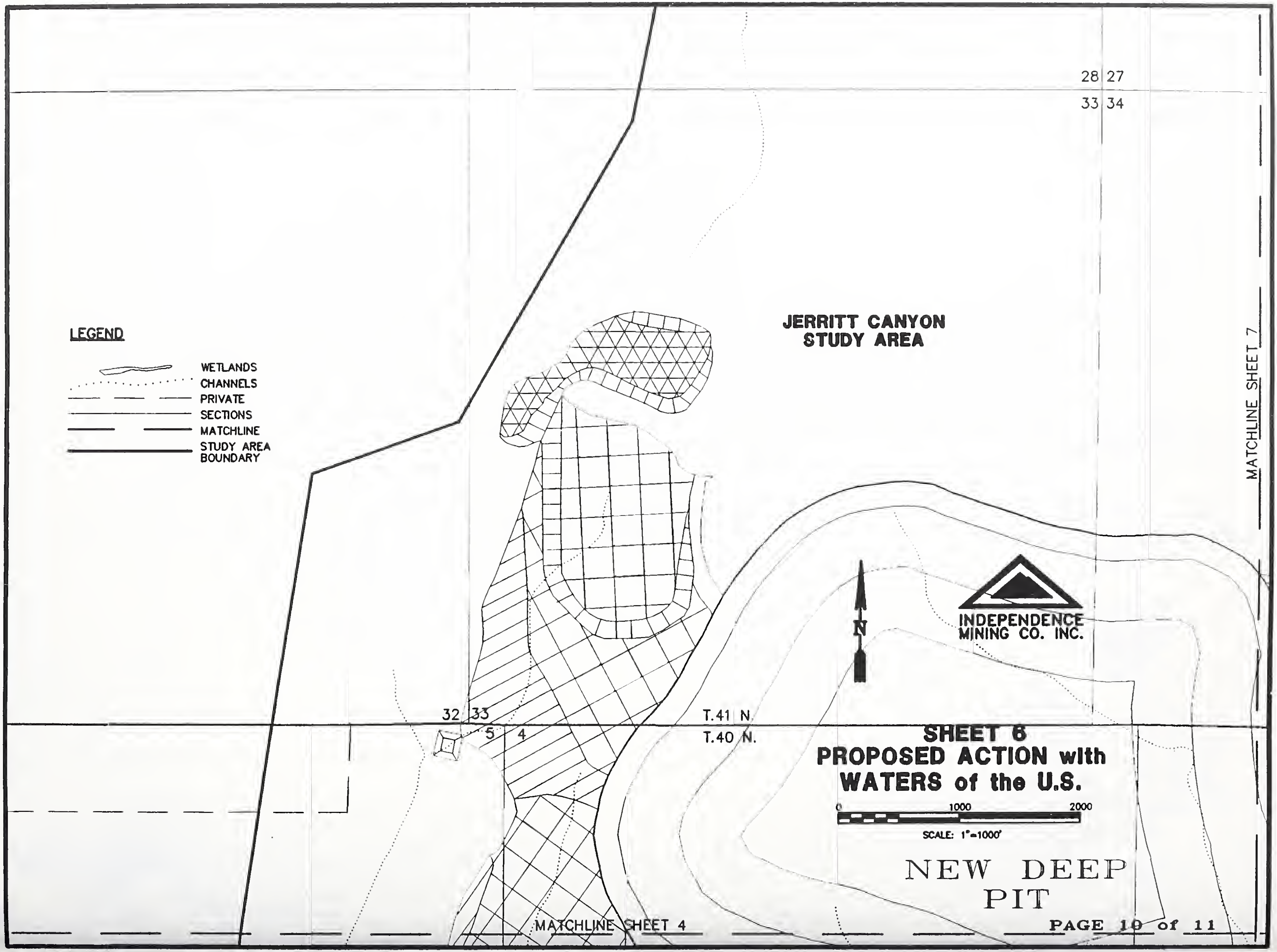

MATCHLINE SHEET 2
MATCHLINE SHEET 3
16 15
21 22
BURNS BASIN
STUDY AREA
BURNS BASIN
PIT
N
LEGEND
WETLANDS
CHANNELS
PRIVATE
SECTIONS
MATCHLINE
STUDY AREA
BOUNDARY
INDEPENDENCE
MINING CO. INC.
SHEET 1
PROPOSED ACTION with
WATERS of the U.S.
0
1000
2000
SCALE: 1"=1000'
PAGE 5 of 11

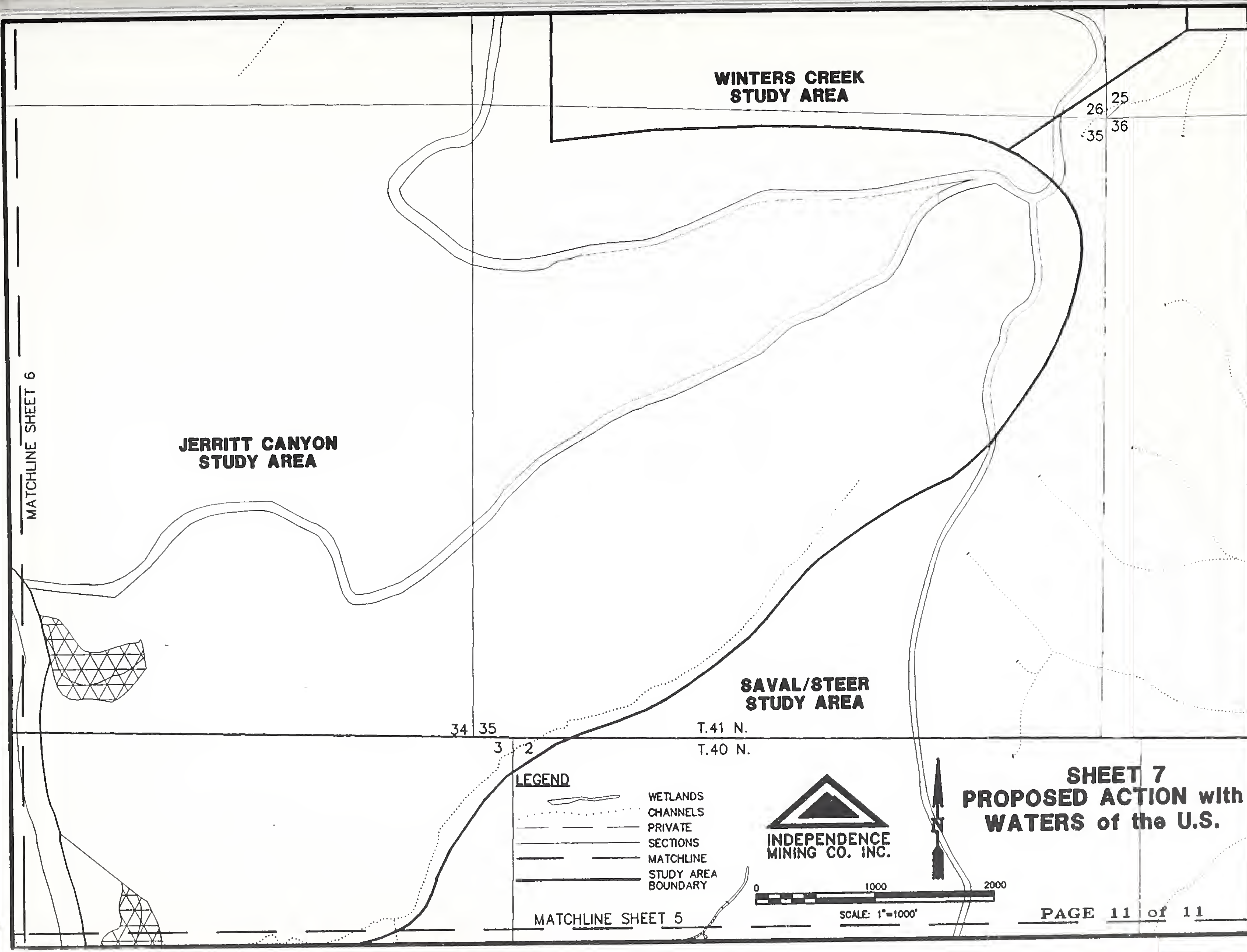

MATCHLINE SHEET 4
LEGEND
WETLANDS
CHANNELS
PRIVATE
SECTIONS
MATCHLINE
STUDY AREA BOUNDARY
SAVAL/STEER STUDY AREA
8
9
17
16
SAVAL/STEER PIT
MATCHLINE SHEET 3
INDEPENDENCE MINING CO. INC.
BURNS BASIN STUDY AREA
N
SHEET 2
PROPOSED ACTION with WATERS of the U.S.
0
1000
2000
SCALE: 1"=1000'
MATCHLINE SHEET 1


MATCHLINE SHEET 5
CALIFORNIA
MOUNTAIN
STUDY AREA
SAVAL/STEER
STUDY AREA
SAVAL/STEER
PIT
10 11
15 14
MATCHLINE SHEET 2
LEGEND
WETLANDS
CHANNELS
PRIVATE
SECTIONS
MATCHLINE
STUDY AREA
BOUNDARY
INDEPENDENCE
MINING CO. INC.
N
BURNS BASIN
STUDY AREA
SHEET 3
PROPOSED ACTION with
WATERS of the U.S.
0
2000
SCALE: 1"=1000'
MATCHLINE SHEET 1


MATCHLINE SHEET 6
NEW DEEP PIT
JERRITT CANYON STUDY AREA
SHEET 5
MATCHLINE
LEGEND
WETLANDS
CHANNELS
PRIVATE
SECTIONS
MATCHLINE
STUDY AREA BOUNDARY
SAVAL/STEER STUDY AREA
5 4
8 9
N
INDEPENDENCE MINING CO. INC.
SHEET 4
PROPOSED ACTION with WATERS of the U.S.
0 1000 2000
SCALE: 1"=1000'
MATCHLINE SHEET 2


MATCHLINE SHEET 7
JERRITT CANYON
STUDY AREA
LEGEND
WETLANDS
CHANNELS
PRIVATE
SECTIONS
MATCHLINE
STUDY AREA
BOUNDARY
N
INDEPENDENCE
MINING CO. INC.
SHEET 5
PROPOSED ACTION with
WATERS of the U.S.
SAVAL/STEER
STUDY AREA
0
1000
2000
SCALE: 1"=1000'
2
1
11
12
MATCHLINE SHEET 4
CALIFORNIA
MOUNTAIN
STUDY AREA
MATCHLINE SHEET 3


28 27
33 34
JERRITT CANYON STUDY AREA
LEGEND
WETLANDS
CHANNELS
PRIVATE
SECTIONS
MATCHLINE
STUDY AREA BOUNDARY
MATCHLINE SHEET 7
INDEPENDENCE MINING CO. INC.
N
32 33
5 4
T.41 N.
T.40 N.
SHEET 6
PROPOSED ACTION with WATERS of the U.S.
0
1000
2000
SCALE: 1"=1000'
NEW DEEP PIT
MATCHLINE SHEET 4


WINTERS CREEK
STUDY AREA
25
26
36
35
JERRITT CANYON
STUDY AREA
MATCHLINE SHEET 6
SAVAL/STEER
STUDY AREA
34
35
3
2
T.41 N.
T.40 N.
LEGEND
WETLANDS
CHANNELS
PRIVATE
SECTIONS
MATCHLINE
STUDY AREA BOUNDARY
INDEPENDENCE
MINING CO. INC.
N
0
1000
2000
SCALE: 1"=1000'
MATCHLINE SHEET 5
SHEET 7
PROPOSED ACTION with
WATERS of the U.S.
PAGE 11 of 11

Appendix D

Mule Deer Habitat Improvement Plan

MULE DEER HABITAT IMPROVEMENT PLAN
FOR
IMC MITIGATION MONEY

NEVADA DEPARTMENT OF WILDLIFE
MAY, 1993

Memorandum of Understanding

In March of 1993, a Memorandum of Understanding (MOU) was signed between the Humboldt National Forest (USFS), Independence Mining Company (IMC) and the Nevada Department of Wildlife (NDOW). The purpose of this MOU was to facilitate mitigation of impacts to National Forest Lands from mining activity in the Independence Mountains. This document specified an amount of money that would be contributed to help mitigate mining impacts occurring to mule deer habitat on National Forest Lands within the Independence Range. IMC will contribute a total of $500,000 by 1994 to a habitat fund administered by NDOW. The MOU stipulates that the money will be used to improve deer habitat, primarily within Management Area Six. The following is a plan that outlines how this money will be spent to benefit mule deer in Area Six.

BACKGROUND

The Independence Range is one of the most productive deer ranges within Nevada. The fawn ratio, which is indicative of summer habitat productivity, is the highest in the State. It is believed that prior to 1970, the Area Six deer herd was the largest in Nevada.

Exotic annual cheatgrass was introduced into the western Elko County area in the 1930's. Excessive yearlong grazing by domestic livestock in the early to mid 1900's severely reduced the perennial grass understory. This allowed for the rapid spread of the volatile cheatgrass into the sagebrush communities. Starting in the mid 1960's, large range fires began destroying large tracts of land in the southern portions of Area Six. In 1964 for example, one series of fires burned more than 300,000 acres in a five day period. Since the mid 1960's, over 70% of the crucial deer winter range in the southern portion of Area Six has burned. Thousands of additional acres of important intermediate range have also burned.

Mining has greatly accelerated within northeastern Nevada and has impacted several important areas within Area Six. Key deer winter and intermediate habitats are being altered by mining in the South Tuscarora Range and in the Independence Range. The greatest of these impacts are occurring in Jerritt Canyon where more than 3,000 acres of high quality deer habitat are expected to be disturbed in the near future.

The result of the loss of winter and intermediate ranges has been the long term decline of the Area Six deer population. Harvest data and computer modeling indicate that Area Six now supports about half of the deer that it did prior to 1970.

GOAL

The goal of the Mitigation Money from IMC is to mitigate impacts from mining on USFS lands within the Independence Range. The best opportunities for enhancing deer habitat are through the rehabilitation of crucial burned winter ranges in key areas. Other opportunities could arise in the future that would enhance deer winter habitat within Area Six. These other opportunities could include but are not limited to the purchase of property or easements on winter range or the mitigation of migration barriers.

Most of the habitat improvement work would be accomplished off National Forest System lands (NFS) because:

1) There are limited opportunities on NFS lands,

2) Deer winter range off NFS lands is important to the deer that spend some time in the Independence Mountains.

3) In considering the needs of mule deer that use the Independence Range, off-site mitigation would provide the greatest opportunity to mitigate the effects of mining.

If the over-all goal of improving deer habitat on crucial winter ranges is achieved, then it would be expected that the long term decline of the Area Six deer population would be reversed.

STRATEGIES FOR IMPROVING AND PROTECTING CRITICAL DEER HABITAT

Old Fire Rehabilitation:

The primary emphases for the next six years will be on restoring crucial deer winter ranges that have burned and have little chance of returning to a productive state on their own as close to NFS lands as possible. Cheatgrass and annual weed ranges will be seeded with perennial shrubs, grasses and forbs. In most cases, cheatgrass competition will be reduced prior to seeding. This will be accomplished primarily through mechanical means although herbicides and burning may be used on some sites. Plant species that are crucial for deer winter survival such as sagebrush, fourwing, forage kochia, and white stem rabbitbrush will be emphasized on these seedings. Plant species that reduce the risk of reoccurring range fires will also be incorporated into the seedings. The majority of work will occur within the Izzenhood and the Sheep Creek Ranges. Work may also be accomplished within the Dunphy Hills, Adobe Mountains and on the Owyhee Desert. The major criteria for selecting rehabilitation sites will be as follows: Sites will be located within crucial deer winter ranges that support very large numbers of deer, have good potential to be rehabilitated, and have livestock management that assures adequate protection and long-term maintenance of the seeding.

Approximately 6,000 acres meeting the above criteria have been identified and are being reviewed by the Bureau of Land Management (BLM). It is unknown at this time if these projects will obtain BLM approval. The following is a preliminary schedule of projects. For each project, the likely mitigation funding source(s) is identified. For each project, federal aid, sportsmen group dollars or some other funding source may be used to maximize the acreage treated.

Fall, 1993 Rooster Comb Seeding Project, Izzenhood Range (807 acres). A combination of Barrick and IMC money will be used to fund this project. The attached addendum contains a more detailed explanation of this project.

Fall, 1994 Rooster Comb Seeding Project, Izzenhood Range (1,100 acres). A combination of Barrick and IMC money will be used to fund this project.

Fall, 1995 Northwest Izzenhood Seeding Project, Izzenhood Range (1,100 acres). A combination of Barrick and IMC money will be used.

Fall, 1996 Northwest Izzenhood Seeding Project, Izzenhood Range (1,100 acres). Mostly IMC mitigation money with some Barrick money will be used.

Fall, 1997 Northwest Izzenhood Seeding Project, Izzenhood Range (1,100 acres). IMC money will be used.

Fall, 1998 Rock Creek Seeding Project, Sheep Creek Range (1,000 acres). Combination of IMC and Dee Gold mitigation money will be used.

Additional sites have been identified as potential rehabilitation areas but have not yet been thoroughly scoped. They include:

1) Southwest Izzenhood.
2) Southwest Sheep Creek.
3) IL Ranch Burn.
4) Owyhee River, Pipeline burn.
5) Adobe Range, east side.

The over-seeding of sagebrush and forage kochia into burned sites that have a high percentage of perennial grasses present will be attempted on an experimental basis. If successful, large scale efforts using this technique can be implemented. Advantages of over-seeding these sites would be greatly reduced costs, and the ability to seed steep and rocky areas that are crucial to deer.

Rehabilitation of Current Year's Burns:

There is little doubt that more range fires will occur within crucial Area Six deer winter ranges in the near future. There may be opportunities to quickly rehabilitate some of these fires using IMC mitigation money. The advantage of current year rehabilitation is that cheatgrass competition is reduced so there is no need for disking or other control methods. The costs are substantially reduced. Criteria for determining which burns would receive funding would be as follows:

1) Burns that are located in crucial deer winter ranges that receive very heavy deer use.

2) Burns that are located in areas that have little chance of returning to productive deer habitat on their own.

3) Project areas that receive proper rest and long term livestock management.

4) Areas receiving rehabilitation funding from the Land Management agency or the Private land owner will probably have priority.

Conservation Easements or Land Acquisition:

It may be advantageous to deer to protect crucial areas through either conservation easements or through land acquisitions. With this option, it allows us to be opportunistic should a key piece of land become available for a reasonable price. At this time no specific areas are identified. However, land on the Marsh Creek Bench and on the west side of the Independence Range are extremely important and would merit consideration should an opportunity arise.

Monitoring:

Monitoring will be conducted jointly between NDOW and the USFS on fire rehabilitation projects. The purpose of monitoring will be to determine success and failures of the project as a whole and to determine if objectives are being met. Specific components of a project such as individual species establishment will also be monitored.

For the purpose of this plan, planted shrub species will be the primary component monitored to determine project success. The "FREQDENS" method will most likely be the primary monitoring technique used. This method monitors initial establishment and the persistence of seeded species. Three vegetation attributes are sampled with four study techniques. The sampling techniques are Nested Plot Frequency, Plot Density, Point Cover, and 1/100 Acre Shrub density.

Establishing criteria that will be used in monitoring is difficult. Every site is different and the degree of success will vary. Also, species are being planted that will naturally reproduce. What may not be considered a successful established stand in the initial years may reproduce to an acceptable stand in future years.

Criteria for determining the success of a seeding was obtained from the USFS Intermountain Research Station located in Provo, Utah. By the end of the third summer of the seeding, a density of 400-500 plants/acre is considered a seeding that should be able to fully establish itself within the near future. The uniformity of a stand is also a key criteria that will be looked at to determine the success of a seeding.

ADDITIONAL OPPORTUNITIES

The mitigation money provides opportunities other than direct habitat improvement. Some of the major opportunities available are as follows:

1) Rehabilitate three acres in the southern winter ranges for every acre disturbed on the west side of the Independence Range. Analysis using deer survey data collected over a long period of time indicate that winter range on the west side of the Independence Range supports over three times the deer that even the best unburned southern winter ranges support. Therefore, using IMC money and other potential funding sources, a three to one ratio will be strived for when rehabilitating southern winter ranges.

2) Strive to reduce the cheatgrass/fire cycle within crucial deer winter ranges. It would be a wasted effort if burned ranges were rehabilitated only to have them burn again in the near future. Money will be expended within deer winter range projects and in crucial unburned areas to reduce the likelihood of fire. It is believed that the mitigation money can contribute to the overall reduction of cheatgrass dominated lands and can ultimately help reverse the cheatgrass/fire cycle.

3) Develop better and more cost effective methods for rehabilitating unproductive sites. Very little work has been accomplished in Nevada in rehabilitating cheatgrass dominated sites. The IMC mitigation money provides the opportunity to develop and improve methods for very large scale and long-term projects. Other species of wildlife as well as watersheds and domestic livestock operations will benefit as a result of cheatgrass conversions to perennial vegetation.

4) Provide incentive to encourage other funding sources. Other avenues of funding will be explored to match with the IMC Mitigation money. The combination of funding sources will maximize habitat improvement for deer.

5) Use Mitigation money to start a long-term fund that will be used to provide long-term funding for habitat projects. It is hoped that the Mitigation Money from IMC can be used as an incentive to establish a viable long-term account. This account would be self sustaining by producing enough interest to fund large scale projects on a yearly basis. In order for this concept to work, other large funding sources will have to be added to this account.

6) Ensure this mitigation plan is flexible. Environmental conditions are dynamic and can change rapidly. Other projects that will be of a greater benefit to deer may arise in the future. It is critical that other options for spending this money be constantly explored. The projects that will maximize deer habitat will be funded whether they occur on Forest, BLM or private lands.

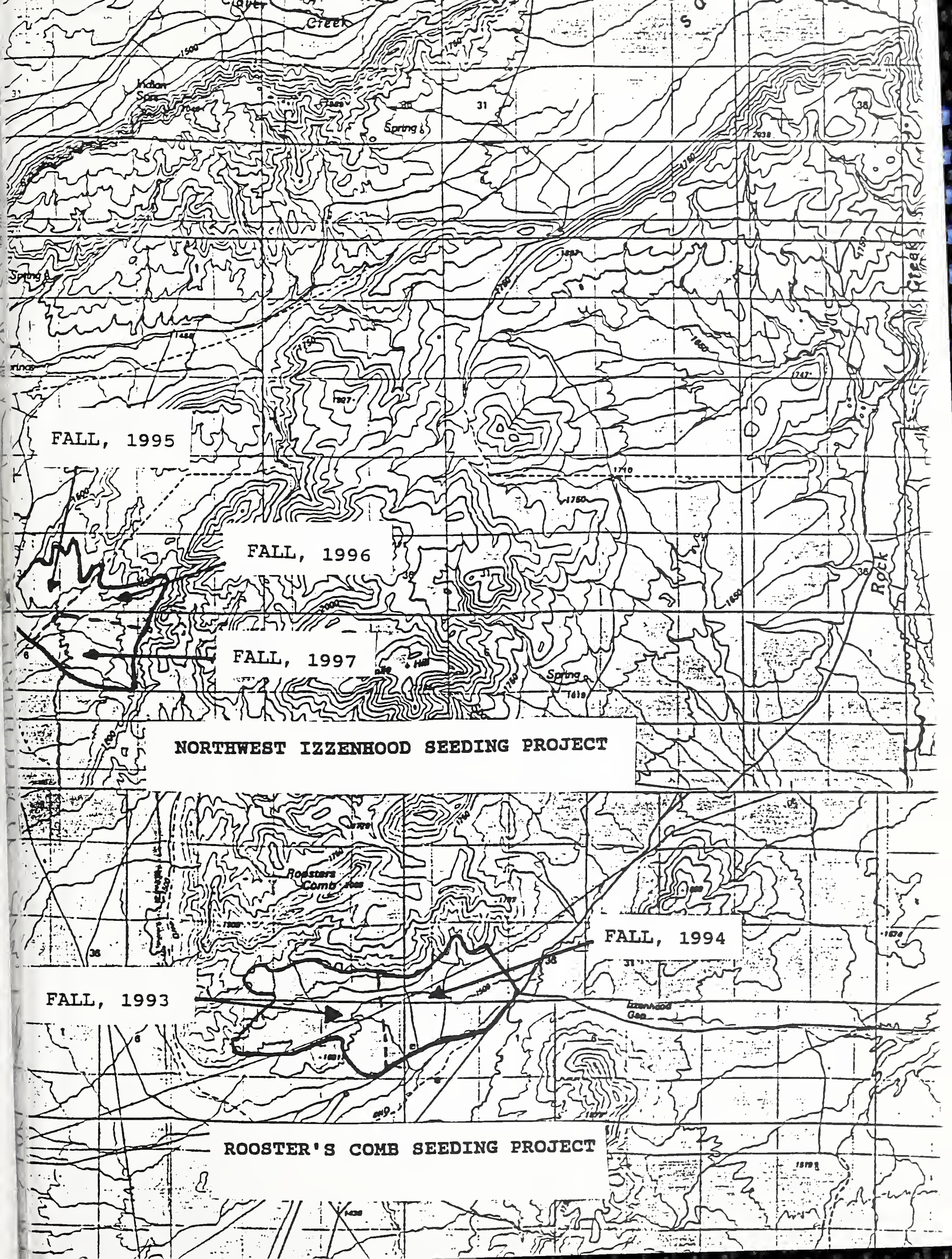
CONCLUSION

It will take between eight and 15 years before rehabilitated areas become fully productive for deer. It is expected that the Area Six deer population will continue its downward trend until a significant number of these rehabilitated acreages become productive.

This plan is designed to be flexible. It is important that we have the ability to build on successes and learn from failures. It is critical that we have the ability to quickly respond to opportunities should they become available. Above all else, it is imperative that we maximize the improvement of deer habitat to the best of our abilities through these funds.

NDOW will produce an annual report to the USFS, IMC, and other involved or interested parties by the first day in January of each year. This report will specify what has been accomplished in the proceeding year and what will be accomplished in the following year. It will also give a full accounting of the money that has been spent to date. In addition, it will provide an update on all projects that have been previously completed.

The Forest Service needs to be involved throughout the entire mitigation process to assure that their objectives and responsibilities are being met.


Creek
Spring
FALL, 1995
FALL, 1996
FALL, 1997
Spring
Rock Creek
NORTHWEST IZZENHOOD SEEDING PROJECT
Roosters Comb
FALL, 1994
FALL, 1993
Izzenhood Gap
ROOSTER'S COMB SEEDING PROJECT


FALL, 1998
ROCK CREEK SEEDING PROJECT
LANDER
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Landing Strip
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Gaging Sta
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DITCH
CREEK
BOULDER
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